BIDDING DOCUMENT

FOR

"Supply, Erection, Testing and Commissioning of Instrument Transformers at 132 KV Sankardevnagar GSS, AEGCL and Dalmia End for supplying power to 132 KV Calcom Unit-II at Lanka"

FUND: "Deposit Work-Dalmia Cement"

(E-Tender)

VOLUME -2

https://assamtenders.gov.in

BID IDENTIFICATION NO: **AEGCL/MD/Tech-933/OA-Dalmia Cement/BID**

ASSAM ELECTRICITY GRID CORPORATIONLIMITED

Rs.5000

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 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, current transformers, Potential transformers 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,

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 Licence issued by the Chief Electrical Inspector, Govt. of Assam, as per the provision of Law. An attested copy of the aforementioned Licence 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 authorised 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 licensed 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 coordinated 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 all items/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 dispatch 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 theEmployer.

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

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 approved drawings. Following are the list of drawings attached with this bidding document for reference purpose only:*

(i) Drg. No. AEGCL/Karimganj/Hatsingimari/Structure/STR/01 (Sheet 1 to 5): 132 kV Equipment Mounting Structure.

(ii) Drg. No. AEGCL/Karimganj/Equipment/FND/01 (Sheet 1 to 6): Foundation Details of 132 kV Equipment Mounting Structure.

2.1.3 *The above sets of drawings are tentative and may require modifications depending upon project, site conditions, exact equipment dimensions, etc. The Contractor shall be required to prepare his own drawings based on project with modifications as and if required and shall submit those for Employer's scrutiny.*

2.1.4 *Further, drawings are not complete sets of drawings normally required in similar type of installation. The contractor will be required to prepare the balance drawings and submit those for approval of Employer.*

2.1.5 *Only single diagrams are supplied for bus bar and equipment support structures (excluding mounting structures for Circuit Breakers and Isolators). The Contractor will be required to develop the fabrication drawings based on these SLDs and will submit those for approval of the Employer. As far as Mounting Structures of Circuit Breakers and Isolators are concerned it is responsibility of the Contractor to design the same as per this technical specification.*

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 and building plinths shall be minimum 300 mm and 500 mm above finished ground level respectively.

2.4.1.5 Minimum 75 mm thick lean concrete (1:4:8) 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- sulphonate type 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 lattic.

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	35.05 mm	28.62 mm	21.00 mm
4	Breaking load	136.38 kN	130.32 kN	130.32 kN
5	Weight of conductor	2004 Kg/km	1621 kg/km	974 kg/km
6	Co-efficient of linear expansion	$23x10^{-6}$ / ºC	$19.35x10^{-6}$ / ºC	$19.35x10^{-6}$ / ºC
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 20º 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 ground	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 be 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 in any 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 stainlesssteel.

h) Suspension and tension insulators shall be wet process porcelain with ball and socket connection. Insulators shall be interchangeable and shall be suitable for forming either suspension or tensionstrings.

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 necessary for their satisfactory performance. Such parts shall be deemed to be within the scope of this specification.

2.12.1.1 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	510 kV	650 kV	170 kV
5	Minimum Creepage Distance	31mm/kV	31mm/kV	31mm/kV
6	Minimum Bending Strength (upright)	6 kN	4 kN	3 kN

2.13.0 CLAMPS, CONNECTORS AND SPACERS

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: -

(i) For connecting ACSR: Aluminium alloy casting conforming to designation A6 of IS 617.
(ii) For connecting equipment: Bimetallic connectors made from aluminium alloy terminals made of copper casting conforming to designation A 6 of IS 617.
(iii) For connecting GI Shield wire: Malleable iron casting.
(iv) Expansion Connectors: Copper lamination to grade FRTP-2 of IS 191.
(v) Bolts, nuts, plain washers: Hot dip galvanised mild steel and spring washers for items (i), (ii) and (iii).

2.13.3 Spacers

Spacers shall conform to IS 10162. Spacers for bundle conductors (where specified) shall be provided at but not limited to the following locations:

(i) At intervals not exceeding 2.5 meters in case of strung bus bars or other bundled strung conductors.
(ii) At one meter interval in case of jumper connections.

No magnetic material shall be used in fabrication of spacers except for the GI bolts and nuts.

2.13.4 **T Clamp and Equipment Clamps**

a) T Clamps:

i. Standard Specification and tests shall be as per IS:5561.
ii. For connecting ACSR conductor aluminium alloy casting conforming to designation A 6 of IS 617.

iii. Bolts, nuts and washers shall be made of mild steel and hot dip galvanized as per IS 2629. Small fittings like spring washers, nuts etc. may be electrogalvanized.
iv. The quality of HDG ferrous components shall be determined by the test given in IS:2633 and shall satisfy the requirement of that standard.
v. The rated short time current shall be one of the standard values laid down in Indian Standards for the associated circuit breakers, Switches etc.
vi. Current carrying capacity same as conductor full current rating. For two different conductors, conductor with smaller rating shall be considered.
vii. No part of a clamp shall be less than 12 mm thick for fittings suitable up to size of ACSR Panther conductor, no part of a clamp shall be less than 15 mm thick for fittings suitable for ACSR Zebra conductor and ACSR Moose conductor.
viii. All sharp edges and corners shall be blurred and rounded off.
ix. For bimetallic connectors, copper alloy liner of minimum thickness of 2 mm shall be cast integral with aluminium body.
x. From outermost hole edge to nearest edge of any clamps and connectors the distance shall not be less than 10 mm.

b) <u>Equipment Clamps (CVT, CB, ISOLATOR, CT, etc.):</u>

i. Standard Specification and tests shall be as per IS:5561.
ii. For connecting ACSR conductor aluminium alloy casting conforming to designation A 6 of IS 617.
iii. Bolts, nuts and washers shall be made of mild steel and hot dip galvanized as per IS 2629. Small fittings like spring washers, nuts etc. may be electrogalvanized.
iv. The quality of HDG ferrous components shall be determined by the test given in IS:2633 and shall satisfy the requirement of that standard.
v. The rated short time current shall be one of the standard values laid down in Indian Standards for the associated circuit breakers, Switches etc.
vi. Current carrying capacity same as conductor full current rating. For two different conductors, conductor with smaller rating shall be considered.
vii. No part of a clamp shall be less than 12 mm thick for fittings suitable up to size of ACSR Panther conductor, no part of a clamp shall be less than 15 mm thick for fittings suitable for ACSR Zebra conductor and ACSR Moose conductor.
viii. All sharp edges and corners shall be blurred and rounded off.
ix. For bimetallic connectors, copper alloy liner of minimum thickness of 2 mm shall be cast integral with aluminium body.
From outermost hole edge to nearest edge of any clamps and connectors the distance shall not be less than 10 mm.

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 monthin
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 mild steel reinforcement bars, high yield strength deformed (HYSD) bars, 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 M10conforming 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 galvanizing, 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 given in 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	35.05 MM	28.62 mm	21.00 mm
4	Breaking load	136.38 KN	130.32 kN	130.32 kN
5	Weight of conductor	2004 Kg/KM	1621 kg / km	974 kg / km
6	Co-efficient Of Linear Expansion	23x10-6 /0C	19.35x10-6 /0C	19.35x10-6 /0C
7	Number of 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.

ii. **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 AND PAINTING

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 materials shall 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 ASEB for inspection before dispatch giving a minimum time of not less than 30 days. Samples of fabricated structure materials shall be subjected to following tests:

a) Steel: The structural steel shall conform to IS 226 and IS 8500, BS 4360-1068 or ISO / R 630 other such authoritative international standards. Manufacturer's test certificate shall be submitted for all used steel.
b) Galvanising: The galvanising shall be as per IS 2633 or BS 729 other such authoritative international standards. Zinc coating over the galvanised surfaces shall not be less than 610 gm per square meter.
c) Bolts and nuts: Manufacturer's test certificate as per standard practice shall be submitted.

