BIDDING DOCUMENT

FOR

"Supply of materials against "Design, Engineering & Supply of 132kV CT and PT along with necessary accessories for metering purpose of Railway bay at Lanka TSS, Monipurbagan TSS and Sankardevnagar GSS."

FUND: "Deposit Work- Railway"

(E-Tender)

https://assamtenders.gov.in

VOLUME-2 TECHNICAL SPECIFICATION

BID IDENTIFICATION NO:
AEGCL/MD/ Tech-1079/RLY works/General File /2023/P3/BID

Assam Electricity Grid Corporation Limited

VOLUME-2 TECHNICAL SPECIFICATION

Section-1
SCOPE AND GENERAL TECHNICAL CONDITIONS

1.1.0 INTENT OF THESPECIFICATION

1.1.1 This volume of the specification deals with the general technical information & criteria for design, manufacture, supply & delivery of equipment/material, erection, testing & commissioning and setting to workofconstructionofnew132kVBayson"Design,SupplyandInstall"basisasdefinedinVolume-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 specifiedherein.

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 of various equipment and materials including substation steelstructures as per 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 the bidding document.
ii) Supply of substation/ equipment mounting steel structure.

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 HIMSELFFULLY

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 belevied.

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 SERVICECONDITIONS

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 LOCALREGULATIONS**:

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 beapplicable.

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 statutoryauthorities.

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

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 thebid.

1.7.0 CONTRACTOR'SREQUIREMENT

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 ofsites.

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

1.8.0 ENGINEERINGDATA

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 thesespecifications.

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 FORAPPROVAL

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 ContractDrawings.

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 SYSTEMSOFTWARE

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

1.12.0 DESIGNIMPROVEMENTS

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 modifiedaccordingly.

1.13.0 DESIGNCO-ORDINATION

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

1.14.0 DESIGN REVIEW MEETING

1.14.1 The contractor will be called upon to attend design review meetings with the Employer, and the consultants of the Employer during the period of Contract. The contractor shall attend such meetings at his own cost at Assam or at mutually agreed venue as and when required. Such review meeting will be heldgenerallyminimumonceamonthorthefrequencyofthesemeetingshallbemutuallyagreed
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 QualityAssurance

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 thefollowing:

a) His organization structure for the management and implementation of the proposed quality assurance programme
b) Documentation controlSystem.
c) Qualification data for Contractors keypersonnel.
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 purchasesetc.
e) System for shop manufacturing including process controls and fabrication and assemblycontrols.
f) Control of non-conforming items and system for correctiveaction.
g) Control of calibration and testing of measuring and testingequipment.
h) Inspection and test procedure formanufacture.
i) System for indication and appraisal of inspectionstatus.
j) System for qualityaudits.
k) System for authorizing release of manufactured product to theEmployer.
l) System for maintenance ofrecords.
m) System for handling storage and deliveryand
n) A quality plan detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item ofsupply.

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'SSUPERVISION

1.16.1 To eliminate delays and avoid disputes and litigation it is agreed between the parties to the Contract that all mattersandquestionsshallberesolvedinaccordancewiththeprovisionsofthisdocument.

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 & INSPECTIONCERTIFICATE

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 ofcharge.

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 PriceBid.

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 theContract.

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 theContract.

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 thesetests.

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 thatlot.

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

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 byhim.

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 thePurchaser.

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 AssuranceProgramme.

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, asapplicable.

1.19.0 GUARANTEED TECHNICALPARTICULARS

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/morestringentvaluesthanthoserequiredasperspecificationexceptwherestatedotherwise.

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 androad.

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. whereverapplicable.

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 CONTRACTORetc.

1.21.0 CONSTRUCTION TOOLS, EQUIPMENTSETC.

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 theEmployer.

1.22.0 MATERIALS HANDLING ANDSTORAGE

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 theContractor.

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 theContractor.

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 atSite.

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

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

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 andloss.

1.22.8 The Employer will verify the storage facilities arranged by the contractor and dispatch clearance will be provided only after Employer issatisfied.

1.23.0 CONTRACTOR'S MATERIALS BROUGHT ON TOSITE

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 damagethereto.

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 owingtohimbytheContractor,underinrespectoforbyreasonsoftheContract. Aftergivingafifteen(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 COMMISSIONINGSPARES

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 completionof 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.

2.7.0 ACSRCONDUCTORS

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

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

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/	Al: 54/ 3.18 mm St: 7/	Al: 30/ 3.00 mm St: 7/

		3.53 mm	3.18 mm	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 at20⁰C	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 ELECTRICALCLEARANCES

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

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 EARTHINGSYSTEM

2.9.1 General

(a) Earthing system shall installed as per drawings provided with this biddingdocument.

(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 regularintervals.

(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 afterwelding.

(d) Minimum depth of burial of main earthing conductors shall be 600 mm fromFGL.

(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/structurefoundations.

