BIDDING DOCUMENT

FOR

"Turnkey Construction of a 132KV Bus Coupler Bay at 132KV GSS, AEGCL, Dhemaji"

FUND: O&M HQ UAR for the FY 2023-24

(E-Tender)

https://assamtenders.gov.in

VOLUME-2 TECHNICAL SPECIFICATION

BID IDENTIFICATION NO:

AEGCL/MD/CGM(UAR)/Bus-Coupler-Bay/Dhemaji/2023/BID

Assam Electricity Grid Corporation Limited.

VOLUME-2 TECHNICAL SPECIFICATION

CONTENTS

Section-1
SCOPE AND GENERAL TECHNICAL CONDITIONS

1.1.0 INTENT OF THE SPECIFICATION

1.1.1 This volume of the specification deals with the general technical information & criteria for design, manufacture, supply & delivery of equipment/material, erection, testing & commissioning and setting to work of construction of new 132kV Bays on "Design, Supply and Install" basis as defined in Volume-1.

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

1.2.0 SCOPE

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

1.2.2 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 judgement is not in full accordance therewith.

1.2.3 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) Erection, testing and commissioning of all switch & control gears such as circuit breakers, isolators, current transformers, relay & control panels, Lightning Arresters etc. as specified in Bill of Materials.
iii) Supply and erection of substation/ equipment mounting steel structure.
iv) Other works includes site development, construction of equipment and structure foundations, supply etc. as brought out in the Specification and Schedule of Requirements.
v) Integration of all switch & control gears of the bay including control and relay panel along with the ABT metering module into the existing Substation Automation System at Dhemaji GSS.

1.2.4 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.

1.2.5 The tentative Bill of Quantities is furnished in Section 2: BIDDING FORMS of Vol-1 of this Bidding Document.

1.3.0 CONTRACTOR TO INFORM HIMSELF FULLY

1.3.1 The Contractor 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.

1.3.2 The Purchaser shall not be responsible for any misunderstanding or incorrect information obtained by

the CONTRACTOR other than information given to the CONTRACTOR in writing by the Purchaser

1.4.0 SERVICE CONDITIONS

1.4.1 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°C
b)	Minimum night temperatures		0°C
c)	Reference ambient day temperature		45°C
d)	Relative Humidity	(a)Maximum	100 %
		(b)Minimum	10 %
e)	Altitude		Below1000 M above MSL
f)	Maximum wind pressure:		As per IS: 802 latest code
g)	Other Data		Refer Meteorological data pertaining to the locations
h)	Seismic Intensity		ZONE-V as per IS 1893.

1.5.0 **CONFORMITY WITH INDIAN ELECTRICITY RULES & OTHER LOCAL REGULATIONS**:

1.5.1 The CONTRACTOR 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.

1.6.0 STANDARDS

1.6.1 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.

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

1.6.2.1 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.

1.7.0 CONTRACTOR'S REQUIREMENT

1.7.1 The Contractor should be in possession of a valid E.H.V. Electrical License issued by the Chief Electrical Inspector, Govt. of Assam, as per the provision of Law. An attested copy of the aforementioned License must be handed over to the Employer for his record prior to handing/ taking over of sites.

1.7.2 All the works shall also be inspected by the Chief Electrical Inspector, Govt. of Assam or his authorized representatives. It is the responsibility of the Contractor to obtain pre-requisite commissioning clearance of any equipment from the said Inspectorate. The Contractor will pay necessary fees to the Inspectorate, which it may levy.

1.8.0 ENGINEERING DATA

1.8.1 The furnishing of engineering data by the CONTRACTOR 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 CONTRACTOR, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications.

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

1.9.0 DRAWINGS AND DOCUMENTS FOR APPROVAL

1.9.1 In addition to those stipulated in clause regarding drawings in GENERAL CONDITIONS OF CONTRACT (Vol-1), the following sub clauses shall also apply in respect of Contract Drawings.

1.9.2 All drawings submitted by the CONTRACTOR 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.

1.9.3 Each drawing submitted by the CONTRACTOR 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.

1.9.4 The drawings submitted for approval to the Purchaser shall be in quadruplicate. One print of such drawings shall be returned to the CONTRACTOR by the Purchaser marked "approved/approved with corrections", if found generally in accordance with the specifications.

1.9.5 Initial submitted drawings may be in soft copies forwarded through emails. However, in this case drawings must be in Auto-CAD.
The CONTRACTOR 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.
The Contractor shall perform the work strictly in accordance with these drawings and no deviation shall be permitted without the written approval of the Employer, if so required.

1.9.6 All manufacturing, fabrication and erection work under the scope of Contractor prior to the approval of the drawings shall be at the Contractor's risk. The contractor may make any changes in the design which are necessary to conform to the provisions and intent of the contractor and such changes will again be subject to approval by the Employer.

1.9.7 The approval of the documents and drawings by the Employer shall mean that the Employer is satisfied that:
a) The Contractor has completed the part of the Works covered by the subject document (i.e., confirmation of progress of work).
b) The Works appear to comply with requirements of Specifications.
In no case the approval by the Employer of any document does imply compliance with neither all technical requirements nor the absence of errors in such documents. If errors are discovered any time during the validity of the contract, then the Contractor shall be responsible of their consequences.

1.9.8 All drawings shall be prepared using AutoCAD software version 2000 or later only. Drawings, which are not compatible to AutoCAD software version 2000 or later, shall not be acceptable.
After final approval all the drawings shall be submitted to the Employer in readable CD's.

1.9.9 The following is the general list of the documents and drawings that are to be approved by the Employer.

1.9.10 All Designs / Drawings / Calculations/ Data submitted by the contractor, from time to time shall become the property of the Employer and Employer has the right to use or replicate such designs for future contracts / works without the permission of the Contractor. The Employer has all rights to use/ offer above designs/drawings/data sheets to any other authority without prior Permission of the Contractor.

1.10.0 FINAL DRAWINGS AND DOCUMENTS

1.10.1 The successful Contractor shall require to provide following drawings and documents for each substation in printed form and as well as in soft copies. All soft copies of drawings must be in 'AutoCAD' file format.

(a) All approved drawings (AS BUILD) of equipment and works related to a particular substation in three (3) copies.

(b) Instruction manuals of all equipment related to a particular substation in three (3) copies. These instruction manuals shall generally consist of
   (i) Operation Manuals, (ii) Maintenance Manuals and (iii) Spare Parts Bulletins.

(c) Copies of routine test reports (in triplicate) of relevant equipment.

(d) Final Guaranteed and Other technical particulars of relevant equipment (in triplicate).

1.10.2 In addition to the above, the Contractor shall provide five (5) sets of all the printed drawings and documents including the soft copies to Employer for his reference and record.

1.11.0 APPLICATION AND SYSTEM SOFTWARE

1.11.1 Contractor shall provide copies of licenced copies application software / configuration & system software in the form of CD (in duplicate) for all IEDs, meters, SAS etc.

1.12.0 DESIGN IMPROVEMENTS

1.12.1 The Employer or the Contractor may propose changes in the specification and if the parties agree upon any such changes and the cost implication, the specification shall be modified accordingly.

1.13.0 DESIGN CO-ORDINATION

1.13.1 Wherever, the design is in the scope of Contractor, the Contractor shall be responsible for the selection and design of appropriate material/item to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

1.14.0 DESIGN REVIEW MEETING

1.14.1 The contractor will be called upon to attend design review meetings with the Employer, and the consultants of the Employer during the period of Contract. The contractor shall attend such meetings at his own cost at Assam or at mutually agreed venue as and when required. Such review meeting will be held generally minimum once a month or the frequency of these meeting shall be mutually agreed between the Employer and the Contractor. Frequency of Design Review Meetings shall depend upon the project requirement to ensure project implementation as per the Master Programme.

1.15.0 QUALITY ASSURANCE, INSPECTION & TESTING

1.15.1 Quality Assurance

To ensure that the supply and services under the scope of this Contract whether manufactured or performed within the Contractor's works or at his Sub Contractor's premises or at site or at any other place of work are in, accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Employer after discussions before the award of Contract. A quality assurance programme of the Contractor shall generally cover but not limited to the following:

a) His organization structure for the management and implementation of the proposed quality assurance programme
b) Documentation control System.
c) Qualification data for Contractors key personnel.
d) The procedure for purchases of materials, parts components and selection of sub-contractors services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
e) System for shop manufacturing including process controls and fabrication and assembly controls.
f) Control of non-conforming items and system for corrective action.
g) Control of calibration and testing of measuring and testing equipment.
h) Inspection and test procedure for manufacture.
i) System for indication and appraisal of inspection status.
j) System for quality audits.
k) System for authorizing release of manufactured product to the Employer.
l) System for maintenance of records.
m)System for handling storage and delivery and
n) A quality plan detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of supply.

The Quality plan shall! be mutually discussed and approved by the Employer after incorporating necessary corrections by the Contractor as may be required.

1.15.2 Quality Assurance Documents

The Contractor shall be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of Employers inspection of equipment/material.
The Employer or his duly authorized representatives reserves the right to carry out Quality Audit and quality surveillance of the systems and procedures of the Contractors/his vendors Quality Management and Control Activities.

1.16.0 EMPLOYER'S SUPERVISION

1.16.1 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.

1.16.2 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.
(f) Review and suggest modification and improvement in completion schedules from time to time, and
(g) Supervise the Quality Assurance Programme implementation at all stages of the works.

1.17.0 INSPECTION & INSPECTION CERTIFICATE

1.17.1 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 CONTRACTOR and their sub-CONTRACTOR(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.

1.17.1.1 All routine and acceptance tests whether at the premises or works of, the CONTRACTOR or of any Sub-CONTRACTOR, the CONTRACTOR 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 CONTRACTOR free of charge.

1.17.1.2 If desired by the Purchaser, the CONTRACTOR 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 CONTRACTOR 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.

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

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

1.18.0 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 CONTRACTOR 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 CONTRACTOR and the Purchaser.

1.18.1 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 CONTRACTOR and the Purchaser in the Quality Assurance Programme.

1.18.2 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.

1.19.0 GUARANTEED TECHNICAL PARTICULARS

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

by them.

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

1.20.0 PACKING

1.20.1 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 CONTRACTOR shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.

1.20.2 The CONTRACTOR 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.

1.20.3 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.

1.20.4 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.

1.20.5 Each package shall be legibly marked by the-CONTRACTOR 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 CONTRACTOR etc.