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 towerre-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 members 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-5
TECHNICAL SPECIFICATION OF OUTDOOR CURRENT AND POTENTIAL TRANSFORMERS

CHAPTER 23: TECHNICAL SPECIFICATION FOR 132KV CURRENT TRANSFORMERS (AIS)

4.1.0. SCOPE OF CONTRACT

4.1.1. This Section of the Specification covers general requirements for design, engineering, manufacture, assembly and testing at manufacturer's works of 132 kV outdoor Current and Potential Transformers.

4.2.0. STANDARDS

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

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

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

(i)	IS: 2705(Part-I)	Current transformers: General requirement.
(ii)	IS: 2705(Part-II)	Current transformers : Measuring Current transformers
(iii)	IS: 2705(Part-III)	Current transformers : Protective Current transformers
(iv)	IS: 2705(Part-IV)	Current transformers: Protective Current transformers for special purpose application.

4.3.0. GENERAL REQUIREMENTS

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

4.3.2. Current transformers shall be of Live Tank design.

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

4.3.4. The instrument transformers shall be completely filled with oil.

4.3.5. A complete leak proof secondary terminal arrangement shall be provided with each instrument transformers, secondary terminal shall be brought into weather, dust and vermin proof terminal box. Secondary terminal boxes shall be provided with facilities for easy earthing, shorting, insulating and testing of secondary circuits. The terminal boxes shall be suitable for connection of control cable gland. IP rating of terminal box shall be IP 55. Spare terminals shall be provided. The exterior of the secondary terminal box shall be hot dipped galvanized.

4.3.6. All instrument transformers shall be of single-phase unit.

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

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

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

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

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

4.4.0. INSULATING OIL

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

4.5.0. COMMON MARSHALLING BOXES (shall be supplied by CT manufacturer)

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

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

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

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

4.5.5. 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 better arrangement.

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

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

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

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

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

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

i) Inside: Glossy White

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

4.6.0. BUSHINGS AND INSULATORS

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

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

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

4.6.4. 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 31 mm/KV.

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

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

4.6.7. Rain shed/drain cover/dome shall be present in CT.

4.6.8. Bellow level indicator shall be present in CT.

4.6.9. **Nitrite butyl rubber/Neoprene gaskets shall be used.**

4.7.0. TESTS

4.7.1. **Routine/Acceptance Tests (all units)**

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

4.7.2. **Type Tests:** The bidder shall furnish type test certificates and results for the all tests as per relevant Standards along with the bid for current and potential transformers of identical design.
Type test certificates so furnished shall not be older than 5 (five) years as on date of Bid opening.
QAP: QAP shall be submitted.

4.7.3 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. 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.

4.8.0. NAME PLATES

4.8.1. All equipment shall have non-corrosive name plates fix at a suitable position indelibly mark with full particular there on in accordance with the standard adapted. Thickness (1mm), purchase order, project name, serial no etc. shall be present in the Name plate.

4.9.0. MOUNTING STRUCTURES

4.9.1. 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.

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

4.10.0. SAFETY EARTHING

4.10.1. The non-current carrying metallic parts and equipment shall be connected to station earthing grid. For these two terminals suitable for 65mm X 12mm GS strip shall be provided on each equipment.

4.11.0. TERMINAL CONNECTORS (Shall be under manufacturer scope)

4.11.1. The equipment shall be supplied with required number of terminal connectors of approved type suitable for ACSR. The type of terminal connector, size of connector, material, and type of installation shall be approved by the Employer, as per installation requirement while approving the equipment drawings. No part of a clamp shall be less than 12mm. thick.

4.12.0. PRE-COMMISSIONING TESTS

4.12.1. 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).

4.13.0. TECHNICAL DATA SHEET FOR CURRENT

4.13.1. For 245/145/36 kV CTs the instrument security factor at all ratios shall be less than five (5) for metering core. If any auxiliary CTs/reactor are used in the current transformers then all parameters specified shall have to be met treating auxiliary CTs as an integral part of the current transformer. The auxiliary CTs/reactor shall preferably be inbuilt construction of the CTs. In case these are to be mounted separately these shall be mounted in the central marshalling box suitably wired up to the terminal blocks.

4.13.2. **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.

SL No.	**A. Item**	**Ratings and Particulars**	
I	**II**	**III**	**IV**
A	Nominal system voltage	132 kV	
B	Highest system voltage, kV	145	
C	Rated frequency ,HZ	50	
D	System earthing	Solidly earth	
E	Insulation level		
a)	Impulse withstand voltage: kVp	650	
b)	One-minute p.f. Withstand voltage, kV (r.m.s.)	275	
F	Short time current for 3 seconds, kA	40	
G	Minimum creepage distance, mm	4495	
H	Temperature rise	As per ISS	
I	**FEEDER C.T. (Shankardevnagar end)**		
	(i) No. of Cores	4	2
	(ii) Transformation ratio	400-200-100/1-1-1-1 (101CT-1)	400-200-100/1-1 (101 CT-2)
	(iii) Rated out put		
	(a) Core-1	30 VA	30VA
	(b) Core-2	30 VA	30VA
	(c) Core-3	-	-
	(d) Core-4	-	-
	(iv) Accuracy class		
	(a) Core-1	0.2S	0.2S
	(b) Core-2	5P	0.2S
	(c) Core-3	PS	-

	(d) Core-4	PS	-
	(v) Accuracy limit factor		
	(a) Core-1	-	-
	(b) Core-2	20	-
	(c) Core-3	-	-
	(d) Core-4	-.	-
	(vi) Instrument security factor		
	(a) Core-1	<5	<5
	(b) Core-2	-	<5
	(c) Core-3	-	-
	(d) Core-4	-	-
	(vii) Minimum Knee point voltage, Volts		
	(a) Core-1	-	-
	(b) Core-2	-	-
	(c) Core-3	≥1200 (at 400A)	-
	(d) Core-4	≥1200 (at 400A)	-
	(viii) Maximum secondary resistance, ohm		
	(a) Core-1	-	-
	(b) Core-2	-	-
	(c) Core-3	3 (at 400A)	-
	(d) Core-4	3(at 400A)	-
	(ix) Maximum exciting current, at Vk/4 mA		
	(a) Core-1	-	-
	(b) Core-2	-	-
	(c) Core-3	10 (at 400A)	-
	(d) Core-4	10 (at 400A)	-

I	**C.T. (DCNEL end)**		
	(i) No. of Cores	4	
	(ii) Transformation ratio	400-200-100/1-1-1-1 (101MCT and 102MCT)	
	(iii) Rated out put		
	(a) Core-1	30 VA	
	(b) Core-2	30 VA	
	(c) Core-3	30 VA	
	(d) Core-4	-	
	(iv) Accuracy class		
	(a) Core-1	0.2S	
	(b) Core-2	0.2S	
	(c) Core-3	5P	

	(d) Core-4	PS	
	(v) Accuracy limit factor		
	(a) Core-1	-	
	(b) Core-2	-	
	(c) Core-3	20	
	(d) Core-4	-.	
	(vi) Instrument security factor		
	(a) Core-1	<5	
	(b) Core-2	<5	
	(c) Core-3	-	
	(d) Core-4	-	
	(vii) Minimum Knee point voltage, Volts		
	(a) Core-1	-	
	(b) Core-2	-	
	(c) Core-3	-	
	(d) Core-4	≥1200 (at 400A)	
	(viii) Maximum secondary resistance, ohm		
	(a) Core-1	-	
	(b) Core-2	-	
	(c) Core-3	-	
	(d) Core-4	3(at 400A)	
	(ix) Maximum exciting current, at Vk/4 mA		
	(a) Core-1	-	
	(b) Core-2	-	
	(c) Core-3	-	
	(d) Core-4	10 (at 400A)	

Note:

(i) 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.