(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 bewelded.
(h) All metallic supporting structures and non-current carrying metallic parts of all equipment shall be provided with doubleearthing.
(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 earthgrid.
(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 withpeak.
(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 enamelpaint.
(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 GIflats.
(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 thesubstation.

2.9.2 Summary of EarthingSystem

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 DIRECTLIGHTNING

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

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

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 beused.

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 mainearth-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 ofspikes.
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 : 3.66mm
c) Minimum Breaking Load : 6970KG
d) Overall Diameter : 10.98mm
e) Area : 72.25mm2

2.11.0 BAY MARSHALLINGKIOSK

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 followingpurpose: -

(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)** outgoing415V, 16 Amps 3 phase AC supplies to be controlled byMCB.
(b) Todistribute**3(three)**outgoing240V,16Ampssinglephasesuppliestobecontrolledby MCB.
(c) To distribute **3(three)** outgoing 240V, 10 Amps single phase supplies to be controlled byMCB

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 IP55.

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

2.12.0 INSULATOR AND HARDWAREFITTINGS

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 smoothlyglazed.

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 ofassembly.

d) The design of the insulator shall be such that stress due to expansion and

contraction in any part of theinsulatorshallnotleadtodeterioration.Theporcelainshallnotengagedirectlywithhardmetal.

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 otherprocess.

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 asrequired.

j) The items of hardware and fittings shall make complete assemblies which are necessary for their satisfactoryperformance.Suchpartsshallbedeemedtobewithinthescopeofthisspecification.

2.12.2 Disc Insulator Strings

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

Sl. No.	Description	No of Disc Insulator Unit for		
		220 kV	**132 kV**	**33 kV**
1	No. of Disc, Suspension String	14	9	3
2	No. of Disc, Tension String	15	10	4
3	Creepage Distance of complete String (min)	6125 mm	3625 mm	900 mm

2.12.3 Parameters

2.12.3.1 Disc Insulators

a) Type : Ball andSocket
b) Colour : Brown
c) Surface :Glazed
d) LockingDevice : W or R type securityclip
e) Sizeof Disc : 255 mm x 145 mm
f) Size of Pin Ball : 16 mm
g) CreepageDistance
(Min subjected requirement of clause 2.19.2):25 mm/kV
h) ElectromechanicalStrength : 70 KN
i) Power frequency withstandtestvoltage : 75 KV Dry
j) Minimum dryImpulsewithstand : 125 KV
peak Test voltage (+/-wave)
k) PunctureVoltage : 1.3 X actual dry flash overvoltage.

2.12.3.2 PostInsulators

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

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

2.13.2 Clamps and connectors shall be made of materials listedbelow:-

ForConnectingACSR : Aluminium alloy casting conforming to designation A 6 of IS 617.

ForConnectingEquipment madeofCopper : Bimetallic connectors made from aluminiumalloy casting conforming to designation A 6 of IS617.

For Connecting G.IShieldWire : Malleable IronCasting.

ExpansionConnectors : Copper lamination to grade FRTP-2

of IS 191. Bolts, nuts,plainwashers And spring washers for items (i), (ii) and (iii) : Hot dip galvanised mildsteel.

2.14.0 ILLUMINATIONSYSTEM

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

Sl. No.	Location/Area	Average Illumination Level, 'Lux'	Limiting Glare Index
1	Control Room	300	19
2	Battery Room	100	19
3	Carrier Room	300	
4	Office/Conference Room	300	
5	Stairs and Corridors	10	

		0	
6	Air Conditioning Plant	15 0	
7	Outdoor Switchyard	20	
8	Approach Road	20	
9	Store Room	10 0	

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

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

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

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

2.15.0 PAINITNG

2.15.1 All surfaces of ferrous materials used for construction of outdoor equipment and enclosures such as instrumenttransformermaintanksandequipment,marshallingboxes,kiosk,operatingboxes,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 tanksof 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. Thepaint shall not scale off or crinkle or be removed by abrasion due to normalhandling.

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

2.15.4 The paint work done shall be guaranteed for a minimum period of 5 years from the date ofreceipt 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'srepresentative.

2.16.0 Steel

The Contractor shall procure rods and structural steel, etc. from primary steel producer TATA,SAIL, Jindal,RINL,SHYAM of grade 500 SD or higher, 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 biddingdocument.

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 achievingwater-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 centralbulb.
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 seaworthiness.

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 craftpapershallbeprovidedoverthescreedlayertodestroythebondbetweenthescreedandthe
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 hisoffer.

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 isexpected.

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 IndianStandards.

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 thescope.

SECTION-3
SPECIFICATION FOR DESIGN AND FABRICATIONOF SUBSTATION STEEL STRUCTURES

3.10 SCOPE

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

3.2.0 MATERIALS

3.2.1 StructuralSteel

The structures shall be of structural steel conforming to any of the grade, as appropriate, of IS 2062 (latest edition) Steel conforming IS 8500 may also be used. Medium and high strength structural steels with known properties conforming to any other national or international standards may also be used.