1.21.0 CONSTRUCTION TOOLS, EQUIPMENTS ETC.

1.21.1 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.

1.22.0 MATERIALS HANDLING AND STORAGE

1.22.1 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.

1.22.2 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.

1.22.3 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.

1.22.4 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.

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

1.22.6 The Contractor shall be responsible for making suitable indoor storage facilities, to store allitems/materials, which require indoor storage.

1.22.7 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.

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

1.23.0 CONTRACTOR'S MATERIALS BROUGHT ON TO SITE

1.23.1 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 thereto.

1.23.2 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.

1.23.3 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.

1.24.0 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 unutilised 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.

SECTION-2
TECHNICAL SPECIFICATION FOR CONSTRUCTION WORKS IN SUBSTATIONS

2.1.0 GENERAL

2.1.1 The intent of this Section of the Specification is to cover requirements which are to be followed in construction of switchyards including civil works in the switchyard.

2.1.2 The work shall be generally carried out as per drawings which needs to be approved by AEGCL / Employer.

2.2.0 SURFACE PREPARATION AND STONE SPREADING

2.2.1 Before taking up PCC base (pro 1:3:6) and stone filling at the location in the construction site, the area shall be thoroughly de-weeded including removal of roots as directed by the Engineer-in-Charge.

2.2.2 After all the structures, equipment & earthing system are erected and after construction of cable trenches, the surface of the switchyard area shall be maintained, rolled/ compacted to the lines and grades as decided by Engineer-in-Charge. De-weeding including removal of roots shall be done before rolling is commenced. Engineer-in-Charge shall decide final formation level so as to ensure that the site appears uniform devoid of undulations. The final formation level shall however be very close to the formation level indicated in the drawing using half ton roller with suitable water sprinkling arrangement to form a smooth and compact surface.

2.2.3 A base layer of PCC of 80 mm thickness with proportion of 1:3:6 shall be provided before spreading of crushed rocks. PCC base shall be done in panels of 4 m x 4 m with expansion gap of 25 mm between panels. The gap shall be filled with same grade of concrete. Each panel shall be provided with four (4) numbers of PVC pipes (per panel) of 100 mm dia of length 450 mm for soaking of water. The pipes will be provided with gratings at the top and the same will be flushed with the PCC top.

2.2.4 Over the PCC layer, a surface course of minimum 100mm thickness of 20mm nominal size single size ungraded broken stone shall be spread.

2.3.0 CABLE TRENCHES AND CABLE TRAYS

2.3.1 Construction of cable trenches with pre-cast removal R.C.C cover (with lifting arrangement) as per drawings supplied with the Bid Documents shall be carried out by the Contractor.

2.3.2 The Contractor shall provide embedded steel plates of adequate size on the walls of concrete cable trench for supports for cable trays. Insert plates will be provided at an interval of 2000mm.

2.3.3 If asked for, the cable trench walls shall be designed for following loads: -
(a) Dead load of 155 kg/M length of cable support (tray) + 75 kg on one tier at the end.
(b) Triangular earth pressure + uniform surcharge pressure of 2T/m2.

2.3.4 RCC cable trench cover shall be designed for self-weight of slab + UDL of 2000 kg/m2 + a concentrated load of 200 kg at center of span on each slab panel.

2.3.5 Cable trench inside the Control Room shall be covered with 6 mm thick chequered plates with lifting arrangement and exposed plate area shall be covered with rubber mat.

2.3.6 Cable trench crossing the road/rails shall be designed for class AA. Loading of IRC/relevant IS Code and should be checked for transformer loading.

2.3.7 Trenches shall be drained. Necessary sumps be constructed and sump pumps if necessary shall be supplied. Cable trenches shall not be used as storm water drains.

2.3.8 All metal parts inside the trench shall be connected to the earthing system.

2.3.9 Cables from trench to equipment shall run in hard conduit pipes.

2.3.10 Trench wall shall not foul with the foundation. Suitable clear gap shall be provided.

2.3.11 The trench bed shall have a slope of 1/500 along the run and 1/250 perpendicular to the run.

2.3.12 All the construction joints of cable trenches i.e., between base slab to base slab and the junction of vertical wall to base slab as well as from vertical wall to wall and all the expansion joints shall be provided with approved quality PVC water stops of approx. 230 x 5 mm size for those sections where the ground water table is expected to rise above the junction of base slab and vertical wall of cable trenches.

2.3.13 Cable trenches shall be blocked at the ends if required with brick masonry in cement sand mortar 1:6 and plaster with 12 mm thick 1:6 cement sand mortar.

2.3.14 Cable Trays

(i). The cable trays shall be of G.S. sheet and minimum thickness of sheet shall be 2 mm.
(ii). The Contractor shall perform all tests and inspection to ensure that material and workmanship are according to the relevant standards. Contractor shall have to demonstrate all tests as per specification and equipment shall comply with all requirements of the specification.
a) Test for galvanising (Acceptance Test)
The test shall be done as per approved standards.
b) Deflection Test: (Type Test)
A 2.5 metre straight section of 300mm, wide cable tray shall be simply supported at two ends. A uniform distributed load of 76 kg/m shall be applied along the length of the tray.The maximum deflection at the mid-span shall not exceed 7mm.

2.4.0 FOUNDATION AND RCC CONSTRUCTION

2.4.1 General

2.4.1.1 Work covered under this Clause of the Specification comprises the design and construction of foundations and other RCC constructions for switchyard structures, equipment supports, trenches, drains, jacking pad, control cubicles, bus supports, transformer, marshalling kiosks, auxiliary equipment and systems, buildings, tanks, boundary wall or for any other equipment or service and any other foundation required to complete the work.

2.4.1.2 Concrete shall conform to the requirements mentioned in IS: 456 and all the tests shall be conducted as per relevant Indian Standard Codes as mentioned in Standard field quality plan appended with the specification.
A minimum grade of M20 concrete shall be used for all structural/load bearing members as per latest IS 456.

2.4.1.3 If the site is sloppy, the foundation height will be adjusted to maintain the exact level of the top of the structures to compensate for such slopes.

2.4.1.4 The switchyard foundation's plinths minimum 300 mm and above finished ground level respectively.

2.4.1.5 Minimum 75 mm thick lean concrete (1:3:6) shall be provided below all underground structures, foundations, trenches, etc., to provide a base for construction.

2.4.1.6 Concrete made with Portland slag cement shall be carefully cured and special importance shall be given during the placing of concrete and removal of shuttering.

2.4.1.7 The design and detailing of foundations shall be done based on the approved soil data and subsoil conditions as well as for all possible critical loads and the combinations thereof. The Spread footings foundation or pile foundation as may be required based on soil/sub-soil conditions and superimposed

loads shall be provided.

2.4.1.8 If pile foundations are adopted, the same shall be cast-in-situ driven/bored or pre cast or under reamed type as per relevant parts of IS Code 2911. Only RCC piles shall be provided. Suitability of the adopted pile foundations shall be justified by way of full design calculations. Detailed design calculations shall be submitted by the bidder showing complete details of piles/pile groups proposed to be used. Necessary initial load test shall also be carried out by the bidder at their cost to establish the piles design capacity. Only after the design capacity of piles has been established, the Contractor shall take up the job of piling. Routine tests for the piles shall also be conducted. All the work (design & testing) shall be planned in such a way that these shall not cause any delay in project completion.

2.4.2 Design

2.4.2.1 All foundation shall be of reinforced cement concrete. The design and construction of RCC structures shall be carried out as per IS: 456 and minimum grade of concrete shall be M-20.
Higher grade of concrete than specified above may be used at the discretion of Contractor without any additional financial implication to the Employer.

2.4.2.2 Limit state method of design shall be adopted unless specified otherwise in the specification.

2.4.2.3 For detailing of reinforcement IS: 2502 and SP: 34 shall be followed. Cold twisted deformed bars (Fe-415 N/mm2) conforming to IS: 1786 shall be used as reinforcement. However, in specific areas, mild steel (Grade-I) conforming to IS: 432 can also be used. Two layers of reinforcement (on inner and outer face) shall be provided for wall and slab sections having thickness of 150 mm and above. Clear cover to reinforcement towards the earth face shall be minimum 40 mm.

2.4.2.4 RCC water retaining structures like storage tanks, etc., shall be designed as uncracked section in accordance with IS: 3370 (Part I to IV) by working stress method. However, water channels shall be designed as cracked section with limited steel stresses as per IS: 3370 (Part I to IV) by working stress method.

2.4.2.5 The procedure used for the design of the foundations shall be the most critical loading combination of the steel structure and or equipment and or superstructure and other conditions, which produces the maximum stresses in the foundation or the foundation component and as per the relevant IS Codes of foundation design. Detailed design calculations shall be submitted by the bidder showing complete details of piles/pile groups proposed to be used.

2.4.2.6 Design shall consider any sub-soil water pressure that may be encountered following relevant standard strictly.

2.4.2.7 Necessary protection to the foundation work, if required shall be provided to take care of any special requirements for aggressive alkaline soil, black cotton soil or any other type of soil which is detrimental/ harmful to the concrete foundations.

2.4.2.8 RCC columns shall be provided with rigid connection at the base.

2.4.2.9 All sub-structures shall be checked for sliding and overturning stability during both construction and operating conditions for various combinations of loads. Factors of safety for these cases shall be taken as mentioned in relevant IS Codes or as stipulated elsewhere in the Specifications. For checking against overturning, weight of soil vertically above footing shall be taken and inverted frustum of pyramid of earth on the foundation should not be considered.

2.4.2.10 Earth pressure for all underground structures shall be calculated using co-efficient of earth pressure at rest, co-efficient of active or passive earth pressure (whichever is applicable).
However, for the design of sub-structures of any underground enclosures, earth pressure at rest shall be considered.

2.4.2.11 In addition to earth pressure and ground water pressure etc., a surcharge load of 2T/Sq.m shall also be considered for the design of all underground structures including channels, sumps, tanks, trenches, sub-structure of any underground hollow enclosure, etc., for the vehicular traffic in the vicinity of the structure.

2.4.2.12 Following conditions shall be considered for the design of water tank in pumps house, channels, sumps, trenches and other underground structures:

a) Full water pressure from inside and no earth pressure and ground water pressure and surcharge pressure from outside (application only to structures, which are liable to be filled up with water or any other liquid).

b) Full earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.

c) Design shall also be checked against buoyancy due to the ground water during construction and maintenance stages. Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the superimposed loadings.