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

CHAPTER 13: TECHNICAL SPECIFICATION FOR 132KV IVT

5.1. SCOPE:

5.1.1. This specification provides for the design, manufacture, assembly inspection and testing at the manufacturer's works, packing and delivery at site, erection, testing and commissioning of outdoor mounted type, single phase, oil filled, self-cooled, single unit type Inductive voltage transformers for 132KV systems to be used for voltage indication, supply of potential to energy meters, relays for feeder protection in Grid Sub- stations of AEGCL, ASSAM.

5.1.2. The IVTs shall be complete in all respects with insulators, bimetallic connectors, fixing details etc. as described herein.

5.1.3. Bidders are required to quote for 0.2 accuracy class [metering winding] for 132KV IVTs in the following manner.

(a) Guaranteed Technical Particulars.
(b) Technical literatures, brochures and drawings as per this specification.
(c) Type Test reports.
(d) List of orders, executed and Users' certificates with offer, failing submission of the above particulars with the offer, the tender may not be considered for evaluation.

5.2. Following is the list of documents constituting this Specification:

(i) Technical Specification (TS).
(ii) Technical requirements.

5.3. STANDARDS:

5.3.1 The IVTs shall conform in all respects to high standards of Engineering, design, workmanship and latest revisions of relevant standards at the time of offer and the Purchaser shall have the power to reject any work or material which in his judgement is not in full accordance therewith.

5.3.2. Except to the extent modified in the specifications, the IVTS shall conform to the latest editions and the amendments of the standards listed hereunder:

Sl. No.	Standard Ref. No.	Title
01	IEC-44(4)	Instrument Transformer – measurement of PDS.
02	IEC-60	High voltage testing techniques.
03	IEC-171	Insulation co-ordination.
04	IEC-186	Voltage Transformers.
05	IEC-186(A)	Voltage Transformers (first supp. to IEC-186)
06	IEC-270	Partial discharge measurement.
07	IS-335	Insulating oil for transformers and switchgears.
08	IEC-8263	Method for RIV Test on high voltage insulators.
09	IS-2071	Method of high voltage testing.
10	IS-2099	High Voltage porcelain bushings.
11	IS-2147	Degree of protection provided by enclosures for low voltage switchgear and control.
12	IS-2165	Insulation co-ordination for equipments of 100KV and above.
13	IS-3156 (Part-I to IV).	Voltage transformers.
14	IS-3347	Dimensions of porcelain transformer bushings.
15	IS-4146	Application guide for voltage transformers.
16	IS-5547	Application guide for Capacitor Voltage Transformers.
17	IS-9348	Coupling Capacitor & Capacitor Devices.

5.3.3 All the above along with the amendments thereof shall be read and interpreted together. However, in case of a contradiction between the Technical Specification and any other volume, the provisions of this Technical Specification will prevail.

5.3.4. The voltage transformers with the requirements of other authoritative standards, which ensure equal or better quality than the standards, mentioned above shall also be acceptable. Where the equipments, offered by the supplier conform to other standards, salient points of difference between the standards shall be brought out in the offer. 4 (four) copies of the reference standards in English language shall be furnished along with the offer.

5.3.5. **The supplier is to furnish the standards as mentioned above from Sl. 1 to 17 at their own cost, if required by the purchaser.**

5.4. CLIMATIC AND SERVICE CONDITIONS:

5.4.1 Earthquake Incidence:

The VTS are to be designed to withstand earthquake of intensity, equivalent to 0.5g in the horizontal and 0.6g in the vertical direction

Where, 'g' stands for acceleration due to gravity.

5.5. INSTALLATION:

The VTS covered under this specification shall be suitable for outdoor installation without any protection from rain, dust, mist and direct rays of the sun.

5.6. GENERAL TECHNICAL REQUIREMENTS:

5.6.1. GENERAL TECHNICAL REQUIREMENTS FOR IVT:

5.6.1.1. Each IVT shall be supplied, filled with insulating oil and shall be hermetically sealed to prevent atmosphere coming in contact with oil, avoiding filtration and change of oil. Stainless steel diaphragm Bellow with bellow level indicator shall be provided. IVT shall be of dead tank type design.

5.6.1.2. However, the IVT shall have a provision for draining and filling insulating oil after drying or preferably must have arrangement for drying the oil by continuous process with oil filters.

5.6.1.3. The IVT shall be suitable for transport in horizontal position if the transport limitations so demand.

5.6.1.4. Secondary Terminal Box:

5.6.1.4.1. The secondary terminals shall be brought out in a weatherproof terminal box with a rating not less than IP-55.

5.6.1.4.2 All secondary terminals shall be brought out in a compartment on one side of each IVT for easy access.

5.6.1.4.3. The exterior of this terminal box shall be hot dip galvanized.

5.6.1.4.4. The terminal box shall be provided with removable gland plate and glands suitable for 1100 volts grade. PVC insulated, PVC sheathed multi core 4 sq.mm to 6 sq.mm stranded copper conductor cable.

5.6.1.4.5. The terminal box shall be provided with a door in front so as to have easy access of secondary terminals. The door shall have a sealing/locking arrangement and shall be suitable to prevent penetration of moisture and rainwater.

5.6.1.4.6. The dimensions of the terminal box and its openings shall be adequate to enable easy access and sufficient working space for use of normal tools.

5.6.1.4.7. The terminal blocks shall be standard type and provided with ferrules indelibly marked or numbered and their identifications shall correspond to the designation on the relevant wiring diagram.

5.6.1.4.8. Secondary wiring terminal studs shall be provided with at least three nuts, plain and spring washers. The studs, nuts and washers shall be of brass, duly nickel plated. The minimum diameter of the studs shall be 6 mm. The length of at least 15 mm shall be available on the studs for inserting the leads.

5.6.1.4.9. Primary earthling link should be provided for measurement of capacitance & di-electric dissipation factor.

5.6.1.4.10. Separate point should be provided

5.6.1.5. Polarity shall be indelibly marked on each primary and secondary terminal.

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

5.6.1.7. The castings of base, collar etc. shall be die cast and tested before assembly to detect cracks and voids, if any.

5.6.1.8. The characteristics of the IVTS shall be such as to provide satisfactory performance such as voltage error and phase displacement at rated frequency shall not exceed the values as per relevant standards at any voltage between 80% and 120% of rated voltage and with burdens of between 25% and 100% of rated burden at a power factor of 0.8 lagging. The error shall be determined at the terminals of the IVT and shall include the effects of any fuses or resistors as an integral part of the IVT.

5.6.1.9. Inductive voltage transformers shall be designed so as to achieve the minimum risk of explosion in service. The bidder shall bring out in his offer, measures taken to achieve this.

5.6.1.10. Primary Winding:

Primary winding of the IVT will be connected phase to neutral with the neutral point solidly earthed. The arrangement for this shall be included in the scope of supply. The primary conductor shall be of adequate cross-section so that the maximum permissible current density shall not be exceeded even during short-circuit conditions. Primary Windings shall be made of Copper.

5.6.1.11. Secondary Winding:

Suitably insulated copper wire of electrolytic grade shall be used for secondary windings. The secondary conductor shall be of adequate cross section so that the maximum permissible current density shall not be exceeded even during short- circuit conditions. Secondary windings details, burden & accuracy class are mentioned in Appendix-I. Secondary windings shall be used for metering, relaying and synchronizing. Each winding shall comply requirements of both Part-II and III of up-to-date editions of IS-3156/IEC-186.