3.2.2 Bolts

Bolts used shall conform to IS12427 or bolts of property class 4.6 conforming to IS 6639 may also be used.
High strength bolts, if used (only with steel conforming to IS 8500) shall conform to property class 8.8 of IS 3757.
Foundation Bolts shall conform to
IS 5624. Step bolts shall conform
to IS 10238

3.2.3 Nuts

Nuts shall conform to IS 1363 (Part 3). The mechanical properties shall conform to property class 4 or 5 as the case may be as specified in IS 1367 (Part 6) except that the proof stress for nuts of property class 5 shall be as givenin IS12427.
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 IS4759.
Spring washers shall be hot dip galvanized as per service grade 4 of IS 4759 or IS 1537.

3.2.6 OtherMaterials

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

3.3.0 DESIGNPARAMETERS

3.3.1 Switchyard structures such as columns, beams and equipment mounting structures shall be designed as per drawing provided along with this biddingdocument.
Note: Structures with earth peak shall assume to have four earth wires for designpurpose in normal condition.

3.3.2 Spans: -

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

a).Line gantries (structures to terminatelines):

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

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

3.3.3 DeviationAngle

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 ShieldWires

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 tabulatedbelow:

	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 switchyards.

3.4.0 DESIGNDRAWINGS

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 andbolts.

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 thePurchaser. 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 ClampsAttachments

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 theCONTRACTOR.

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 theCONTRACTOR.

3.5.3 Earth wire ClampsAttachment

i. **Suspension Clamp**

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

a) **Tension Clamps**

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

3.6.0 FABRICATION

3.6.1 The fabrication of substation steel structures shall be in conformity with thefollowing:

a. Except where hereinafter modified, details of fabrication shall conform to IS: 802 (Part-II) or the relevant internationalstandards.
b. The tower structures shall be accurately fabricated to connect together easily at site without any undue strain on thebolts.
c. No angle member shall have the two leg flanges brought together by closing theangle.
d. The diameter of the hole shall be equal to the diameter of bolt plus1.5mm.
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 andPunching

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 anddrilled.

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 asfollows:

a) Holes must be perfectly circular and no tolerances in this respect arepermissible.
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 wallsparallel.

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 Erectionmark

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 ANDPAINTING

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 beaccepted.

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 oiledonly.

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

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 earthlingstrip.

3.9.0 TEST AND TESTCERTFICATE

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 followingtests:

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 usedsteel.
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 squaremeter.
c) Bolts and nuts: Manufacturer's test certificate as per standard practice shall besubmitted.

3.10.0 TEST AT CONTRACTOR'SPREMISES

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 member and assembled in exactly the same manner as to be done at site. The structure then shall be set on foundation as nearly similar as practicable to site and tested with equivalent test load for which the structure has beendesigned.

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

SECTION-4
TECHNICAL SPECIFICATION OF OUTDOOR SF6 CIRCUIT BREAKERS

4.1.0 SCOPE

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

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

4.1.3 Erection, Testing and Commissioning of CircuitBreakers.

4.2.0 GENERALREQUIREMENTS

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

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

4.2.3 Thecircuitbreakershallbecapableofswitchingtransformer-magnetizingcurrentsandshallberestrike- free.

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

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

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

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

4.3.0 OPERATINGMECHANISM

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

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

4.3.3 Each mechanism shall have an operationcounter.

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

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

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

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

4.3.8 Disagreement circuit shall be provided which shall detect pole positiondiscrepancy.

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

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

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

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

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

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

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

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

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

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

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

4.4.0 OPERATING MECHANISMCONTROL

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

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

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

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

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

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

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

4.5.0 SF6 GASSYSTEM

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

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

4.5.3 All gasketted surfaces shall be smooth, straight and reinforced, if necessary, to minimise distortion and to make a tight seal, the operating rod connecting the operating mechanism to the arc chamber (SF6 media) shall have adequate seals.

The SF6 gas leakage should not exceed 1% peryear.

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

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

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

It shall be possible to dismantle the density monitor for checking/replacement without draining the SF6 gas by providing suitable interlocked non return valve coupling.

4.6.0 BUSHINGS ANDINSULATORS

4.6.1 Bushings and Insulators shall be of Porcelain, Solid coretype.

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

4.6.3 Porcelain used for the manufacture of bushings and insulators shall be homogeneous, free from defects, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious tomoisture.

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

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

4.6.6 Bushings shall satisfactorily withstand the insulation level specified in datasheet.

4.7.0 FIXED AND MOVINGCONTACTS

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

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

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

4.8.0 INTERLOCKS

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

4.9.0 ADDITIONAL DUTYREQUIREMENTS

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

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

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

a) Breaking of inductive currents and capacitivecurrents.
b) Charging of long lines andcables.
c) Clearing developing faults within the full rating of thebreaker.
d) Opening on phaseopposition.