2.4.2.13 The foundations shall be proportioned so that the estimated total and differential movements of the foundations are not greater than the movements that the structure or equipment is designed to accommodate.

2.4.2.14 The foundations of transformer and circuit breaker shall be of block type foundation. Minimum reinforcement shall be governed by IS: 2974 and IS: 456.

2.4.2.15 The tower and equipment foundations shall be checked for a factor of safety of 2.0 for normal condition and 1.50 for short circuit condition against sliding, overturning and pull out. The same factors shall be used as partial safety factor overloads in limit state design also.

2.4.3 Admixtures & Additives

2.4.3.1 Only approved admixtures shall be used in the concrete for the Works. When more than one admixture is to be used, each admixture shall be batched in its own batch and added to the mixing water separately before discharging into the mixer. Admixtures shall be delivered in suitably labelled containers to enable identification.

2.4.3.2 Admixtures in concrete shall conform to IS: 9103. The water proofing cement additives shall conform to IS: 2645. Employer shall approve concrete Admixtures/Additives.

2.4.3.3 The Contractor may propose and the Employer may approve the use of a water-reducing set retarding admixture in some of the concrete. The use of such an admixture will not be approved to overcome problems associated with inadequate concrete plant capacity or improperly planned placing operations and shall only be approved as an aid to overcoming unusual circumstances and placing conditions.

2.4.3.4 The water reducing set-retarding admixture shall be an approved brand of Ligno- sulphonatetype admixture.

2.4.3.5 The water proofing cement additives shall be used as required/advised by the Employer.

2.5.0 SUBMISSION

2.5.1 The following information shall be submitted for review and approval to the Employer as far as Civil Works are concerned:

(a) Design criteria shall comprise the codes and standards used, applicable climatic data including wind loads, earthquake factors maximum and minimum temperatures applicable to the building locations, assumptions of dead and live loads, including equipment loads, impact factors, safety factors and other relevant information.

(b) Structural design calculations and drawing (including constructions / fabrication) for all reinforced concrete and structural steel structures.

c) Any other data, drawings and information required to be submitted as per various clauses of the specification.

Approval of the above information shall be obtained before ordering materials or starting fabrication or construction as applicable

2.6.0 BUS BARS AND BUS BAR SUPPORTS

2.6.1.1 The bus bars shall be outdoor strung bus bars with ACSR conductor supported on lattice.

2.6.1.2 If asked for, the substation steel structures shall be designed as per ***Section-3*** of this specification.

2.7.0 ACSR CONDUCTORS

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

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

Sl. No.	DESCRIPTION	ACSR 'MOOSE'	ACSR 'ZEBRA'	ACSR 'PANTHER'
1	Code name	MOOSE	ZEBRA	PANTHER
2	Number of strands & size	Al: 54/ 3.53 mm St: 7/ 3.53 mm	Al: 54/ 3.18 mm St: 7/ 3.18 mm	Al: 30/ 3.00 mm St: 7/ 3.00 mm
3	Overall diameter	31.77 mm	28.62 mm	21.00 mm
4	Breaking load	161.2 kN	130.32 kN	89.67 kN
5	Weight of conductor	2004 Kg/km	1621 kg/km	974 kg/km
6	Co-efficient of linear expansion	$19.35x10^{-6}$ / ^{0}C	$19.35x10^{-6}$ / ^{0}C	$19.35x10^{-6}$ / ^{0}C
7	Number of strand			
	Steel centre	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 20^0 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

2.8.0 ELECTRICAL CLEARANCES

2.8.1 Following minimum electrical clearances (outdoor) shall be maintained in the switchyard:

Sl. No.	Clearance	220 KV	132 KV	33 KV
1	Phase to Phase	2400 mm	1300 mm	320 mm
2	Phase to Earth	2400 mm	1300 mm	320 mm
3	Sectional Clearance	5000 mm	4000 mm	2800 mm
4	Live part to plinth	5500 mm	4600 mm	3700 mm
5	Base of insulator (supporting live part) to ground	2500 mm	2500 mm	2500 mm

2.9.0 EARTHING SYSTEM

2.9.1 General

(a) Earthing system shall installed as per drawings provided with this bidding document.
(b) The main earthing system for the switch yard shall consist of a mesh made out of Galvanised MS flats of size not less than 65 mm in width and12 mm thick covering the entire switchyard area and earth electrodes distributed all over the mesh. The earth electrodes shall also be placed all around the periphery of the mesh at regular intervals.
(c) The earth mat shall be created by laying the earthing conductor (Galvanised MS flats) in both directions perpendicularly. The mesh points so created and all other joints shall be welded and painted and painted with rust proof paint after welding.
(d) Minimum depth of burial of main earthing conductors shall be 600 mm from FGL.
(e) Wherever earthing conductor crosses cable trenches, underground service ducts, pipes, tunnels, railway tracks etc., it shall be laid minimum 300 mm below them and shall be circumvented in case it fouls with equipment/structure foundations.
(f) The earthing system must conform to requirements of the Indian Electricity Rules and the provisions of IS: 3043.
(g) All earth electrodes and risers for equipment and other earthing must be connected at mesh points of the earth mat. All such connections shall be welded.
(h) All metallic supporting structures and non-current carrying metallic parts of all equipment shall be provided with double earthing.
(i) All LAs, VTs, CVTs and all transformer neutrals must be earthed through separate earth electrodes and in turn these electrodes shall be connected to the main earth grid.
(j) One number 40mm dia, 3000 mm long MS earth electrode with test link, CI frame and cover shall be provided to connect each down conductor of surge arresters, capacitive &inductive voltage transformers, lightning masts and towers with peak.
(k) 50mm x 6mm MS flat shall run on the top tier and all along the cable trenches and the same shall be welded to each of the racks. Further this flat shall be earthed at both ends and at an interval of 30 mtrs. The M.S. flat shall be finally painted with two coats of Red oxide primer and two coats of Post Office red enamel paint.
(l) The earthing system in the Control Room must also be connected to the main station grid. For this purpose earthing conductor around the building shall be buried in earth at a minimum distance of 1500 mm from the outer boundary of the building which in turn shall be connected to the main earth grid by two runs of 65mm x 12mm GI flats.
(m) Each earthing lead from the neutral of the power transformers shall be directly connected to two pipe electrodes in treated earth pit (as per IS) which in turn, shall be buried in Cement Concrete pit with a cast iron cover hinged to a cast iron frame to have an access to the joints. All accessories associated with transformer like cooling banks, radiators etc. shall be connected to the earthing grid at minimum two points. These electrodes must also be connected to the Main Earth Mat of the substation.

2.9.2 Summary of Earthing System

Sl. No.	Item	Size	Materials
1	Main Earthing Conductor to be buried in ground	65mm x 12 mm	GI Flat
2	Conductor above ground & earthing leads (for equipment)	65mm x 12 mm	GI Flat
3	Conductor above ground & earthing leads (for columns & aux. structures)	65mm x 12 mm	GI Flat
4	Earthing of indoor LT panels, Control panels and outdoor marshalling boxes, MOM boxes, Junction boxes & Lighting Panels etc.	50mm x 6 mm	GI Flat

5	Rod Earth Electrode	40mm dia, 3000 mm long	Mild Steel
6	Pipe Earth Electrode (in treated earth pit) as per IS 3043	40mm dia, 3000 mm long	Galvanised Steel

2.10.0 PROTECTION AGAINST DIRECT LIGHTNING

2.10.1 Protection against direct lightning shall be provided by stringing GI shield wires and/or by lightning masts (SPIKES) as per layout drawings attached.

2.10.2 Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.

2.10.3 Down conductors shall be cleated on the structures at 2000 mm interval. For grounding of lightning spikes and shield wires, 7/3.66 mm GI steel wires shall be used.

2.10.4 Connection between each down conductor and rod electrodes shall be made via test joint (pad type compression clamp) located approximately 1500 mm above ground level. The rod electrode shall be further joined with the main earth-mat.

2.10.5 Two runs of down conductors shall be used for grounding of each Lightning Spikes. For that, lugs with bolts shall be provided at base of spikes.
G.I. wires for shielding shall conforming to IS 2141.Parameters of galvanised steel wires shall be as follows:
a) No of Strand : 7
b) Diameter of single strand : 3.66 mm
c) Minimum Breaking Load : 6970 KG
d) Overall Diameter : 10.98 mm
e) Area : 72.25 mm2

2.11.0 BAY MARSHALLING KIOSK

2.11.1 **1(One)** number of bay marshalling **kiosk** shall be **provided for each 132 kV bay** under present scope. In addition to the requirements specified elsewhere in the specification, the bay marshalling kiosk shall have two distinct compartments for the following purpose:-

(i) Incoming:
To receive **2(two)** incoming 415V, 3 phase, 63Amps, AC supply with auto changeover and MCB unit and

(ii) Outgoing:
(a) To distribute **4(four)** outgoing 415V, 16 Amps 3 phase AC supplies to be controlled by MCB.
(b) To distribute **3(three)** outgoing 240V, 16 Amps single phase supplies to be controlled by MCB.
(c) To distribute **3(three)** outgoing 240V, 10 Amps single phase supplies to be controlled by MCB

2.11.2 The steel sheet thickness of BMK shall be minimum 3.15 mm and painting shall be as per Clause 2.15.0.

2.11.3 The BM shall be protective Class of IP 55.

2.11.4 The BMK shall have a minimum of 700 mm clearance to switchyard floor.

2.12.0 INSULATOR AND HARDWARE FITTINGS

2.12.1 General

a) The Contractor shall supply insulators of suspension, tension and post type as required complete with all necessary hardware and accessories, including fittings for fixing insulators to steel structures as required.

b) The porcelain shall be sound, free from defects, thoroughly vitrified and smoothly glazed.

c) Unless otherwise specified, the glaze shall be brown colour. The glaze shall cover all the porcelain parts of the insulators except those areas which serve as support during firing or are left unglazed for purpose of assembly.

d) The design of the insulator shall be such that stress due to expansion and contraction inany part of the insulator shall not lead to deterioration. The porcelain shall not engage directly with hard metal.

e) Cement use in the construction of insulator shall not cause fracture by expansion or loosening by contraction and proper care shall be taken to locate the individual parts correctly during cementing. The cement shall not give rise to chemical reaction with metal fitting and its thickness shall be as uniform as possible.

f) Pins and caps shall be made of drop forged steel, duly hot dip galvanized as per IS 2629.These shall not be made by jointing, welding, shrink fitting or any other process.

g) Security clips/split pins shall be made of good quality of stainless steel.

h) Suspension and tension insulators shall be wet process porcelain with ball and socketconnection. Insulators shall be interchangeable and shall be suitable for forming eithersuspension or tension strings.

i) Post type insulators shall be of long rod type or solid core type and preferably of single piece type for all voltage classes. These shall be complete with necessary fittings to hold Aluminium tubes or ACSR conductor as required.

j) The items of hardware and fittings shall make complete assemblies which are necessaryfor their satisfactory performance. Such parts shall be deemed to be within the scope of this specification.