5.6.1.12. Core:

Core laminations shall be of cold rolled grain-oriented silicon steel or other equivalent alloys of low hysteresis and eddy current losses, high permeability to ensure accuracy i.e. 0.2 accuracy class at both normal and high over voltage. **The core material, thickness of lamination, the relevant graphs showing the characteristics of the core materials shall be submitted along with the offer**.

5.6.1.5. Tank:

5.6.1.5.1. Both expansion chambers and tanks of the IVT shall be made of high-quality steel / Aluminum and shall be able to

withstand full vacuum and pressure, occurring during transit and thermal and mechanical stresses resulting from maximum short circuit current during operation. The tanks along with all ferrous parts shall be hot- dip galvanized as per relevant standard.

5.6.1.5.2. The metal tanks shall have bare minimum number of welded joints so as to minimize possible locations of oil leakage. Welding in horizontal plane is to be avoided as welding at this location may give way due to vibrations during transport resulting in oil leakage. Supplier has to obtain specific approval from the purchaser for any horizontal welding, used in the bottom tank

5.6.1.5.3. Paint inside the metallic housing shall be of anti-condensation type.

5.6.1.14. Porcelain Housing:

5.6.1.14.1. The housing shall be made up of homogeneous, vitreous porcelain of high mechanical and dielectric strength; glazing of porcelain shall be of uniform brown or dark brown colour with a smooth surface, arranged to shed away rainwater or condensed water particles (fog). The details of location and type of joint, if provided on the porcelain, shall be furnished by the Bidder along with the offer.

5.6.1.14.2. The bushings of the IVTS shall conform to latest edition of IS-2099.The hollow porcelain insulators shall conform to the latest edition of IS-5621

5.6.1.14.3. The insulators shall be cemented with Portland cement to the flanges resulting in high mechanical, tensile and breaking strength

5.6.1.14.4. The bushings shall have ample insulation, mechanical strength and rigidity for the condition under which they shall be used and shall be used and shall be designed to prevent accumulation of explosive gases and provide adequate oil circulation to remove the internal heat.

5.6.1.14.5. Cast metal and caps for the bushings shall be of high strength hot dip galvanized malleable iron. They shall have smooth surface to prevent discharge taking place between the metal parts and porcelain as a result of ionisation.

5.6.1.14.6. The insulation of bushings shall be co-ordinated with that of the IVT such that the flashover, if any, shall occur only external to the IVT.

5.6.1.14.7. Oil level gauge and convenient means of filling, sampling and draining of oil shall be provided.

5.6.1.14.8. End shields should be provided for distribution of stresses.

5.6.1.14.9. Corona shields for bushings, if required, should be provided.

5.6.1.15. Insulating Oil:

The quantity of insulating oil for the filling and the complete specification of the insulating oil shall comply in all respects with the provisions of the latest edition of IS-335. The IVTs shall be supplied completely filled with purified oil.

5.6.1.16. Prevention of Oil Leakage and Entry of Moisture:

The supplier shall ensure that the sealing of the IVT is properly achieved. In this connection, the arrangement provided by the supplier at various locations including the following ones shall be described, supported by sectional drawings

(a) Locations of emergence of primary & secondary terminals.
(b) Interface between porcelain housing and metal tank(s).
(c) Cover of the secondary terminal box.

5.6.1.16.1. Nuts and bolts or screws used for fixation of the interfacing porcelain bushings for taking out terminals shall be provided on flanges, cemented to the bushings and not on the porcelain.

5.6.1.16.2. For gasketed joints, wherever used, **nitrite butyl rubber/Neoprene gaskets shall be used**. The gasket shall be fitted in properly machined groove with adequate space for accommodating the gasket under compression.

5.6.1.17. Fittings and Accessories:

Fittings and accessories listed below shall be supplied with each IVT. Any fitting required essential other than those listed below shall also be supplied along with each IVT.

(a) Oil level gauge.
(b) Oil filling hole and cap.
(c) Pressure relieving device.
(d) Lifting lugs for core and windings, bushings & complete transformers.
(e) Phase terminal connectors.
(f) Tank earthing pads/terminals with necessary nuts and bolts and washers for connecting to Purchaser's strip.
(g) Name/Rating plate.
(h) H.R.C. fuse of Adequate rating
i) Bellow
j) IVT junction box

5.6.1.18. Provisions

5.6.1.18.1. Oil Level Gauge:

An oil level gauge shall be provided to indicate the oil level in the IVT. This gauge shall be mounted in such a way that the oil level can be seen from the ground level.

5.6.1.18.2. Pressure Relieving Device:

Each IVT shall be provided with a pressure relieving device so as to protect bushing of the IVT even under unfavourable conditions.

5.6.1.18.3. Oil Drain Cock:

An oil drain cock along with a stop cock shall be provided in the bottom flange so as to permit taking of oil samples for testing, if required.

5.6.1.18.4. Earthing:

Metal tank of each IVT shall be provided with two separate earthing terminals for bolted connection to 65mm x 12mm flat to be provided by the Purchaser for connection to station earth-mat.

5.6.1.18.5. Lifting Arrangement:

The IVT shall be provided with suitable lifting arrangement to lift the entire unit. The lifting arrangement shall be clearly shown in the general arrangement drawing.

Lifting arrangement [Lifting eye] shall be positioned in such a way so as to avoid any damage to the porcelain housing or the tanks during lifting for installation/transport. Necessary string guides shall be offered which shall be of removable type.

5.6.1.18.6. Name Plate:

The IVT shall be provided with non-corrosive legible name plate with the information specified in relevant standards, duly engraved/punched on it.

5.6.1.18.7. Gasket Joint:

The manufacturer shall furnish the type of gasket used or setting methods.

5.6.1.18.8. Terminal Connectors:

All the IVTs shall be provided with bimetallic solder less clamp type, rigid type terminal connectors, suitable for ACSR Conductor as per site requirement. Each terminal connector shall be of universal type, suitable for both horizontal and vertical connections to the transmission line conductors/station bus bar.

5.6.1.18.8.1. Terminal Connectors shall be manufactured and tested as per IS:5561.

5.6.1.18.8.2. All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

5.6.1.18.8.3. No part of a clamp shall be less than 12mm. thick.

5.6.1.18.8.4. All ferrous parts shall be hot dip galvanized conforming to IS-2633. For bimetallic connectors, copper alloy linear of minimum thickness of 2 mm shall be cast integral with aluminium body.

5.6.1.18.8.5. All current carrying parts shall be designed and manufactured to have minimum contact resistance.

5.6.1.18.8.6. Connectors shall be designed to be corona free in accordance with the requirements, stipulated in IS-5561.

5.6.1.18.9. Secondary Wiring:

The Secondary wiring shall be enclosed in conduits and shall be brought to a terminal block ready for external connections. The wiring shall be of adequate cross-section and not less than 4.00 sq.mm copper wire.

5.6.1.18.10. The supplier shall supply necessary hardwares, required for connection of phase side conductor to the line terminal and the grounding strip to the grounding terminal.

5.6.1.18.11. Necessary nuts and bolts for fixing the IVTS on the supporting structures shall be in tenderer's scope of supply.

5.7. TESTS:

5.7.1 Type Tests:

The offered 132KV Inductive voltage transformer should have been subjected to the following type tests in a Government approved Test Laboratory. The bidder shall furnish four sets of type test reports along with the offer. These tests must not have been conducted earlier than five years from the date of opening of the bid. For any change in the design/type already type tested and to the design/type offered against this specification, the purchaser reserves the right to demand repetition of some or all type tests/special tests without any extra cost to AEGCL in the presence of purchaser's representative at the cost of the supplier.