4.10.0 ACCESSORIES

4.10.1 Gas PressureDetector

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

Gas pressure monitor shall be provided for each pole individually.

4.10.2 Position Indicator

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

4.10.3 Terminals

Each circuit breaker shall be provided with suitable terminal pads of high conductivity aluminiumalloy for connecting to theline.

4.10.4 AuxiliarySwitches

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

4.10.5 Terminal Blocks

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

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

a) Padlocks and duplicate keys.

b) Space heaters equipped with automatic thermostaticcontrol.
c) Local/remote changeoverswitch.
d) Manually operated tripping push button/lever (mechanical) conveniently located to trip all three phasessimultaneously.
e) Control switches to cut off control powersupplies.
f)Fuses asrequired.
g) Two earthingterminals.
h) Auxiliary relays required for satisfactoryoperation.
i)Motor contactor with thermalrelease
j)Provision for mechanical interlock withisolator.
k) Readable wiring diagram shall be pasted inside the front cover of the operating mechanism box with indelibleink.

4.11.0 SUPPORTSTRUCTURES

4.11.1 The Circuit Breakers shall be suitable for mounting on steelstructures.

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

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

4.12.0 NAMEPLATES

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

4.13.0 EARTHING

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

4.14.0 TERMINALCONNECTORS

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

4.15.0 TESTS

4.15.1 All routine tests shall be carried out in accordance with relevantIS.
All routine/acceptance tests shall be witnessed by the Purchaser/his authorised representative. The tests shall include the following:

a) Routine/Acceptance Tests (allunits)

i) Mechanical Operationtests
ii) Power frequency voltage withstand test(dry)
iii) Tests on auxiliary & controlcircuits

iv) Measurement of resistance of the maincircuit.

b) Type Tests:

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

i) Breaking and making capacitytest
ii) Short-time currenttest
iii) Temperature risetests
iv) Lightning Impulse voltagetest

c) Special Tests:

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

d) TestCertificates

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

i) Complete identification data, including serial No. of thebreaker.
ii) Method of application, where applied, duration and interpretation of results in eachtest.

4.16.0 PRE-COMMISSIOING TESTS

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

(a) Insulation resistance of eachpole.
(b) Check adjustments, if any suggested bymanufacturer.
(c) Breaker closing and openingtime.
(d) Slow and Power closing operation andopening.
(e) Trip free and anti-pumpingoperation.
(f) Minimum pick-up voltage ofcoils.
(g) Dynamic Contact resistancemeasurement.
(h) Functional checking of control circuits interlocks, tripping through protective relays andauto reclose operation.
(i) Insulation resistance of control circuits, motoretc.
(j) Resistance of closing and trippingcoils.
(k) SF6 gas leakagecheck.
(l) Dew PointMeasurement
(m) Verification of pressure switches and gas densitymonitor.
(n) Checking of mechanical ‘CLOSE’ interlock, whereverapplicable.
(o) Testing of gradingcapacitor.
(p) Resistance measurement of maincircuit.
(q) Checking of operatingmechanism.
(r) Check for annunciations in controlroom

4.17.0 SPECIAL TOOLS ANDTACKLES

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

4.17.2 TECHNICAL DATA SHEET FOR CIRCUITBREAKER

	Particulars	Unit	Datafor 132 kV CB	Data for 33 kV CB
1	Type		Sf_6	Sf_6
2	No of poles		3 (3 Phase Ganged Unit)	3 (3 Phase Ganged Unit)
3	Service		Outdoor	Outdoor
4	Rated System Voltage	kV	132	33
5	Highest System Voltage	kV	145	36
6	System earthing		Solidly earthed system	Solidly earthed system
7	Rated Voltage of Breaker	kV	145	36
8	Rated Continuous Current	Amps	1250	1250
9	Rated Frequency	Hz	50	50
10	Rated Short Circuit breaking current (I) – 3 sec - symmetrical	kA	31.5	25
11	Rated Short Circuit making current	kA	2.5*I	2.5*I
12	Duty cycle		0-0.3 Sec-CO-3Min –CO	0.3Sec-CO-3Min–CO
13	First pole to clear factor		1.3	1.3
14	Operating time			
	i) Opening Time	ms	Not exceeding50ms	Not exceeding 50ms
	ii) Closing Time	ms	Not exceeding120ms	Not exceeding 120ms
15	Insulation level			
	i) Power Frequency with Stand Voltage	kV	275	70
	ii) Impulse withstand Voltage	kV	650	170
16	Minimum clearance between phases	m	1300	320
17	Minimum clearance between phase to earth	mm	1300	320
18	Minimum Ground clearance (from bottommost live part to plinth level)	mm	4600	4000
19	Minimum clearance from bottom Of Support insulator to plinth level	mm	2500	2500
20	i) Minimum Creepage Distance (Total)	mm	3635	900