2.12.2 Disc Insulator Strings

Each insulator string shall consist of following numbers of Disc & parameters.

Sl. No.	Description	No of Disc Insulator Unit for		
		220 kV	**132 kV**	**33 kV**
1	No. of Disc, Suspension String	14	9	3
2	No. of Disc, Tension String	15	10	4
3	Creepage Distance of complete String (min)	7595	4495	1116

2.12.3 Parameters

2.12.3.1 Disc Insulators

a) Type : Ball and Socket
b) Colour : Brown
c) Surface : Glazed
d) Locking Device :W or R type security clip
e) Size of Disc : 255 mm x 145 mm
f) Size of Pin Ball : 16 mm
g) Creepage Distance
(Min subjected requirement of clause 2.19.2):25 mm/kV
h) Electro mechanical Strength : 70 KN
i) Power frequency withstand test voltage : 75 KV Dry
j) Minimum dry Impulse withstand : 125 KV peak

Test voltage (+/- wave)

k) Puncture Voltage : 1.3 X actual dry flash over voltage.

2.12.3.2 Post Insulators

Sl. No.	Parameters	220 kV	132 kV	33 kV
1	Highest system voltage	245 kV	145 kV	36 kV
2	Dry one minute power frequency test voltage	510 kV	275 kV	75 kV
3	Wet one minute power frequency test voltage	460 kV	275 kV	75 kV
4	Impulse voltage withstand test	1050 kV	650 kV	170 kV
5	Minimum Creepage Distance	31mm/kV	31mm/kV	31mm/kV
6	Minimum Bending Strength (upright)	10 kN	8 kN	6 kN

2.13.0 CLAMPS, CONNECTORS

2.13.1 Clamps and connectors shall conform to IS 2121 unless otherwise mentioned hereunder.

2.13.2 Clamps and connectors shall be made of materials listed below: -

For Connecting ACSR : Aluminium alloy casting conforming to designation A 6 of IS 617.

For Connecting Equipment made of Copper : Bimetallic connectors made from aluminium alloy casting conforming to designation A 6 of IS 617.

For Connecting G.I Shield Wire : Malleable Iron Casting.

Expansion Connectors : Copper lamination to grade FRTP-2 of IS 191.

Bolts, nuts, plain washers And spring washers for items (i), (ii) and (iii) : Hot dip galvanised mild steel.

2.14.0 ILLUMINATION SYSTEM

2.14.1 The Contractor shall design, supply and install illumination system for the entire substation. The average illumination level and limiting glare index for different parts of the substation shall be as follows:

Sl. No.	Location/Area	Average Illumination Level, 'Lux'	Limiting Glare Index
1	Control Room	300	19
2	Battery Room	100	19
3	Carrier Room	300	
4	Office/Conference Room	300	
5	Stairs and Corridors	100	
6	Air Conditioning Plant	150	
7	Outdoor Switchyard	20	
8	Approach Road	20	
9	Store Room	100	

2.14.2 The lighting system of a particular area whether indoor or outdoor shall be designed such a way that uniform illumination level is achieved. In outdoor switchyard illumination shall be aimed as far as possible towards transformers, circuit breakers, isolators etc.

2.14.3 Following types of lamps shall be used for various location of the substation:

Sl. No.	Location/Area	Type of Lamp	Type of Fitting
1	Control Room, Office, Carrier Room	LED	Decorative
2	Battery Room	Fluorescent	Acid Proof, Industrial
3	Outdoor Switchyard	LED	Water Tight Flood Light
4	External Lighting on Buildings	LED	Water Tight Flood Light
5	Gate Lighting	LED	Post type, water tight Flood Light

2.14.4 Provisions shall be made in the switchyard steel structures for mounting of lamps for switchyard.

2.15.0 PAINITNG

2.15.1 All surfaces of ferrous materials used for construction of outdoor equipment and enclosures such as instrument transformer main tanks and equipment, marshalling boxes, kiosk, operating boxes, metallic enclosures etc. shall be cleaned and painted as given below if not specified otherwise in respective Sections.
The quality of paint such that its colour should not fade even if it is exposed to temperature up to 1200 degree C.

Description	Surface preparation	Primer coat	Intermediate undercoat	Finish coat	DFT	Colour Shade
CT & PT Main tanks of CT, PT and other oil filled equipment, etc. (**External surface)**	Shot Blast cleaning Sa 2½ (ISO 8501-1)	Epoxy base zinc primer (30-40 mm)	Epoxy high build micaceous iron oxide (75 mm)	Aliphatic Polyurethane 2 coats (25 mm/coat)	Minimum 155 mm	Shade No. 631 of IS:5
do (**Internal surfaces)**	Shot Blast cleaning Sa 2½ (ISO 8501-1)	Hot oil resistant, non-corrosive varnish or paint or epoxy			Minimum 30 mm	Glossy white or paint
Marshalling boxes, operating	Chemical/Shot Blast cleaning Sa	Epoxy base zinc primer (30-40 mm)				

2.15.2 All paints shall be carefully selected to withstand heat, rain and extremes of weather. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

2.15.3 In case finish paint chips off or crinkle during transit or installation, the contractor shall arrange for repainting transformer at site at his cost. The paint for repainting/touchup shall be supplied by the contractor.

2.15.4 The paint work done shall be guaranteed for a minimum period of 5 years from the date of receipt of the equipment.

2.15.5 1(One) coat of additional paint to the exposed exterior surfaces shall be given at site prior to commissioning in presence of the Employer's representative.

2.16.0 SUPPLY OF CONSTRCUTION MATERIALS BY THE CONTRACTOR

2.16.1 The contractor has to make his own arrangements for procurement, supply and use of construction materials like cement, M.S. rounds, H.B.G. metal and sand.

2.16.2 Cement

The contractor has to make his own arrangements for the procurement of cement to required specifications required for the work subjected to the follows:

a) The contractor shall procure cement (approved BSI marked of PPC of Grade 53),required for the works only from reputed cement factories (Main producer) acceptable to the Engineer-in-Charge. The contractor shall be required to be furnished to the Engineer in-Charge bills of payment and test certificates issued by the manufacturers to authenticate procurement of quality cement from the approved cement factory.

The contractor shall make his own arrangement for adequate storage of cement.

b) The contractor shall procure cement in standard packing of all 50 kg per bag from the authorized manufacturers. The contractor shall make necessary arrangement at his own cost to the satisfaction of Engineer-in-Charge for actual weighment of random sample from the available stock and shall conform with the specification laid down by the Indian Standard Institution or other standard foreign institutions laid down by the Indian Standard Institution or other standard foreign institutions as the case may be. Cement shall be got tested for all the tests as directed by Engineer-in-Charge at least one month in advance before the use of cement bags brought and kept on site Stores. Cement bags required for testing shall be supplied by the contractor free of cost. If the tests prove unsatisfactory, then the charges for cement will be borne by the Contractor.

c) The Contractor should store the cement of 60 days requirement at least one month in advance to ensure the quality of cement so brought to site and shall not remove the same without the written permission of the Engineer-in-Charge.

The Contractor shall forthwith remove from the works area any cement that the Engineer-in-Charge may disallow for use, an account of failure to meet with required quality and standard.

d) The contractor shall further, at all times satisfy the Engineer-in-Charge on demand, by production of records and books or by submission of returns and other proofs as directed, that the cement is being used as tested and approved by Engineer-in-Charge for the purpose and the Contractor shall at all times, keep his records up to date to enable the Engineer-in-Charge to apply such checks as he may desire.

e) Cement which has been unduly long in storage with the contractor or alternatively has deteriorated due to inadequate storage and thus become unfit for use in the works will be rejected by the department and no claim will be entertained. The Contractor shall forthwith remove from the work area, any cement the Engineer-in-Charge may disallow for use on work and replace it by cement complying with the relevant Indian Standards.

2.16.3 Steel

The Contractor shall procure steel grade Fe-500 from primary producer TATA, SAIL, JINDAL etc, rods and structural steel, etc., required for the works, only from the main or secondary producers manufacturing steel to the prescribed specifications of Bureau of Indian Standards or equivalent and licensed to affix ISI or other equivalent certification marks and acceptable to the Engineer-in-Charge. Necessary ISI list certificates are to be produced to Engineer-in-Charge before use on works. The unit weight and dimensions shall be as prescribed in the relevant Indian Standard specification for steel.

2.17.0 SUPPLY OF CONSTRCUTION MATERIALS BY THE EMPLOYER

2.17.1 As it is a single responsibility contract supply, and/or arrange all materials and services including construction and testing equipment to complete the works in all respects described in the specification, shall be under the scope of the Contractor unless otherwise specifically mentioned elsewhere in the bidding document.

2.18.0 MISCELLANEOUS GENERAL REQUIREMENTS

2.18.1 Dense concrete with controlled water cement ratio as per IS-code shall be used for all underground concrete structures such as pump-house, tanks, water retaining structures, cable and pipe trenches etc. for achieving water-tightness.

2.18.2 All joints including construction and expansion joints for the water retaining structures shall be made water tight by using PVC ribbed water stops with central bulb.
However, kicker type (externally placed) PVC water stops shall be used for the base slab and in other areas where it is required to facilitate concreting.
The minimum thickness of PVC water stops shall be 5 mm and minimum width shall be 230 mm.

2.18.3 All steel sections and fabricated structures which are required to be transported on sea shall be provided with anti-corrosive paint to take care of sea worthiness.

2.18.4 A screed concrete layer not less than 100 mm thick and of grade not weaker than M20 conforming to IS:456-1978 shall be provided below all water retaining structures. A sliding layer of bitumen paper or craft paper shall be provided over the screed layer to destroy the bond between the screed and the base slab concrete of the water retaining structures.

2.18.5 Bricks having minimum 75 kg/cm2 compressive strength can only be used for masonry work. Contractor shall ascertain himself at site regarding the availability of bricks of minimum 75kg/cm2 compressive strength before submitting his offer.