For 132 KV IVT:

(a) Temperature rise test.
(b) Lightning Impulse Test.
(c) High Voltage power frequency wet withstand voltage tests.
(d) Determination of errors.
(e) IP-55 Test on secondary Terminal Box.

N.B.: (i) The dielectric type tests should have been carried out on the Same transformer.
(ii) After the IVT was subjected to the dielectric tests, it should have been subjected to all routine tests as per relevant standards.
(iii) For Temperature Rise Test, the test must have been made with the appropriate rated burden, connected to each secondary winding.

5.7.2 Routine Tests:

The following routine tests shall be conducted on each IVT in the presence of Purchaser's representative for which no charges will be payable by AEGCL. No sampling is allowed.

(a) Verification of terminal markings.
(b) Power frequency withstand tests on primary windings/capacitor voltage divider for IVT
(c) Partial discharge measurement for 132kV IVT

(e) Power frequency withstand tests between sections.
(f) Determination of errors on complete IVT.
(g) Measurement of Insulation resistance.
(h) Oil leakage test.
(i) Measurement of capacitance and dielectric dissipation factor before and after dielectric tests (as per IEC-358)
(k) Any other test as per relevant national & international standards.

N.B.: Determination of errors shall be performed after the other tests. The standard reference IVT to be used during testing for determination of ratio error and phase angle error should of 0.05 accuracy class or better as per standard practice, presently adopted by AEGCL.

5.8. INSPECTION:

5.8.1. The Purchaser shall have access at all times to the works and all other places of manufacture, where the IVTs are being manufactured and the supplier shall provide all facilities for unrestricted inspection of the supplier's works, raw materials, manufacturer of all the accessories and for conducting the necessary tests.

5.8.2. The Supplier shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of equipment in its various stages so that arrangement could be made for inspection at the discretion of the Purchaser.

5.8.3. No material shall be dispatched from its manufacture unless the material has been satisfactorily inspected, tested and dispatch clearance issued. However, the Purchaser reserves the right to alter the despatch schedule attached to this Specification.

5.8.4. The acceptance of any quantity of equipment shall in no way relieve the supplier of his responsibility for meeting all the requirements of this Specification and shall not prevent subsequent rejection, if such equipments are found to be defective.

5.8.5. Clear 15 (Fifteen) days' notice shall be given to this office for deputing officer(s) for inspection. The Voltage Transformers shall be despatched only after the inspection is conducted by a representative of AEGCL and release order, issued from this office after approval of Routine Test Certificates. The shop routine test certificates in triplicate for all the Voltage Transformers along with the calibration certificates of all the meters and equipments to be used during testing (as per Annexure-B of the Specification) should be furnished along with the Inspection Offer. The Inspecting Officer will be authorised for inspection of the Voltage Transformers subject to the condition that the routine test certificates and calibration certificates of the testing equipments/meters will be found to be in order.

5.9. QUALITY ASSURANCE PLAN:

5.9.1. The Bidder shall invariably furnish following informations along with his offer.

(i) Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards, according to which the raw materials are tested, list of tests, normally carried out on raw materials in presence of Bidder's representative, copies of test certificates.
(ii) Information and copies of test certificates as in (i) above in respect of bought out items.
(iii) List of manufacturing facilities available.
(iv) Level of automation achieved and list of areas where manual processing exists.
(v) List of areas in manufacturing process where stage inspections are normally carried out for quality control and details of such tests and inspection.
(vi) Special features provided in the equipment to make it maintenance free.
(vii) List of testing equipments, meters and test plant limitation, if any, vis-à-vis the type, acceptance and routine tests, specified in the relevant standards. These limitations shall be very clearly brought out in the offer.
(viii) All the testing equipments, meters etc. should have been calibrated in a Government approved laboratory. The Bidder must submit the list of testing equipments and meters test as per the Technical Specification.

5.9.2. The Supplier shall within 30 days of placement of order submit the following information to the Purchaser.

(i) List of raw materials as well as bought out accessories and the names of the materials as well as bought out accessories and the name of Sub-suppliers selected from those, furnished along with the offer.
(ii) Type test certificates of the raw materials and bought out accessories.
(iii) Quality Assurance Plan (QAP) with hold points for the Purchaser's possible inspection. The QAP and hold points shall be discussed between the Purchaser and the Supplier before the QAP if finalised.

5.9.3. The Supplier shall submit the routine test certificates of bought out items and raw materials at the time of acceptance testing of the fully assembled equipment.

5.10. DOCUMENT:

The supplier shall furnish four sets of following drawings/documents along with his offer.

(a) General outline and assembly drawings of the Inductive Voltage Transformers
(b) Sectional views showing:
  i) General constructional features.
  ii) Materials/gaskets/sealing used.
  iii) The insulation of the winding arrangements, method of connection of primary/ secondary winding to the primary/secondary terminals etc.

(c) Schematic drawing.
(d) Rating & diagram plate as per relevant IEC/ISS
(e) Secondary Terminal Box.
(f) Assembly Sectional view of Primary terminal/capacitor voltage divider
(g) Assembly drawing for secondary terminal
(h) The detailed dimensional drawing of Porcelain Housing such as ID, OD, thickness and insulator details such as height, profile of petticoats, angle of inclination and gap between successive petticoats, total creepage distance etc.
(i) Sectional view of pressure release device.
(j) Drawing showing details of Oil level.
(k) All type test reports relating to the tests as specified in Clause-8.1 of the above.
(l) Ratio and phase angle error curves for IVTS
(m) Magnetization characteristic curves such as B-H curves and Sp. Loss vs. Flux density curves for core material, used for IVT

5.11. TEST REPORTS:

(i) Four copies of type test/special test reports shall be furnished to the Purchaser with the tender offer.
(ii) Copies of acceptance test reports and routine test reports shall be furnished to the Purchaser. One copy will be returned, duly certified by the Purchaser and only thereafter shall the materials be despatched.
(iii) All records of routine test reports shall be maintained by the supplier at his works for periodic inspection by the Purchaser.
(iv) All test reports of tests conducted during manufacture shall be maintained by the supplier. These shall be produced for verification as and when required for by the purchaser.

5.12. The necessary galvanized flanges, bolts etc. for the base of the Inductive Voltage Transformers shall be supplied without any extra cost to the purchaser.

5.13 APPENDIX – I.

TECHNICAL REQUIREMENTS FOR 132kV INDUCTIVE VOLTAGE TRANSFORMERS

Sl. No.	Particulars	132kV IVT (DCNEL end-101 MPT, 102 MPT, 103 MPT)	132kV IVT (DCNEL end-BPT)	132kV IVT (Lanka end)
I	II	III	IV	V
1	Type	Single phase, 50Hz, oil filled, self-cooled, Hermetically sealed, outdoor porcelain type.	Single phase, 50Hz, oil filled, self-cooled, Hermetically sealed, outdoor porcelain type.	Single phase, 50Hz, oil filled, self-cooled, hermetically sealed, outdoor porcelain type.
2	Nominal system voltage.	132kV	132kV	132kV
3	Highest system voltage.	145kV	145kV.	145kV
4	Frequency.	50Hz± 5%	50Hz± 5%	50Hz ± 5%
5	System earthing.	Effectively solidly earthed	Effectively solidly earthed	Effectively solidly earthed.
6	Number of phases.	3 [single phase]	3 [single phase]	3 [single phase]
7	(i) Number of secondary windings. (ii) Purpose of windings.	3 [three] Protection & metering.	3 [three] Protection & metering.	2 [two] Protection & metering.
8	Rated primary voltage.	33/1.732kV	132/1.732kV	132/1.732kV
9	Rated secondary voltage.	Winding-III- 110/1.732V (Protection) Winding-I&II- 110/1.732V (Metering)	Winding-II &III- 110/1.732V (Protection) Winding-I- 110/1.732V (Metering)	Winding-I- 110/1.732V Winding-II- 110/1.732V
10	Ratio	132kV/1.732: 110V/1.732 110V/1.732 110V/1.732	132kV/1.732: 110V/1.732 110V/1.732 110V/1.732	132kV/1.732: 110V/1.732 110V/1.732
11	Rated burden.	Winding-I(M)- 100VA Winding-II(M)-100VA Winding-III(P)-100VA	Winding-I(M)- 100VA Winding-II(P)-100VA Winding-III(P)-100VA	Winding-I (M)-100VA Winding-II (P)- 100VA
12	Accuracy class	0.2/0.2/3P	0.2/3P/3P	0.2/3P
13	Rated voltage factor at rated frequency.	1.2 continuous. 1.5 for 30second.	1.2 continuous. 1.5 for 30second.	1.2 continuous. 1.5 for 30second.
14	Temperature rise at 1.2 times the rated primary voltage, rated frequency & rated burdens.	As per IEC- 186.	As per IEC-186.	As per IEC- 186
15	Temperature rise at 1.5 times the rated primary voltage for 30 seconds, rated frequency	As per IEC- 186.	As per IEC-186.	As per IEC- 186.