	ii) Minimum Creepage Distance (Protected)	mm	1813	460
21	Arcing horn			Yes
22	Operating mechanism:			
	a) Type		Spring Charged	Spring Charged
	b) Rating of Drive Motor	V	Universal Motor/ 1 Phase 50 Hz 230V AC	Universal Motor/ 1 Phase 50 Hz 230V AC
	c) Rated voltage of Shunt trip coil & operating range	V. DC	220 or 110 [50% - 110%]	220 or 110 [50% - 110%]
	(d) Rated voltage of Closing coil & operating range	V. DC	220 or 132 [80% - 110%]	220 or 132 [80% - 110%]
	(e) No. of trip coils	No	2 per CB	2 per CB
	(f) No. of closing coils	No	1 perCB	2 perCB
	g) No of spare auxiliary contacts & contact rating	Nos. AMPS	10 N/O+10 N/C (per CB) 10A at 240V AC & 2A at 220V/110V DC	10 N/O+10 N/C (per CB) 10A at 240V AC & 2A at 220V/110V DC
	h) Minimum thickness of sheet steel forcontrol cabinet	mm	3	3
	i) Enclosure Protection		IP55	IP55
23	Reclosing		Three Phase Auto Reclosing	Three Phase Auto Reclosing
24	Support structure (Painted / Galvanised)		Galvanised	Galvanised
25	All other parts (Painted /Galvanised)		Synthetic enamel shade 631 of IS5(125 microns)	Synthetic enamel shade 631 of IS5(125 microns)
26	Minimum size of control wiring (Copper)	Sq.mm	2.5	2.5

SECTION-5

TECHNICAL SPECIFICATION OF OUTDOORCURRENT AND POTENTIAL TRANSFORMERS

5.1.0 SCOPE

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

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

5.1.3 Erection, Testing and Commissioning of InstrumentTransformers.

5.2.0 STANDARDS

5.2.1 The equipment covered by this specification shall, unless otherwise stated be designed, constructed and tested in accordance with the latest revisions of relevant Indian Standards or equivalent IEC and shall conform to the regulations of local statutoryauthorities.

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

5.2.3 The current transformer shall comply also with the latest issue of the following Indianstandard.

(i) IS:2705(Part-I) Current transformers: Generalrequirement.
(ii) IS: 2705(Part-II) Current transformers : Measuring Currenttransformers
(iii) IS: 2705(Part-III) Current transformers : Protective Currenttransformers
(iv) IS: 2705(Part-IV) Current transformers: Protective Current transformers forspecial
(v) Purposeapplication.
(v) IS:3156(Part-I) Potential transformers: Generalrequirement.
(vi) IS: 3156 (Part-II) Potential transformers : Measuring Potentialtransformers
(vii) IS: 3156 (Part-III) Potential transformers : Protective Potentialtransformers

5.3.0 GENERALREQUIREMENTS

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

5.3.2 Instrument transformers shall be of **Live Tankdesign.**

5.3.3 The instrument transformers shall be truly hermetically sealed to completely prevent the oil inside the tank coming into contact with the outside temperature. To take care of oil volume variation the tenderer are requested to quote the current transformers with stainless steel diaphragm(bellow).
All parts of bellow shall be stainless steel only. A ground glass window shall be provided to monitor the position of the metal bellow.

5.3.4 The instrument transformers shall be completely filled withoil.

5.3.5 A complete leak proof secondary terminal arrangement shall be provided with each instrument transformers. All secondary terminals shall be brought out into weather, dust and vermin proof terminal box. Secondary terminal boxes shall be provided with facilities for easy earthing, shorting, insulating and testingofsecondarycircuits.Theterminalboxesshallbesuitableforconnectionofcontrolcablegland.

5.3.6 All instrument transformers shall be of single phaseunit.

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

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

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

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

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

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

5.3.13 Allsteelworkshallbedegreased,pickledandphosphateandthenpaintedinaccordancewithClause 2.15.0 (Painting)

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

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

5.4.0 INSULATINGOIL

5.4.1 The quantity of insulating oil for instrument transformers and complete specification of oil shall be stated in the tender. The insulating oil shall conform to the requirement of latest edition of IS: 335 / IEC 60296 (required for first filling)

5.5.0 COMMON MARSHALLINGBOXES

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

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

5.5.3 1(One) common marshalling box shall be supplied with each set of instrument transformers. The marshalling box shall be made of sheet steel and weather proof. The thickness of sheet steel used shall benotlessthan3.0mm.Itisintendedtobringallthesecondaryterminalstothecommonmarshalling.

5.5.4 The enclosures of the common marshalling boxes shall provide a degree of protection of not less than IP 55 (As per IS2147).

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

5.5.6 Each marshalling box shall be fitted with terminal blocks made out of moulded non-inflammable plastic materials and having adequate number of terminals with binding

screws washers etc. Secondary terminals of the instrument transformers shall be connected to the respective common marshalling boxes. All out going terminals of each instrument transformer shall terminate on the terminal blocks of the common marshalling boxes. The terminal blocks shall be arranged to provide maximum accessibility to all conductorterminals.