2.18.6 Angles 50 x 50 x 6 mm (minimum) with lugs shall be provided for edge protection all round cut outs/ openings in floor slab, edges of drains supporting grating covers, edges of RCC cable/pipe trenches supporting covers, edges of manholes supporting covers, supporting edges of manhole pre-cast cover and any other place where breakage of corners of concrete is expected.

2.18.7 Anti- termite chemical treatment shall be given to column pits, wall trenches, foundations of buildings, filling below the floors etc. as per IS: 6313 and other relevant Indian Standards.

2.18.8 Items/components of equipment/materials/components etc. not explicitly covered in the specification but required for completion of the project shall be deemed to be included in the scope.

SECTION-3
SPECIFICATION FOR DESIGN AND FABRICATIONOF SUBSTATION STEEL STRUCTURES

3.10 SCOPE

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

3.2.0 MATERIALS

3.2.1 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.

3.2.2 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

3.2.3 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 givenin IS 12427.

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

3.2.4 Washers

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

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

3.2.5 Galvanisation

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.

3.2.6 Other Materials

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

3.3.0 DESIGN PARAMETERS

3.3.1 Switchyard structures such as columns, beams and equipment mounting structures shall be designed as per drawing provided along with this bidding document.

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

3.3.2 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

3.3.3 Deviation Angle

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

3.3.4 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	31.77 MM	28.62 mm	21.00 mm
4	Breaking load	161.2	130.32	89.67
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 strand			
	Steel centre	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	0.05552ohm/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.

3.4.0 DESIGN DRAWINGS

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

3.4.2 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 CONTRACTOR only and the CONTRACTOR shall ensure that all the members can be fitted while erecting without any undue strain on them.

3.5.0 ACCESSORIES

3.5.1 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.

3.5.2 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 CONTRACTOR.

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 CONTRACTOR.

3.5.3 Earth wire Clamps Attachment

i. **Suspension Clamp**

The detailed drawing shall be submitted by the CONTRACTOR for Purchaser's approval.
The CONTRACTOR 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 CONTRACTOR shall also supply the U-bolts wherever required and take Purchaser's approval for details of the attachments before the mass fabrication.

3.6.0 FABRICATION

3.6.1 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

3.6.2 Drilling and Punching

3.6.2.1 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.

3.6.2.2 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 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.

3.6.2.3 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.

3.6.3 Erection mark

3.6.3.1 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.

3.7.0 GALVANIZING

3.7.1 Galvanising of the various members of the structures shall be done only after all works of sawing, shearing, drilling, filling, bending and matching are completed. Galvanising shall be done by the hot dip process as recommended in IIS: 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 galvanising and the galvanising process itself must not affect adversely the mechanical properties of the treated materials. No manual Galvanization process will be accepted.

3.7.2 All assembly bolts shall be thoroughly hot dip galvanised 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 galvanised, but oiled only.

3.7.3 The outside surface shall be galvanised. Sample of galvanised materialsshall be supplied to the galvanised test set out in IIS 729 or other such authoritative international standards.

3.8.0 EARTHING

3.8.1 To keep provision in the structures for earthling, holes shall be drilled on two diagonal opposite legs of the towers/columns/mounting structures. The holes shall be suitable for bolting 65 mm X 1 2 mm GII 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.

3.9.0 TEST AND TEST CERTFICATE

3.9.1 Each consignment ready for transportation shall be offered to AEGCL 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.

3.10.0 TEST AT CONTRACTOR'S PREMISES

3.10.1 The CONTRACTOR 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.

3.10.1.1 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.

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

SECTION-4
TECHNICAL SPECIFICATION OF OUTDOOR SF6 CIRCUIT BREAKERS

4.1.0 SCOPE

4.1.1 The intention of this Section of the Specification is to cover design, manufacture, testing at manufacturer's works of Circuit Breakers with all fittings and accessories including mounting structures as applicable

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

4.1.3 Erection, Testing and Commissioning of Circuit Breakers.

4.2.0 GENERAL REQUIREMENTS

4.2.1 The circuit breaker shall be of three phase unit (gang operated) (or) three identical single-phase units (as said in data sheet), outdoor, single pressure puffer type. The operating mechanism shall be electrically and mechanically trip/free with anti-pumping facility suitable for remote electrical closing, tripping as well as local Operation facility as specified. The CBs are meant for installation with Transformers LV side & bus section.

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

4.2.3 The circuit breaker shall be capable of switching transformer-magnetizing currents and shall be restrike - free.

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

4.2.5 All cable ferrules, lugs, tags, etc. required for cabling from equipment control cabinet/operating mechanism to the central control cabinet of the breaker shall be supplied loose as per approved schematics.

4.2.6 The SF6 breaker shall be designed to ensure that condensation of moisture is controlled by proper selection of organic insulating materials having low moisture absorbing characteristics.

4.2.6.1 The support structure of circuit breaker shall be hot dip galvanised. Sufficient galvanising thickness shall be achieved with 615 gm/m². All other parts shall be painted as per painting specification enclosed separately.

4.3.0 OPERATING MECHANISM

4.3.1 A power spring operated mechanism for closing and tripping shall be provided in the breaker control cabinet. This device shall be so interlocked that while it is under maintenance, the breaker cannot be operated from remote. A slow acting, manually operated device shall be provided for inspection and maintenance purposes.

4.3.2 Circuit breaker operating mechanism shall be capable of storing energy for atleast two complete closing and tripping operations.

4.3.3 Each mechanism shall have an operation counter.

4.3.4 The operating mechanism shall be mounted and enclosed in a weather proof, vermin-proof, sheet steel

cabinet conforming to IP: 55 degree of protection. Sheet steel thickness shall be as specified in data sheet. The cabinet shall also house relays, control and auxiliary equipment of each breaker and provision for terminating all control, alarm and auxiliary circuits. It shall be provided with hinged doors with provision for locking and removable gland plates to be drilled at site. Inspection window shall be provided for observation of the instruments without opening the cabinet. It shall be mounted so as to provide convenient access from ground level.

4.3.5 The cabinet shall be fitted with a thermostatically controlled anti-condensation heater, a 15A, 1 phase, 5 pin socket outlet with switch and a cubicle illuminating lamp suitable for operation on 240 V AC 50Hz supply.

4.3.6 Circuit breakers shall feature high repeatability of absolute closing time over a wide range of parameters (ambient temperature, pneumatic pressure, control voltages, etc).

4.3.7 Main poles shall operate simultaneously. There shall be no objectionable rebound and the mechanism shall not require any critical adjustment. It shall be strong, rigid, positive and fast in operation.

4.3.8 Disagreement circuit shall be provided which shall detect pole position discrepancy.

4.3.9 The design of the circuit breaker shall be such that contacts will not close automatically upon loss of gas/ air pressure.

4.3.10 Closing release shall be capable of operating within the range of the rated voltage as specified in the data sheet. Shunt trip shall operate satisfactorily under all operating conditions of the circuit breaker up to the rated breaking capacity of the circuit breaker within the range of the rated voltages specified in the Data sheet.

4.3.11 Working parts of the mechanism shall be of corrosion resisting material. Bearings which require grease shall be equipped with pressure type grease fittings. Bearing pin, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing adjustment with repeated operation of the breaker.

4.3.12 All controls, gauges, relays, valves, hard drawn copper piping and all other accessories as necessary shall be provided including the following:

4.3.12.1 Low pressure alarm and lock out relay with adjustable pressure setting suitable for operation on DC system.

4.3.12.2 A no-volt relay for remote indication of power failure for compressor motor/ Spring Charge motor.

4.3.13 As long as power is available to the motor, continuous sequence of closing and opening operations shall be possible.

4.3.14 After failure of power supply to the motor, at least one open-close-open operation of the circuit breaker shall be possible.

4.3.15 Motor rating shall be such that it requires only about 30 seconds for full charging of the closing spring.

4.3.16 Closing action of the circuit breaker shall compress the opening spring ready for tripping.

4.3.17 During closing, springs are discharged and after closing of breaker, springs shall automatically be charged for the next operation. Facility for manual charging of closing springs shall be provided. Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is already in the closed position.

4.4.0 OPERATING MECHANISM CONTROL

4.4.1 The breaker shall normally be operated by remote electrical control. Two electrically independent trip circuit including two trip coils per pole shall be provided. However, provision shall be made for local electrical control. For this purpose a local/remote selector switch, close and trip control switch/push button shall be provided in the breaker central control cabinet.

4.4.2 The two way Local/Remote switch shall have minimum 4 (four) pair of contacts and wiring shall be made available to monitor local/remote status from local SCADA/SAS.

4.4.3 The trip coils shall be suitable for trip circuit supervision during both open and close position of the breaker. Necessary terminals shall be provided in the central control cabinet of the circuit breaker by the CONTRACTOR.

4.4.4 The auxiliary switch of the breaker shall be positively driven by the breaker operating rod.

4.4.5 A conveniently located manual tripping lever or button shall also be provided for local tripping of the breaker and simultaneously opening the reclosing circuit. A local manual closing device which can be easily operated by one man standing on the ground shall also be provided for maintenance purpose. Direction of motion of handle shall be clearly marked.

4.4.6 Necessary platform with Ladder shall be provided for easy access to the Operating Box thereby easing out local operation/maintenance.

4.4.7 **When the spring get fully charged either through motor or hand cranking, the spring charging motor and the hand cranking device should get disengaged mechanically from the charged spring and this should not be depended upon only the limit switch**.

4.5.0 SF6 GAS SYSTEM

4.5.1 SF6 gas shall serve as an arc-quenching medium during opening/closing operation and as an insulating medium between open contacts of the circuit breaker.

4.5.2 The circuit breaker shall be single pressure type. The design and construction of the circuit breaker shall be such that there is a minimum possibility of gas leakage and entry of moisture. There should not be any condensation of SF6 gas on the internal insulating surfaces of the circuit breaker.

4.5.3 All gasketted surfaces shall be smooth, straight and reinforced, if necessary, to minimise distortion and to make a tight seal, the operating rod connecting the operating mechanism to the arc chamber (SF6 media) shall have adequate seals. The SF6 gas leakage should not exceed 1% per year.

4.5.4 In the interrupter assembly there shall be an absorbing product box to minimise the effect of SF6 decomposition products and moisture. The material used in the construction of the circuit breakers shall be such as fully compatible with Sf_6 gas decomposition products.