	& rated burden.			
16	One-minute power frequency dry withstands test voltage for primary winding.	275kV[rms]	275kV[rms]	275kV[rms]
17	1-minute power frequency wet withstands test voltage for primary winding.	275kV[rms]	275kV[rms]	275kV[rms]
18	1.2/50 micro second impulse withstand test voltage for primary winding	650kV[peak]	650kV[peak]	650kV[peak]
19 (i) (ii)	One-minute power frequency withstands test voltage for Secondary winding Between LV(HF) terminal & earth terminal	3kV[rms] -	3kV[rms] -	3kV[rms] -
20	Class of insulation.	'B'	'B'	'B'
21	Material of the conductor of primary and secondary windings.	Copper.	Copper.	Copper.
22	Fault level of the bus to which PTs will be connected.	40 kA [rms] for 3 second.	40 kA [rms] for 3 second.	40 kA [rms] for 3 second.
23	Minimum creepage distance.	4495mm	4495mm	4495 mm
24	Quality of oil.	EHV Grade As per IS-335.	EHV Grade As per IS-335.	EHV Grade As per IS- 335.
25	Radio interference voltage at 1.1 times maximum rated voltage at 1.0 MHZ.	500 micro volts.	500 micro volts.	500 micro volts.
26	Partial discharge level.	Less than 10 piccocoulombs.	Less than 10 piccocoulombs.	Less than 10 Piccocoulombs.
27	Seismic acceleration Horizontal – Vertical –	0.5g. 0.6g.	0.5g. 0.6g.	0.5g. 0.6g.
28	Accuracy class of standard V.T. to	0.05 or better.	0.05 or better.	0.05 or better.

	be used during testing towards determination of ratio errors and phase angle errors for metering windings.			

SECTION-6
TECHNICAL SPECIFICATION OF POWER AND CONTROL CABLES

Technical Specifications for XLPE insulated Copper Control and Power Cable

This technical specification intends to cover the following:

1. Technical specifications for design, engineering, manufacturing, inspection, testing at manufacturer's works, packaging and delivery by road (properly packed in non-returnable steel drums), various sizes of copper conductor, XLPE insulated, voltage upto and including 1100 Volts, extruded PVC inner sheathed, extruded FRLS PVC outer sheathed, GI round wire armoured cables, suitable for solidly grounded system. The cables shall confirm to IS 7098-Part 1 with latest amendments. For cable list refer Table-1 (Sl. no. 1.1 to 1.19).
2. Technical specifications for design, engineering, manufacturing, inspection, testing at manufacturer's works, packaging and delivery by road (properly packed in non-returnable steel drums), 6.35/11 kV (Uo/U) Voltage Grade, 3-Core, 185 Sq. mm Stranded Compacted Circular Shaped Aluminium Conductor of H4 Grade, Shielded with extruded Semi-conducting compound, XLPE insulated, PVC sheathed, GI Round wire armoured Power and Control Cables for effectively grounded system. The cable shall confirm to the latest revisions of IS: 7098 (Part –2). For cable list refer Table-1 (Sl. no. 2.0).

Note:

1. Tenders will only be considered from the cable manufacturers and any one supplier to whom manufacturer can authorize. The bidder shall have adequate experience of at least 5 years in manufacturing of LT/MV & HT cables.
2. Copper samples from the finished cable drums shall be tested at any 3rd party NABL accredited lab to ensure its purity.
3. The following document shall be attached with technical part of the bid:
   i. Duly filled & Signed copy of Annexure-I, II, III & IV
   ii. Deviation sheet, if any

Table 1

Sl. no	Power Cable
1	3C X 2.5 Sq.mm, Copper Power Cable Type: 2XWY
2	4C X 2.5 Sq.mm, Copper Power Cable Type: 2XWY
3	3C X 4 Sq.mm, Copper Power Cable Type: 2XWY
4	4C X 4 Sq.mm, Copper Power Cable Type: 2XWY
5	3C X 6 Sq.mm, Copper Power Cable Type: 2XWY
6	4C X 16 Sq.mm, Copper Power Cable Type: 2XWY

7	3C X 10 Sq.mm, Copper Power Cable Type: 2XWY
8	4C X 10 Sq.mm, Copper Power Cable Type: 2XWY
9	3C X 16 Sq.mm, Copper Power Cable Type: 2XWY
10	2C X 16 sqmm
11	2CX50 sqmm
12	3.5 C X 35 sqmm
13	3.5 CX70 sqmm
14	3.5 C X 95 sqmm
15	3.5 C X 150 sqmm
16	3.5 C X 300 sqmm
17	1 C X 1000 sqmm
18	2C X 6 sqmm
Control Cable	
1	2 C, 1.5mmsq
2	4C, 2.5 sq mm
3	5C, 2.5 sq mm
4	7C, 1.5 sq mm
5	7C, 2.5 sq mm
6	10 C, 2.5 sq mm
7	12 C, 2.5 sq mm
8	12 C,1.5 sq mm
9	14 C, 2.5 sqmm
10	17 C,1.5 sqmm
11	19 C,1.5 sqmm
12	19C,2.5 sqmm

This section covers the technical specifications for design, engineering, manufacturing, inspection, testing at manufacturer's works, packaging and delivery by road (properly packed in non-returnable steel drums), 1.1KV grade, Multi-stranded Copper conductor, XLPE insulated, extruded PVC inner sheathed, GI round-wire armoured, extruded FRLS PVC ST2 outer sheathed. Power Cables and Control Cables for effectively grounded system, conforming to the latest revisions of IS: 7098 (Part –I), 1988 & as per the technical specifications attached herewith.

1. STANDARDS

The design, manufacture and testing of the cable shall comply with the latest editions/amendments of the following Indian Standards, unless otherwise specified. Equipments complying with equivalent standards shall also be acceptable.

a.	IS-7098, 1998 (Part-I)	:	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto 1100V.
b.	IS-3961	:	Recommended current ratings for Cables
c.	IS 8130-1984	:	Specification for conductors for insulated electric cables and flexible cords.
d.	IS-3975, 1999	:	Low Carbon galvanized steel wires, formed wires & tapes for armouring of cables
e.	IS-4759	:	Specifications for Hot dipped galvanized coating on round steel Wires
f.	IS-5831	:	PVC insulation and sheath of electric cables.
g.	IS-10418	:	Drums for electric cables.
h.	IS-10810	:	Method of test for cables.

2. SERVICE CONDITION

Service Condition shall be as per General Technical Requirements (GTR).