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

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

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

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

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

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

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

5.6.0 BUSHINGS ANDINSULATORS

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

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

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

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

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

5.6.6 Bushings shall satisfactorily withstand the insulation level specified in datasheet.

5.7.0 TESTS

5.7.1 Routine/Acceptance Tests (allunits)

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

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

5.7.1.3 At factory/works tests the Ten Delta shall not exceed 0.3% (at Um/√3). The same shall not exceed 0.7% at the end of warranty period (refer SCC clause 5.10.0 of Vol-1). If tan delta value of CTs exceed prescribed limit of 0.7% within warranty period, it will be considered as failure within warranty period (Tan delta & capacitance test of CTs shall be measured at 10KV at site). The bidder has to replenish failed CTs within guarantee period without any cost implication to AEGCL.

5.7.2 Type Tests

5.7.2.1 The bidder shall furnish type test certificates and results for the all tests as per relevant Standards along with the bid for current and potential transformers of identicaldesign.

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

5.8.0 NAMEPLATES

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

5.9.0 MOUNTINGSTRUCTURES

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

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

5.10.0 SAFETYEARTHING

5.10.1 The non-current carrying metallic parts and equipment shall be connected to station earthing grid.
Forthistwoterminalssuitablefor40mmX10mmGIstripshallbeprovidedoneachequipment.

5.11.0 TERMINALCONNECTORS

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

installation requirement while approving the equipment drawings.

5.12.0 PRE-COMMSIONING TESTS

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

(a) CurrentTransformers

i) Insulation Resistance Test for primary andsecondary.
ii) Polarity test
iii) Ratio identification test - checking of all ratios on all cores by primary injection ofcurrent.
iv) Dielectric test of oil (whereverapplicable).
v) Magnetising characteristics test.
vi) Tan delta and capacitancemeasurement.
vii) Secondary winding resistancemeasurement
viii) Contact resistance measurement (whereverpossible/accessible)

(b) VoltageTransformers

i) Insulation Resistance Test for primary (if applicable) andsecondary.
ii) Polarity test.
iii) Ratiotest.
iv) Dielectric test of oil (whereverapplicable).
v) Tan delta and capacitance measurement of individual capacitancestacks.
vi) Secondary winding resistancemeasurement

5.13.0 TECHNICAL DATA SHEET FOR CURRENT ANDPOTENTIALTRANSFORMERS

5.13.1 For 220,132 & 33 kV CTs the instrument security factor at all ratios shall be less than five (5) for metering core. If any auxiliary CTs/reactor are used in the current transformers then all parameters specified shall have to be met treating auxiliary CTs as an integral part of the current transformer. The auxiliary CTs/reactor shall preferably be inbuilt construction of the CTs. In case these are to be mounted separately these shall be mounted in the central marshalling box suitably wired upto the terminalblocks.

5.13.2 TYPE ANDRATING:

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

Item	**Ratings and Particulars**		
(A) Nominal systemvoltage	**220kV**	**132kV**	**33 kV**
(B) Highest system voltage,kV	245	145	36
(C) Rated frequency,HZ	50	50	50
(D) Systemearthing	Solidly Earthed	Solidly earth	Solidly earth
(E) Insulationlevel			
(a) Impulse withstand voltage: kVp	1050	550	170
(b) One minutep.f. Withstand voltage,	460	230	70

kV (r.m.s.)			
(F) Short time current for one second, kA	40	31.5	25
(G) Minimum creepage distance, mm	6125	3625	1800
(a) Tan Delta (for CTs only) at Um/√3,(Max)	0.3%	0.3%	0.3%
(H) Temperature rise	As per ISS		
(I) Feeder/ BYPASS/ Bus CouplerCT			
(i) No. of Cores	5	**3**	3
(ii) Transformation Ratio	As per schedule of requirement		
(iii)Rated Output			
(a) Core-1	30 VA	30 VA	30 VA
(b) Core-2	-	15 VA	15 VA
(c) Core-3	-	-	-
(d) Core-4	-	N.A	N.A
(e) Core-5	-	N.A	N.A
(iv) Accuracy Class			
(a) Core-1	0.2	0.2	**0.2**
(b) Core-2	5P	5P	5P
(c) Core-3	PS	PS	PS
(d) Core-4	PS	N.A	N.A
(e) Core-5	PS	N.A	N.A
(v) Accuracy Limit Factor			
(a) Core-1	-	--	-
(b) Core-2	-	10	10
(c) Core-3	-	-	-
(d) Core-4	-	N.A	N.A
(e) Core-5	-	N.A	N.A
(vi) Instrument security factor			
(a) Core-1	< 5		
(b) Core-2	--	10	10
(c) Core-3	-	-	-
(d) Core-4	-	N.A	N.A
(e) Core-5	-	N.A	N.A
(vii) Minimum Knee point voltage, Volts			
(a) Core-1	-	-	-
(b) Core-2	1600	-	-
(c) Core-3	1600	1200	1200
(d) Core-4	800	N.A	N.A
(e) Core-5	800	N.A	N.A
(viii) Maximum secondary resistance, ohm			
(a) Core-1	-	-	-
(b) Core-2	3	-	-
(c) Core-3	3	3	3
(d) Core-4	3	N.A	N.A
(e) Core-5	3	N.A	N.A
(ix) Maximum exciting current, at Vk/4 mA			
(a) Core-1	-	-	-
(b) Core-2	20	-	-
(c) Core-3 (at Vk/4)	20	20	20