4.5.5 Each pole shall form an enclosure filled with Sf_6 gas independent of two other poles (for 245 &**145 kVCBs**) and the Sf_6 density of each pole shall be monitored.
For CBs of voltage class of 36kV, a common Sf_6 scheme/density monitor shall be acceptable.

4.5.6 The dial type SF6 density monitor shall be adequately temperature compensated to model the pressure changes due to variations in ambient temperature within the body of circuit breaker as a whole. The density monitor shall have graduated scale and shall meet the following requirements:

It shall be possible to dismantle the density monitor for checking/replacement without draining the SF6

gas by providing suitable interlocked non return valve coupling.

4.6.0 BUSHINGS AND INSULATORS

4.6.1 Bushings and Insulators shall be of Porcelain, Solid core type.

4.6.2 Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC- 60137, while Hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS: 5621.
The support insulators shall be manufactured and tested as per IS: 2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable

4.6.3 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.

4.6.4 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.

4.6.5 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.

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

4.7.0 FIXED AND MOVING CONTACTS

4.7.1 Main contacts shall have ample area and contact pressure for carrying the rated current and the short time rated current of the breaker without excessive temperature rise which may cause pitting or welding. Contacts shall be adjustable to allow for wear, easily replaceable and shall have minimum moving parts and adjustments to accomplish these results. Main contacts shall be the first to open and the last to close so that there will be little contact burning and wear out.

4.7.2 Arcing contacts, if provided, shall be the first to close and the last to open and shall be easily accessible for inspection and replacement. Tips of arcing and main contacts shall be silver faced.

4.7.3 If multi-break interrupters are used, they shall be so designed and augmented that a fairly uniform voltage distribution is developed across them.

4.8.0 INTERLOCKS

4.8.1 Key release mechanical interlocks shall be incorporated in the operating mechanism for interlocking with the associated isolators, so that operation of the circuit breaker is dependent on a "key-trapped" situation. In addition, electrical interlocks with associated isolators shall be provided.

4.9.0 ADDITIONAL DUTY REQUIREMENTS

4.9.1 Circuit breakers shall be capable of clearing short line faults with the same impedance behind the bus corresponding to the rated fault current.

4.9.2 Circuit breakers shall be capable of breaking 25% of rated fault current at twice rated voltage under out of phase conditions.

4.9.3 The Bid shall highlight the design features provided to effectively deal with:

a) Breaking of inductive currents and capacitive currents.
b) Charging of long lines and cables.
c) Clearing developing faults within the full rating of the breaker.
d) Opening on phase opposition.

4.10.0 ACCESSORIES

4.10.1 Gas Pressure Detector

The circuit breaker shall be provided with gas pressure monitor with temperature compensation for initiating alarm and locking the operating mechanism in the event of abnormality.
Gas pressure monitor shall be provided for each pole individually.

4.10.2 Position Indicator

Each pole of the circuit breaker shall be provided with a position indicator.

4.10.3 Terminals

Each circuit breaker shall be provided with suitable terminal pads of high conductivity aluminium alloy for connecting to the line.

4.10.4 Auxiliary Switches

Each circuit breaker shall be equipped with auxiliary switches with sufficient number of contacts for control, indication and interlocking purposes. Ten normally open and ten normally closed contacts shall be provided as spares. All contacts shall be rated for the DC voltage specified in data sheet.

4.10.5 Terminal Blocks

All accessories and control devices shall be completely wired. All wirings which are connected to external circuit shall be terminated on terminal blocks installed in the control cabinet. The terminal blocks provided shall have twenty (20) percent spare terminals.

4.10.6 Operating mechanism housing shall be supplied with all required accessories including the following:

a) Padlocks and duplicate keys.
b) Space heaters equipped with automatic thermostatic control.
c) Local/remote changeover switch.
d) Manually operated tripping push button/lever (mechanical) conveniently located to trip all three phases simultaneously.
e) Control switches to cut off control power supplies.
f) Fuses as required.
g) Two earthing terminals.
h) Auxiliary relays required for satisfactory operation.
i) Motor contactor with thermal release
j) Provision for mechanical interlock with isolator.
k) Readable wiring diagram shall be pasted inside the front cover of the operatingmechanism box with indelible ink.

4.11.0 SUPPORT STRUCTURES

4.11.1 The Circuit Breakers shall be suitable for mounting on steel structures.

4.11.2 The support structure shall be of steel hot dip galvanised type. The height of support structure shall be designed to keep the bottom most live part and bottom of insulators of circuit breakers at minimum clearance from the plinth as specified in data sheet.

4.11.3 All necessary galvanised bolts, nuts and washers to complete the erection shall be furnished including the embedded anchor bolts for securing the supporting structure to the concrete foundations.

4.12.0 NAME PLATES

4.12.1 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.

4.13.0 EARTHING

4.13.1 Two earthing pads shall be provided on each supporting structure. Each control cabinet or terminal box mounted on the supporting structure shall also be connected to an earthing pad. Separately mounted control cabinets shall be provided with two earthing pads adjacent to the base of the cabinet. The earthing connection shall be bolted type and suitable for receiving 65mm x 12mm MS strip.

4.14.0 TERMINAL CONNECTORS

4.14.1 The equipment shall be supplied with required number of terminal connectors of approved type suitable for ACSR conductors. 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.

4.15.0 TESTS

4.15.1 All routine tests shall be carried out in accordance with relevant IS.

All routine/acceptance tests shall be witnessed by the Purchaser/his authorised representative.

The tests shall include the following:

a) Routine/Acceptance Tests (all units)

i) Mechanical Operation tests
ii) Power frequency voltage withstand test (dry)
iii) Tests on auxiliary & control circuits
iv) Measurement of resistance of the main circuit.

b) Type Tests:

The bidder shall furnish type test certificates and results for the following tests along with the bid for breaker of identical design.

i) Breaking and making capacity test
ii) Short-time current test
iii) Temperature rise tests
iv) Lightning Impulse voltage test

c) Special Tests:

The operating mechanism box shall be tested for paint film thickness and the galvanization test for structure shall be conducted in one of the unit of each type.

d) Test Certificates

Copies of routine/acceptance test certificates shall be produced with the endorsement of the inspecting authority to the Purchaser before effecting dispatch. The test report shall contain the following information.

i) Complete identification data, including serial No. of the breaker.
ii) Method of application, where applied, duration and interpretation of results in each test.

4.16.0 PRE-COMMISSIOING TESTS

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

(a) Insulation resistance of each pole.
(b) Check adjustments, if any suggested by manufacturer.
(c) Breaker closing and opening time.

(d) Slow and Power closing operation and opening.
(e) Trip free and anti-pumping operation.
(f) Minimum pick-up voltage of coils.
(g) Dynamic Contact resistance measurement.
(h) Functional checking of control circuits interlocks, tripping through protective relays and auto reclose operation.
(i) Insulation resistance of control circuits, motor etc.
(j) Resistance of closing and tripping coils.
(k) SF6 gas leakage check.
(l) Dew Point Measurement
(m) Verification of pressure switches and gas density monitor.
(n) Checking of mechanical 'CLOSE' interlock, wherever applicable.
(o) Testing of grading capacitor.
(p) Resistance measurement of main circuit.
(q) Checking of operating mechanism.
(r) Check for annunciations in control room

4.17.0 SPECIAL TOOLS AND TACKLES

4.17.1 The Bidder shall furnish a list of any special tools and tackles required for maintenance and operation purposes with recommended quantities for each substation.

4.17.2 TECHNICAL DATA SHEET FOR CIRCUIT BREAKER

	Particulars	Unit	Data for132 kV CB	Data for33 kV CB
1	Type		Sf_6	Sf_6
2	No of poles		3 (3 Phase Ganged Unit)	3 (3 Phase Ganged Unit)
3	Service		Outdoor	Outdoor
4	Rated System Voltage	kV	132	33
5	Highest System Voltage	kV	145	36
6	System earthing		Solidly earthed system	Solidly earthed system
7	Rated Voltage of Breaker	kV	145	36
8	Rated Continuous Current	Amps	3150	1250
9	Rated Frequency	Hz	50	50
10	Rated Short Circuit breaking current (I) – 3 sec - symmetrical	kA	40	25
11	Rated Short Circuit making current	kA	2.5*I	2.5*I
12	Duty cycle		0-0.3 Sec-CO-3Min –CO	0.3Sec-CO-3Min–CO
13	First pole to clear factor		1.3	1.3
14	Operating time			
	i) Opening Time	ms	Not exceeding50ms	Not exceeding 50ms

	ii) Closing Time	ms	Not exceeding120ms	Not exceeding 120ms
15	Insulation level			
	i) Power Frequency with Stand Voltage	kV	275	70
	ii) Impulse withstand Voltage	kV	650	170
16	Minimum clearance between phases	m	1300	320
17	Minimum clearance between phase to earth	mm	1300	320
18	Minimum Ground clearance (from bottommost live part to plinth level)	mm	4600	4000
19	Minimum clearance from bottom Of Support insulator to plinth level	mm	2500	2500
20	i) Minimum Creepage Distance (Total)	mm	4495	1116
	ii) Minimum Creepage Distance (Protected)	mm	50% of the creepage distance	50% of the creepage distance
21	Arcing horn			Yes
22	Operating mechanism:			
	a) Type		Spring Charged	Spring Charged
	b) Rating of Drive Motor	V	Universal Motor/ 1 Phase 50 Hz 230V AC	Universal Motor/ 1 Phase 50 Hz 230V AC
	c) Rated voltage of Shunt trip coil & operating range	V. DC	220 or 110 [50% - 110%]	220 or 110 [50% - 110%]
	(d) Rated voltage of Closing coil & operating range	V. DC	220 or 132 [80% - 110%]	220 or 132 [80% - 110%]
	(e) No. of trip coils	No	2 per CB	2 per CB
	(f) No. of closing coils	No	1 per CB	2 per CB
	g) No of spare auxiliary contacts & contact rating	Nos. AMPS	10 N/O+10 N/C (per CB) 10A at 240V AC & 2A at 220V/110V DC	10 N/O+10 N/C (per CB) 10A at 240V AC & 2A at 220V/110V DC
	h) Minimum thickness of sheet steel forcontrol cabinet	mm	3	3
	i) Enclosure Protection		IP55	IP55
23	Reclosing		Three Phase Auto Reclosing	Three Phase Auto Reclosing
24	Support structure (Painted / Galvanised)		Galvanised	Galvanised
25	All other parts (Painted / Galvanised)		Synthetic enamel shade 631 of IS5(125 microns)	Synthetic enamel shade 631 of IS5(125 microns)

26	Minimum size of control wiring (Copper)	Sq.mm	2.5	2.5

SECTION-5
TECHNICAL SPECIFICATION OF OUTDOORCURRENT AND POTENTIAL TRANSFORMERS

5.1.0 SCOPE

5.1.1 This Section of the Specification covers general requirements for design, engineering, manufacture, assembly and testing at manufacturer's works of Live Tank type outdoor Current and Potential Transformers, also referred to as Instrument transformers.