3. DESIGN AND CONSTRUCTION PERTICULARS

3.1. General

The cables supplied under this specification shall be adequate insulated to operate continuously at the specified voltage with a high degree of safety and reliability throughout the life of the cables. The sheathing material shall be high quality PVC based compound. The construction of cable shall be as per IS: 7098 (Part I) – 1988.

Cable shall be designed and manufactured to prevent damage during transportation, installation & operation under all climatic & operating condition

3.2. Technical parameters

i. Quantity : Refer Table-1

ii.	Packaging	:	Steel drum packaging, each having single length cable ≥ 500 metres.
iii.	Cable Type	:	A2XWY/ 2XWY (refer Table-1 for details)
iv.	No. of Cores	:	Shall be decided during detailed engineering (Cable sizing calculation)
v.	Voltage Level	:	1.1Kv
vi.	System Grounding	:	Solidly Grounded

vii. Nominal System voltage : 400V ±10%
viii. Nominal System Frequency : 50 Hz
ix. Maximum conductor temperature at rated current : 90 deg C
x. Maximum conductor temperature at Short-circuit : 250 deg C
xi. Conductor Conductor Material : H4-Grade Aluminium of purity > 99.6% Electrolytic grade Copper, Purity > 99.97%
xii. Conductor type : Stranded with number of strands as per IS 8130 (Part-I) 1984
xiii. Insulating material : Cross-Linked-Polyethylene (XLPE) Compound.
xiv. Core Identification Strips : Red, Yellow, Blue & Black (for neutral)
xv. Material of Inner Sheath : FRLS, PVC ST-2 Compound

3.3. Conductor

COPPER

The conductors shall be made from high conductivity copper rods complying with IS: 613-1964. The conductor material used shall be electrolytic grade with high purity. *Two sample conductor randomly selected from finished lot of cables, shall be tested for its purity at any 3rd party NABL accredited lab.*

Cable Joints:

Joints shall be permitted in the individual wires of which the conductor is formed, but no joint shall be within 300 mm of any other joint within the same layer. The joints shall be made by resistance butt welding, fusion welding, cold pressure welding, electric welding, gas welding, brazing or silver soldering. No joint is allowed in the conductor after stranding. A maximum of two joint shall be allowed in any strand forming complete length of the cable.

The conductors shall conform to appropriate dimensions, resistance and number of wire in the conductor (number of strands) as given in IS 8130 (Part I): 1984.

3.4. Insulation

The insulating material for power and control cables shall be extruded cross linked polyethylene (XLPE) compound as per IS-7098(Part-I)-1988. The minimum thickness of insulation shall not be less than the values specified in Table-2 of IS-7098 (Part-I)-1988. No negative tolerance shall be applicable for the thickness. The insulation of the cable shall be designed and manufactured for the specified system voltage. The manufacturing process shall ensure that insulation shall be free from voids. The insulation shall withstand mechanical and thermal stress under steady state and transient operating conditions. The cores shall be identified as per the following colour scheme:

3-Core - Red, Yellow & Blue
3 ½ or 4-Core - Red, Yellow, Blue & Black

3.5. Inner Sheath

The inner sheath shall be extruded FRLS PVC, Type ST2, compatible with thermal rating of insulation conforming to IS-6380-1984. The sheath shall have adequate thickness, mechanical strength and elasticity, as specified in IS 5831. The material shall be soft thermoplastic type, applied by extrusion method. The thickness of the inner sheath shall be as per IS: 7098 (Part I) and the color of the inner sheath shall be Grey. The inner sheath shall be so formed that it fits closely on the laid up cores and could be easily removed without damaging insulation. One or more layer of proofed plastic tape shall be provided over the laid up core before extrusion.

3.6. Armouring

The armouring arranged over the inner sheath shall consist of one layer of galvanized round steel wires for all sizes of cable. The armour round wire used on the cable shall conform to IS: 3975 for all requirements. The direction of lay of armour shall be opposite to that of the cores. The zinc coating on the galvanized steel strip shall comply with relevant standards.

The joints in armour wires/strips shall be made by brazing or welding and the surface irregularities shall be removed. A joint in any wire/strip shall be at least 300 mm away from the nearest joint in any other wire/strip in the completed cable.

3.7. Outer Sheath

Extruded outer sheath shall be provided over the armouring. The material used for sheathing shall be FRLS PVC sheath, Type ST-2 base compound conforming to IS 1554/ IS 5831 for power and control cable. The outer sheath shall be so formed that it fits closely on the laid up armour and could be easily removed without damaging the intermediate sheath and insulation. The colour of the outer sheath shall be black. The thickness of outer sheath shall be in accordance with the IS 1554 (Part-I)-1988. Suitable additives shall be added to prevent attack by rodents and termites. All serving must be given anti-termite treatment.

Cables shall have suitable fillers laid up with the conductor to provide a substantially circular cross section before the sheath is applied. Fillers shall be suitable for the temperature of the cable and compatible with the insulating material. The material shall be of the best quality and workmanship. The fillers and sheath material shall be non-hygroscopic. All materials shall be new, unused and of the finest quality.

4. TESTS

All the tests specified below shall be carried out in accordance with the Indian Standards by the manufacturer in the presence of Purchaser's representative. If the cable fails to pass the test specified, the Purchaser shall have the option to reject it. Shipping release shall be obtained from the Purchaser's representative. The Purchaser, however reserves the right to waive off the inspection.

The tests at works shall include electrical, mechanical and hydraulic tests in accordance with the appropriate clauses of Statutory Regulation, relevant codes and standards, in addition any test called for by the Purchaser or his representative to ensure that the equipment being supplied fulfils the requirement of the specification.

For test not covered by any code or specifically mentioned in this specification, the test procedures are to be agreed with the Purchaser.

Pre Dispatch Inspection

The manufacturer shall be given at least 15 days advance notice prior to the commencement of testing, so that Purchaser's representative can plan to witness the tests.

All the tests indicated in the test clause of this specification shall be carried out in the presence of Purchaser's representative by the manufacturer and shall provide all the facilities and equipment for testing.

Six copies of the Test Certificate shall be furnished to the Purchaser for approval prior to dispatch of cables from factory.

Visual check to conform the details given in this specification is to be done. In addition to the above, the general workmanship of the cable drums and cables laid in drums shall be checked.

Manufacturer shall have proper test set up for testing all the routine tests & type tests on finished cables as per IEC.

List of type tests mentioned in the tender specifications shall be conducted on four drum irrespective of type test certificates given or not.

4.1. **Type Test**

Type tests on four randomly selected cable drums will have to be conducted in the presence of the department's representative. The test samples will be taken from finished cables. This test shall be in accordance to IS: 7098, Part-1,1988.

a. Test on Conductor
- Annealing test for copper conductors
- Tensile test for aluminium conductor
- Wrapping test for aluminium conductor
- Conductor Resistance Test

b. Test on Insulation
- Physical dimension measurement
- Tensile strength and elongation at break
- Hot set test
- Shrinkage test
- Ageing in air oven
- Water absorption test

c. Test on round Armour
- Physical dimension measurement
- Tensile strength
- Elongation at break
- Torsion test for round wires
- Winding test for firmed wire
- Mass of zinc coating.
- Uniformity of zinc coating
- Resistivity measurement, Resistance test for armour

d. Test on Sheath
- Physical dimension measurement
- Tensile strength & Elongation at break test
- Ageing in air oven
- Loss of mass in air oven
- Shrinkage test
- Hot deformation test
- Heat shock test

- Thermal stability test

e. Insulation Resistance Test
f. High Voltage Test at room temperature
g. Volume resistivity at room temperature & at 90° C. (IS-10810-Part 43)
h. Flammability test
i. *Test requirement of FRLS inner and outer sheath*

The inner and outer sheath of cables shall meet the following test requirements related to flame retardant, low smoke emission, low acid and toxic gas emission. The BIDDERs shall have proper test apparatus to conduct all the relevant tests as per the applicable standards:

Flame retardant test on single cable.