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

(d) Core-4	3	3	N.A
(e) Core-5	3	N.A	N.A
POTENTIAL TRANSFORMER			
(i) No. of secondary windings	3	2	2
(ii) Transformation ratio			
(a) Winding I	(220 kV/√3) / (110 V/√3)	(132kV/√3) /(110V/√3)	33kV/√3
(b) Winding II			/ 110V/√3
(c) Winding III		-	
(iii) Rated out put			
(a) Winding I		500	200
(b) Winding II		200	100
(vi) Accuracy class			
(a) Winding I		0.2	0.2
(b) Winding II		3P	3P
(v) Rated voltage factor		1.2	1.2

POTENTIAL TRANSFORMER (Metering)

SN	Particulars	132kV PT (metering)
	II	IV
1	Type	Single phase, 50Hz,oilfilled, self-cooled, Hermetically sealed, outdoor, Porcelain type.
2	Nominal system voltage.	132kV
3	Highest system voltage.	145kV.
4	Frequency.	50Hz+5%
5	System earthing.	Effectively, Solidly earthed
6	Number of phases.	3[single phase]
7	Number of secondary windings. Purpose of windings.	2[two] metering.
8	Rated primary Voltage.	132/1.732kV
9	Rated secondary Voltage.	Winding-I & II-110/1.732V (Metering)

10	Ratio	132kV/1.732: 110V/1.732 110V/1.732
11	Rated Burden	Winding I(M)-100VA, Winding-II(P)-100VA
12	Accuracy class	0.2/0.2

13	Rated voltage factor at rated frequency.	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.
15	Temperature rise at 1.5 times the rated primary voltage for 30 seconds, rated frequency & rated burden.	As per IEC- 186.
16	One-minute power frequency dry/wet withstands test voltage for primary winding.	275kV[rms]
18	1.2/50 micro second impulse withstand test voltage for primary winding	650kV[peak]
19 (i) (ii)	One-minute power frequency withstands test voltage for Secondary winding Between LV(HF) terminal & earth terminal	3kV[rmsj

20	Class of insulation.	B
21	Material of the conductor of primary and secondary Windings	Copper.
22	Fault level	40 kA [rms] for 3 second.
23	Minimum creepage distance.	4495mm

24	Quality of oil.	EHV Grade As per IS-335.
25	Radio interference voltage at 1.1 times Maximum rated voltage at 1.0 MHZ.	500 micro volts.
26	Partial discharge level.	Less than 10 piccocoulombs.
27	Seismic acceleration Horizontal — Vertical —	0.5g. 0.6g.
28	Accuracy class of standard V.T. to be used during testing towards determination of ratio errors and phase angle errors for metering	0.05 or better.
29.	Capacitance (Pf)	-

Note:

It is intended to use different ratios of the same CT at the same time for various protections and metering cores.

The CTS should therefore be suitable for the above purpose by secondary tapings only.

The ratio change by secondary taps is acceptable as long as the required CT specifications are achieved at all ratios.

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

SECTION-6
TECHNICAL SPECIFICATION OF ISOLATORS

6.1.0 SCOPE

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

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

6.1.3 Erection, Testing and Commissioning ofIsolators.

6.2.0 STANDARD

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

6.3.0 GENERAL

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

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

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

6.3.4 The bidder shall offer ac motor operated Isolators and earthswitches.

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

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

(ii) All necessary parts to provide a complete and operable isolator installation, control parts and other devices whether specifically called for herein ornot.

(iii) The isolator shall be designed for use in the geographic and meteorological conditions as given in Section1.

6.4.0 DUTYREQUIREMENTS

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

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

operatingmechanism.

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

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

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

6.4.6 The isolator shall be capable of making/breaking magnetizing current of 0.7A at 0.15 power factor and capacitive current of 0.7A at 0.15 power factor at ratedvoltage.

6.5.0 CONSTRUCTIONALDETAILS

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

6.5.2 Contacts:

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

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

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

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

6.5.3 Blades:

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

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

6.5.3.3 Isolators and earthing switches including their operating parts shall be such that they cannot be dislodged from their open or closed positions by short circuit forces, gravity,

wind pressure, vibrations, shocks, or accidental touching of the connecting rods of the operatingmechanism.