5.1.2 Loading at manufacturer's works, transportation and delivery at respective substation siteincluding unloading at destination site.

5.1.3 Erection, Testing and Commissioning of Instrument Transformers.

5.2.0 STANDARDS

5.2.1 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 or equivalent IEC and shall conform to the regulations of local statutory authorities.

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

5.2.3 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
(v) Purpose application.
(v) IS: 3156(Part-I) Potential transformers: General requirement.
(vi) IS: 3156 (Part-II) Potential transformers: Measuring Potentialtransformers
(vii) IS: 3156 (Part-III) Potential transformers: Protective Potentialtransformers

5.3.0 GENERAL REQUIREMENTS

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

5.3.2 Instrument transformers shall be of **Live Tank design.**

5.3.3 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).
All parts of bellow shall be stainless steel only. ***A ground glass window shall be provided to monitor the position of the metal bellow.***

5.3.4 The instrument transformers shall be completely filled with oil.

5.3.5 A complete leak proof secondary terminal arrangement shall be provided with each instrument transformers. All secondary terminals shall be brought out 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.

5.3.6 All instrument transformers shall be of single phase unit.

5.3.7 All Instrument transformers shall be suitable for upright mounting on latticed steel structures.

5.3.8 The Instrument Transformer shall be complete in all respects and shall conform to the modern practice of design and manufacture.

5.3.9 The instrument transformers shall be so designed to withstand the effects of temperature, wind load, short

circuit conditions and other adverse conditions.

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

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

5.3.12 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.

5.3.13 All steel work shall be degreased, pickled and phosphate and then painted in accordance with Clause 2.15.0 (Painting)

5.3.14 The outer surface of metal tank shall be Hot Dip Galvanized, whereas, the inner portion shall be painted in accordance with Clause 2.15.0(Painting) or hot dip galvanised.

5.3.15 The galvanising shall be as per applicable standard IS: 2629 and minimum thickness of zinc coating shall be 610 gm/sq.mt.

5.4.0 INSULATING OIL

5.4.1 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 / IEC 60296 (required for first filling)

5.5.0 COMMON MARSHALLING BOXES

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

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

5.5.3 1(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.

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

5.5.5 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.

5.5.6 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.

5.5.7 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.

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

5.5.9 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.

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

5.5.11 All steel works of common marshalling boxes shall be hot dipped galvanized.

5.5.12 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)

5.6.0 BUSHINGS AND INSULATORS

5.6.1 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.

5.6.2 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.

5.6.3 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.

5.6.4 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.

5.6.5 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.

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

5.7.0 TESTS

5.7.1 Routine/Acceptance Tests (all units)

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

5.7.1.2 In addition, following tests on Current Transformers shall also be carried out as Routine Tests:
I) Measurement of Capacitance.
II) Oil leakage test.
III) Measurement of tan delta at 0.3, 0.7, 1.0 Um/√3 and 10 kV

5.7.1.3 At factory/works tests the Ten Delta shall not exceed 0.3% (at Um/√3). The same shall not exceed 0.7% at the end of warranty period (refer SCC clause 5.10.0 of Vol-1). If tan delta value of CTs exceed prescribed limit of 0.7% within warranty period, it will be considered as failure within

warranty period (Tan delta & capacitance test of CTs shall be measured at 10KV at site). The bidder has to replenish failed CTs within guarantee period without any cost implication to AEGCL.

5.7.2 Type Tests

5.7.2.1 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.

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

5.8.0 NAME PLATES

5.8.1 All equipment shall have non-corrosive name plates conforming to requirements of IS and fix at a suitable position and indelibly marked with full particular there on in accordance with the standard adapted.
The rated current, extended current rating (if specified) along with year of manufacture must be clearly indicated on the name plate.
The rated thermal current in case of CT shall also be marked on the name plate.

5.9.0 MOUNTING STRUCTURES

5.9.1 All the equipment covered under this specification shall be suitable for mounting on steel structures. Supply of mounting structures is also in the scope of this tender.

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

5.10.0 SAFETY EARTHING

5.10.1 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.

5.11.0 TERMINAL CONNECTORS

5.11.1 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.

5.12.0 PRE-COMMSIONING TESTS

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

(a) Current Transformers

i) Insulation Resistance Test for primary and secondary.
ii) Polarity test
iii) Ratio identification test - checking of all ratios on all cores by primary injection of current.
iv) Dielectric test of oil (wherever applicable).
v) Magnetising characteristics test.
vi) Tan delta and capacitance measurement.
vii) Secondary winding resistance measurement
viii) Contact resistance measurement (wherever possible/accessible)

(b) Voltage Transformers

i) Insulation Resistance Test for primary (if applicable) and secondary.

ii) Polarity test.
iii) Ratio test.
iv) Dielectric test of oil (wherever applicable).
v) Tan delta and capacitance measurement of individual capacitance stacks.
vi) Secondary winding resistance measurement

5.13.0 TECHNICAL DATA SHEET FOR CURRENT AND POTENTIALTRANSFORMERS

5.13.1 For 220,132 & 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 upto the terminal blocks.

5.13.2 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	**220kV**	**132kV**	**33 kV**
(B) Highest system voltage, kV	245	145	36
(C) Rated frequency ,HZ	50	50	50
(D) System earthing	Solidly Earthed	Solidly earth	Solidly earth
(E) Insulation level			
(a) Impulse withstand voltage: kVp	1050	650	170
(b) One minute p.f. Withstand voltage, kV (r.m.s.)	460	275	70
(F) Short time current for one second, kA	50	40	31.5
(G) Minimum creepage distance, mm	7595	4495	1116
(a) Tan Delta (for CTs only) at Um/√3,(Max)	0.3%	0.3%	0.3%
(H) Temperature rise	As per ISS		
(I) Feeder/ BYPASS/ Bus Coupler CT			
(i) No. of Cores	5	**4**	3
(ii) Transformation Ratio	As per schedule of requirement		
(iii)Rated Output			
(a) Core-1	30 VA	30 VA	30 VA
(b) Core-2	-	15 VA	15 VA
(c) Core-3	-	-	-
(d) Core-4	-	N.A	N.A
(e) Core-5	-	N.A	N.A
(iv) Accuracy Class			
(a) Core-1	0.2	0.2	**0.2**
(b) Core-2	5P	5P	5P
(c) Core-3	PS	PS	PS
(d) Core-4	PS	PS	N.A
(e) Core-5	PS	N.A	N.A
(v) Accuracy Limit Factor			
(a) Core-1	-	--	-
(b) Core-2	-	20	10

(c) Core-3	-	-	-
(d) Core-4	-	N.A	N.A
(e) Core-5	-	N.A	N.A
(vi) Instrument security factor			
(a) Core-1	<5		
(b) Core-2	--	10	10
(c) Core-3	-	-	-
(d) Core-4	-	N.A	N.A
(e) Core-5	-	N.A	N.A
(vii) Minimum Knee point voltage, Volts			
(a) Core-1	-	-	-
(b) Core-2	1600	-	-
(c) Core-3	1600	1200	1200
(d) Core-4	800	800	N.A
(e) Core-5	800	N.A	N.A
(viii) Maximum secondary resistance, ohm			
(a) Core-1	-	-	-
(b) Core-2	3	-	-
(c) Core-3	3	3	3
(d) Core-4	3	N.A	N.A
(e) Core-5	3	N.A	N.A
(ix) Maximum exciting current, at Vk/4 mA			
(a) Core-1	-	-	-
(b) Core-2	20	-	-
(c) Core-3 (at Vk/4)	20	20	20
(d) Core-4	20	N.A	N.A
(e) Core-5	20	N.A	N.A
(J) Transformer CT			
(i) No. of Cores	5	4	3
(ii) Transformation Ratio	As per schedule of requirement		
(iii)Rated Output			
(a) Core-1	30 VA	30 VA	30 VA
(b) Core-2	-	15 VA	15 VA
(c) Core-3	-	-	-
(d) Core-4	-	-	N.A
(e) Core-5	-	N.A	N.A
(iv) Accuracy Class			
(a) Core-1	**0.2**	0.2	**0.2**
(b) Core-2	PS	5P	5P
(c) Core-3	PS	PS	PS
(d) Core-4	PS	PS	N.A
(e) Core-5	PS	N.A	N.A
(v) Accuracy Limit Factor			
(a) Core-1	-	--	-
(b) Core-2	-	10	10
(c) Core-3	-	-	-

(d) Core-4	-	-	N.A
(e) Core-5	-	N.A	N.A
(vi) Instrument security factor			
(a) Core-1	-	-	-
(b) Core-2	10	10	10
(c) Core-3	-	-	-
(d) Core-4	-	-	N.A
(e) Core-5	-	N.A	N.A
(vii) Minimum Knee point voltage, Volts			
(a) Core-1	-	-	-
(b) Core-2	-	-	-
(c) Core-3	1600	1200	1200
(d) Core-4	800	800	N.A
(e) Core-5	N.A	N.A	N.A
(viii) Maximum secondary resistance, ohm			
(a) Core-1	-	-	-
(b) Core-2	-	-	-
(c) Core-3	30	30	30
(d) Core-4	20	20	N.A
(e) Core-5	20	N.A	N.A
(ix) Maximum exciting current, at Vk/4 mA			
(a) Core-1	-	-	-
(b) Core-2	3	-	-
(c) Core-3 (at Vk/4)	3	3	3
(d) Core-4	3	3	N.A
(e) Core-5	3	N.A	N.A
POTENTIAL TRANSFORMER			
(i) No. of secondary windings	3	2	2
(ii) Transformation ratio			
(a) Winding I	(220 kV/√3) / (110 V/√3)	(132kV/√3) / (110V/√3)	33kV/√3
(b) Winding II			/ 110V/√3
(c) Winding III		-	
(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.

SECTION-6
TECHNICAL SPECIFICATION OF ISOLATORS

6.1.0 SCOPE

6.1.1 This section of the specification is intended to cover design specifications for design, manufacture, testing at manufacturer's works of **gang operated Isolators** with all fittings and accessories, including mounting structures as applicable.