- Oxygen Index Test

  The critical oxygen index value shall be minimum 29 when tested at 27+2ºC as per ASTMD-2863
- Temperature index test

  Temperature index value shall be minimum 250ºC at oxygen index of 21 when tested as per NES 715.
- Flammability test
- Smoke Density Test

  The cables shall satisfy the tests conducted to evaluate the percentage obscuration by smoke in an optical system placed in the path of the smoke. The maximum smoke density rating shall not be more than 60% when tested as per ASTM-D-2843.
- Acid Gas Generation test (halogen acid gas evolution)

  The hydrochloric acid generation when tested as per IEC 754-1 shall be less than 20% by weight.
- Test for specific optical density of smoke
- Anti termite and rodent property test

The sequence of electric tests shall be as per the relevant Indian/International standards. The Bidder shall submit the sequence of tests for the approval of the purchaser before conducting the tests. A copy of the adopted standard shall also be supplied.

4.2. **Routine Test (On each drum)**

The following routine tests shall be carried out by the Manufacturer on each and every length of the cable in the presence of Purchaser's representative at manufacturer's works.

a. Resistance test for conductors
b. Insulation resistance test
c. High voltage test

4.3. Conductor purity test

Two samples of aluminium and copper shall be taken from any of the finished set of cables at random and the sample shall be tested for its purity at a NABL accredited lab.

Qualifying Criteria:

The test results should be within limits as per IS 7098. All the routine tests as per IS 7098 / IEC shall be conducted and passed as per the limits given in the standards. All the bought out certificates will be verified and the test results shall be as per respective standards.

5. IDENTIFICATION

The following details shall be marked sequentially for each meter run length of the cable by non-erasable embossing on the outer sheath:

a. Reference to Indian Standard
b. Name of the manufacturer/ Trade Name
c. Name of the project:
d. Configuration of the cable: viz. Voltage grade, no. of Core, Sq. mm, A2XWY/2XWY/YWY / YY as applicable
e. Year of manufacturing
f. Sequential marking of running meter length
The running length of the cable shall be identified at regular intervals of one meter (Increasing order from inner end to outer end of the cable)

6. PACKAGING

- Each drum shall consist of single length cable ≥ 500 metres.
- The cable shall be wound on *non-returnable steel drums* of suitable size, packed and marked.
- Packing shall be sturdy to protect the cable from any injury during transportation, handling and storage. The cut ends of the cable shall be sealed by means of non-hygroscopic sealing material preferably Heat shrinkable end caps.
- One end of the cable shall be brought out of the drum and suitably clamped to the drum flange with proper mechanical protection. Location of the other end may be marked on the drum.
-
- The cable shall be placed on drums in such a manner that it will be protected from injury during transit. Each end of the cable shall be firmly and properly secured to the drum. No undue stress shall appear on cables when laid on drums.
- The cable drum shall carry the following information stencilled on a metallic label, securely attached to each end of the drum:
-

i. Reference to the Indian standard
ii. Manufacturer's name, brand or trade mark
iii. Type of cable and voltage grade
iv. No. of cores
v. Nominal cross-sectional area of conductor
vi. Cable code
vii. Length of cable on drum
viii. No. of lengths on reel, drum or coil (if more than one)
ix. Gross weight
x. Country of manufacture
xi. Year of manufacture
xii. Direction of rotation of drum (an arrow)
xiii. ISI certification mark

7. PREFERRED MAKE

POLYCAB/KEI/KEC or reputed brand possessing system certification of ISO 9001:2008, ISO14001:2004, OHSAS18001:2007 & EN 16001-2009 and product certifications IS: 7098 (Part-I), CE, UL etc. Quotations without these certification details will not be considered for technical evaluation.

Preferred make of bought out material:

a.	Aluminium for Conductor	:	Hindalco/Balco/Nalco or better
b.	Copper for Conductor	:	Hindustan Copper/Hindalco or better
c.	XLPE compound of Insulator	:	Dow/Borealis or better

8. GUARANTEE

All the cables shall be guaranteed against faulty material, defective design & poor workmanship for a period of 18 months from the date of commissioning. The materials becoming defective during the guarantee period shall be replaced free of cost and the defects arising out of the works shall be rectified free of charge without delay.

ANNEXURE-I

Technical Data Format for 1.1KV, XLPE Insulated, Copper Cable

The tenderer shall furnish all technical details as called for in the following format for all sizes of cables failing which the tender shall be considered as incomplete. *The details shall be furnished separately for all the cables.*

Sl. No.	Particulars	Details
A	Cores	
1	No. of cores	
2	Nom Area of conductor in sq mm.	
3	Voltage Grade	
B	Conductor	
1	Standard Applicable	
2	Material Copper Grade	
3	Purity	
4	Nominal Cross Sectional Area	
5	Form of conductor/circular shaped	
6	No. of strands	
7	Nominal dia of each strand	
8	Temperature co-efficient of resistance at 20 degree celsius	
C	Insulation	
1	Standard Applicable	
2	Material (Mention Type)	
3	XLPE is cured by steam process or Gas process?	
4	Minimum Average Thickness	

5	Tolerance on the smallest of the measured values of thickness of Insulation	
6	Minimum volume resistivity at 27 deg cel	
7	Minimum volume resistivity at 70 deg cel	
8	Colour Scheme for identification of cores	
9	Average Dielectric Strength	
D	Inner Sheath	
1	Standard Applicable	
2	Material for inner sheath	
3	Minimum thickness of inner sheath	
4	Whether extruded	
E	Armour	
1	Standard Applicable	
2	Shape	
3	Size	
4	Material for Armour	
F	Outer Sheath/Overall Covering	
1	Standard Applicable	
2	Material (type)	
3	Whether extruded	
4	Minimum average thickness	
5	Whether anti-termite treatment has been given in the outer sheath	
6	Whether flame retardant low smoke compound added in the outer sheath	
G	Electrical Properties	
1	Maximum DC Resistance of conductor at 20 deg Celsius in ohms/km	
2	Maximum DC Resistance of amour at 20 deg Celsius in ohms/km	
3	Maximum Permissible conductor temperature	
	Under continuous full load	
	Under transient conditions	
4	Loss Tangent at normal frequency	
5	Reactance at maximum operating temperature 50 Hz (ohm/km)	
6	Capacitance at maximum operating temperature 50 Hz (ohm/km)	
7	Total Impedance at maximum operating temperature 50 Hz (ohm/km)	
8	Recommended continuous current rating	
	In Ground at 30 deg C Ground Temperature (A)	

	In Trench/Ducts at 40 deg C (A)	
	In Air at 40 deg C ambient Temperature (A)	
9	Short Ckt Current Rating for 1 sec duration (in KA)	
	Conductor	
	Armour	
10	Minimum volume Resistivity of insulation	
	At 27 °C in Ohm cm	
	At Max operating temperature in Ohm-cm	
11	Approximate AC resistance at max. Operating temperature	
	Phase	
	Neutral	
H	Mechanical Data	
1	Overall Dia of the cable	
2	Dia of the cable under the sheath	
3	Diameter under armour	
4	Diameter over the stranded cores	
5	Wight of cable per km.	
6	Drum length	
7	Tolerance on drum length	
8	Total weight of the drum	
9	Dimension of the drum	
10	Recommended minimum installation radius/ bending radius	
11	Maximum safe pulling force	
12	Whether identification as per clause of the specification is being provided	
13	Whether packing has been done as per clause of the specification	

10.1.0