6.1.2 Loading at manufacturer's works, transportation and delivery at respective substation site, including unloading at destination site.

6.1.3 Erection, Testing and Commissioning of Isolators.

6.2.0 STANDARD

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

6.3.0 GENERAL

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

6.3.2 Isolators shall be outdoor, off-load type. Earth switches shall be provided on the isolators as and where specified with possibility of being mounted on any side of the isolator.

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

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

6.3.5 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.

6.4.0 DUTY REQUIREMENTS

6.4.1 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.

6.4.2 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.

6.4.3 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.

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

6.4.5 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.

6.4.6 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.

6.5.0 CONSTRUCTIONAL DETAILS

6.5.1 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.

6.5.2 Contacts:

6.5.2.1 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.

6.5.2.2 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.

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

6.5.2.4 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.

6.5.3 Blades:

6.5.3.1 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.

6.5.3.2 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.

6.5.3.3 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.

6.5.3.4 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.

6.5.4 Insulators:

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

6.5.4.2 Pressure due to the contact shall not be transferred to the insulators after the main blades are fully

closed.

6.5.5 Base:

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

6.6.0 EARTHING SWITCHES

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

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

6.6.3 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.

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

6.6.5 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.

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

6.6.7 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.

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

6.7.0 OPERATING MECHANISM

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

6.7.2 Control cabinet/operating mechanism box shall be made of aluminium sheet of adequate thickness (minimum3 mm).

6.7.3 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.

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

6.7.5 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.

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

6.7.7 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.

6.8.0 OPERATION

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

6.8.2 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 inter-pole 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.

6.8.3 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.

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

6.8.5 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.

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

6.8.7 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.

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

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

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

6.9.0 TEST AND INSPECTION

6.9.1 The switches shall be subjected to the following type test in accordance to with IS: 9921.

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

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

(i) Power frequency voltage dry withstand test on Main circuit.
(ii) Voltage Tests on control and auxiliary circuit.
(iii) Measurement of resistance of the main circuit
(iv) Mechanical Operating test.

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

6.10.0 AUXILIARY SWITCHES

6.10.1 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

6.11.0 CONNECTORS

6.11.1.1 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.

6.12.0 MOUNTING STRUCTURES

6.12.1 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 bidder. The isolators should have requisite fixing details ready for mounting them on structures.

6.13.0 PRE-COMMISSIONING TESTS

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

(a) Insulation resistance of each pole.
(b) Manual and electrical operation and interlocks.
(c) Insulation resistance of control circuits and motors.
(d) Ground connections.
(e) Contact resistance.
(f) Proper alignment so as to minimise to the extreme possible the vibration during operation.
(g) Measurement of operating Torque for isolator and Earth switch.
(h) Resistance of operating and interlocks coils.
(i) Functional check of the control schematic and electrical & mechanical interlocks.
(j) 50 operations test on isolator and earth switch

6.14.0 TECHNICAL DATA SHEET FOR ISOLATORS

	Technical Particulars	Isolators class		
		220kV	**132kV**	33 kV
1	Nominal system voltage, kV	220	132	33
2	Highest system voltage, kV	245	145	36
3	Rated frequency, Hz.	50	50	50
4.	Type of Isolator	Single Centre Break	Single Centre Break	Double Break, centre pole rotating
5	Rated continuous current, A	3150	2000	1250
6	Rated short time current, kA	50	40	31.5
7	Rated duration of short time current,(second)	1	1	1
8	Rated lightning impulse Withstand voltage, kV (peak)			
	i) To earth & between poles	1050	650	170
	ii) Across isolating distance	1200	750	195
9	Rated 1 minute power frequency withstand voltage, kV (rms)			
	i) To earth & between poles	460	275	70
	ii) Across isolating distance	530	460	80
10	Minimum Creepage distance of insulators, mm (31mm/kV)	7595	4495	1116
11	Temperature rise	As per relevant IEC 62271-102/ IS 9921 As per relevant IS		

SECTION-10
TECHNICAL SPECIFICATION OF POWER AND CONTROL CABLES

10.1.0 GENERAL REQUIREMENT

10.1.1 Aluminium conductor PVC insulated armoured power cables shall be used for various other applications in switchyard area/control room except for control/protection purposes.

10.1.2 For all control/protection/instrumentation purposes PVC insulated armoured control cables of minimum 2.5 sq. mm Size with stranded Copper conductors shall be used.

10.1.3 Cables shall be laid conforming to IS: 1255.

10.1.4 While preparing cable schedules for control/protection purpose following shall be ensured:

- Separate cables shall be used for AC & DC.
- For different cores of CT & PT separate cable shall be used.
- At least one (1) core shall be kept as spare in each copper control cable of 4C, 5C or 7C size whereas minimum no. of spare cores shall be two (2) for control cables of 10 core or higher size.

10.1.5 For control cabling, including CT/VT circuits, 2.5sq.mm.size copper cables shall be used per connection. However, if required from voltage drop/VA burden consideration additional cores shall be used. Further, for potential circuits of energy meters separate connections by 2 cores of 2.5sq.mm size shall be provided.

10.1.6 Standard technical data sheets for cable sizes up to and including 1100V are enclosed at **Clause 10.3.0**. Cable sizes shall be offered /manufactured in accordance with parameters specified in standard technical data sheets. Technical data sheet for any other cores/sizes required during detailed engineering shall be separately offered for Employer's approval by the contractor/supplier.

10.2.0 TECHNICAL REQUIREMENTS

10.2.1 General

10.2.1.1 The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.

10.2.1.2 The XLPE insulated cables shall be capable of withstanding a conductor temperature of 250°C during a short circuit without any damage. The PVC insulated cables shall be capable of withstanding a conductor temperature of 160°C during a short circuit.

10.2.1.3 The Aluminium/Copper wires used for manufacturing the cables shall be true circular in shape before stranding and shall be uniformly good quality, free from defects. All Aluminium used in the cables for conductors shall be of H2 grade. In case of single core cables, armours shall be of H4 grade Aluminium.

10.2.1.4 The fillers and inner sheath shall be of non-hygroscopic, fire retardant material, shall be softer than insulation and outer sheath shall be suitable for the operating temperature of the cable.

10.2.1.5 Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of all cables.

10.2.1.6 Strip wire armouring method shall not be accepted for any of the cables. For control, cables only round wire armouring shall be used.

10.2.1.7 The cables shall have outer sheath of a material with an oxygen index of not less than 29 and a temperature index of not less than 250°C.

10.2.1.8 All the cables shall pass fire resistance test as per IS:1554 (Part-I)

10.2.1.9 The normal current rating of all PVC insulated cables shall be as per IS: 3961.

10.2.1.10 Repaired cables shall not be accepted.

10.2.1.11 Allowable tolerance on the overall diameter of the cables shall be plus or minus 2mm.

10.2.2 XLPE Power Cables

The XLPE (90°C) insulated cables shall be of FR type, C1 category conforming to IS: 7098 (Part-I) and its

amendments read along with this specification. The conductor shall be stranded aluminium circular/sector shaped and compacted. In multicore cables, the core shall be identified by red, yellow, blue and black coloured strips or colouring of insulation. A distinct inner sheath shall be provided in all multicore cables. For XLPE cables, the inner sheath shall be of extruded PVC of type ST-2 of IS: 5831. When armouring is specified for single core cables, the same shall consist of aluminium wires/strips. The outer sheath shall be extruded PVC of Type ST-2 of IS: 5831 for all XLPE cables.

10.2.3 PVC Power Cables

10.2.3.1 The PVC (70°C) insulated power cables shall be of FR type, C1 category, conforming to IS: 1554 (Part-I) and its amendments read along with this specification and shall be suitable for a steady conductor temperature of 70°C. The conductor shall be stranded aluminium. The Insulation shall be extruded PVC to type-A of IS: 5831. A distinct inner sheath shall be provided in all multicore cables. For multicore armoured cables, the inner sheath shall be of extruded PVC. The outer sheath shall be extruded PVC to Type ST-1 of IS 5831 for all cables.

10.2.4 PVC Control Cables

10.2.4.1 The PVC (70°C) insulated control cables shall be of FR type C1 category conforming to IS: 1554 (Part-1) and its amendments, read along with this specification. The conductor shall be stranded copper. The insulation shall be extruded PVC to type A of IS: 5831. A distinct inner sheath shall be provided in all cables whether armoured or not. The over sheath shall be extruded PVC to type ST-1 of IS: 5831 and shall be grey in colour.

10.2.4.2 Cores shall be identified as per IS: 1554 (Part-1) for the cables up to five (5) cores and for cables with more than five (5) cores the identification of cores shall be done by printing legible Hindu Arabic Numerals on all cores as per clause 10.3 of IS 1554 (Part-1).

10.3 DATA SHEET FOR CABLES

(A) Power Cables

Sl. No.	Description	3 ½ C 300mm$_2$	Other Power Cables	
			70 mm$_2$, 35 mm$_2$, 25mm$_2$, 16 mm$_2$	6 mm$_2$& 4mm$_2$
1	Applicable Standard	IS: 7098/PT-I & its referred standards	IS: 1554/PT-I& its referred standards	
2	Type Designation	A2XWY	AYFY	AYWY
3	Rated Voltage(volts)	1100	1100	1100
4	Type & Category	FR & C1	FR & C1	FR & C1
5	Suitable for earthed or unearthed system	Suitable for both		
6	Conductor			
	a) Material	Stranded Aluminium as per IS : 8130		
	b) Grade	H 2 (Electrolytic grade)		
	c) Number of wires (No.)	As per IS 8130		

	d) Form of Conductor	Stranded compacted circular/sector shaped	Stranded compacted circular/sector shaped	Non- compacted Stranded circular
	e) Direction of lay of stranded layers	Outermost layer shall be R.H lay & opposite in successive layers		

7	Insulation			
	a) Composition of insulation	Extruded XLPE as per IS-7098 Part(1)	Extruded PVC type A as per IS- 5831	Extruded PVC type A as per IS-5831
	b) Thickness of insulation(mm)	As per applicable Standard		
8	Inner Sheath material	Extruded PVC type ST-2 as per IS-5831	Extruded PVC type ST-1 as per IS- 5831	
9	Type and material of armour	Gal. Steel wire	Gal. Steel strip	Gal. Steel wire
10	Outer Sheath (PVC)	ST-1 & FR	ST-2 & FR	ST-2 & FR
11	Overall diameter of cable	As per applicable Standard		