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

6.5.4 Insulators:

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

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

6.5.5 Base:

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

6.6.0 EARTHINGSWITCHES

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

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

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

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

6.6.5 Each earth switch shall be provided with flexible copper/aluminium braids for connection to earth terminal. These braids shall have the same short time current carrying capacity as the earth blade. The transfer of fault current through swivel connection will not beaccepted.

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

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

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

6.7.0 OPERATINGMECHANISM

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

6.7.2 Control cabinet/operating mechanism box shall be made of aluminium sheet of

adequate thickness (minimum3mm).

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

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

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

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

6.7.7 Gear should be of forged material suitably chosen to avoid bending/jamming on operation after a prolonged period of non-operation. Also, all gear and connected material should be so chosen/surface treated to avoidrusting.

6.8.0 OPERATION

6.8.1 The main Isolator and earth switches shall be gangoperated.

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

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

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

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

6.8.6 Signaling of closed position shall not take place unless it is certain that the movable

contacts, have reached a position in which rated normal current, peak withstand current and short time withstand current can be carried safely. Signaling of open position shall not take place unless movable contacts havereachedapositionsuchthatclearancebetweencontactsisatleast80% oftheisolatingdistance.

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

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

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

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

6.9.0 TEST ANDINSPECTION

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

i. Dielectric test (impulse and one minute) power frequency withstandsvoltage.
ii. Temperature rise test
iii. Rated off load breaking currentcapacity
iv. Rated active load breakingcapacity
v. Rated line charging breakingcapacity
vi. Rated short timecurrent
vii. Rated peak withstandcurrent
viii. Mechanical and ElectricalEndurance

6.9.2 The equipment shall be subjected to the following routinetest.

(i) Power frequency voltage dry withstand test on Maincircuit.
(ii) Voltage Tests on control and auxiliarycircuit.
(iii) Measurement of resistance of the maincircuit
(iv) Mechanical Operatingtest.

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

6.10.0 AUXILIARYSWITCHES

6.10.1 All isolators and earth switches shall be provided with 220/110 volts, 6 Ampere auxiliary switches for their remote position indication on the control board and for electrical interlocking with other equipment. In addition to the auxiliary switches required for remote position indications and for their operation. There shall be six pairs of NO and six pairs of NC contacts for each isolating switch and three pairs of NO and threepairsofNCcontactsforeachearthingswitch.Allcontactsshallbebroughtouttoterminal blocks

6.11.0 CONNECTORS

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

6.12.0 MOUNTINGSTRUCTURES

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

6.13.0 PRE-COMMISSIONINGTESTS

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

(a) Insulation resistance of eachpole.
(b) Manual and electrical operation andinterlocks.
(c) Insulation resistance of control circuits andmotors.
(d) Groundconnections.
(e) Contactresistance.
(f) Proper alignment so as to minimise to the extreme possible the vibration duringoperation.
(g) Measurement of operating Torque for isolator and Earthswitch.
(h) Resistance of operating and interlockscoils.
(i) Functional check of the control schematic and electrical & mechanicalinterlocks.
(j) 50 operations test on isolator and earthswitch

6.14.0 TECHNICAL DATA SHEET FOR ISOLATORS

	Technical Particulars	**Isolators class**		
		220kV	**132kV**	33 kV
1	Nominal system voltage, kV	220	132	33
2	Highest system voltage, kV	245	145	36
3	Rated frequency, Hz.	50	50	50
4.	Type of Isolator	Single Centre Break	Single Centre Break	Double Break, centre pole rotating
5	Rated continuous current, A	1250	1250	1250
6	Rated short time current, kA	40	31.5	25
7	Rated duration of short time current,(second)	1	1	1
8	Rated lightning impulse Withstand voltage, kV (peak)			
	i) To earth & between	1050	650	170

	poles			
	ii) Across isolating distance	1200	750	195
9	Rated 1 minute power frequency withstand voltage, kV (rms)			
	i) To earth & between poles	460	275	70
	ii) Across isolating distance	530	460	80
10	Minimum Creepage distance of insulators, mm	6125	3625	31mm/kV 900
11	Temperature rise	As per relevant IEC 62271-102/ IS 9921 As per relevant IS		

SECTION-7
TECHNICAL SPECIFICATION FORSURGE ARRESTORS

7.1.0 SCOPE

7.1.1 This Section covers the specifications for design, manufacture, testing at manufacturers works before dispatch, subsequent dispatch of 132kV and 33kV, 10 kA, Station class heavy duty, gapless metal (zinc) oxide Surge Arrestors complete with fittings & accessories such as surge monitor, terminal connectorsetc . including mounting structures as applicable.

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

7.1.3 Erection, Testing and Commissioning of SurgeArresters.

7.2.0 STANDARDS

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

7.3.0 GENERALREQUIREMENT

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

7.3.2 The surge arrestor shall consist of non-linear resistor elements placed in series and housed in electrical grade porcelain housing/silicon polymeric of specified creepagedistance.

7.3.3 The non-linear blocks shall be of sintered metal oxide material. These shall be provided in such away as to obtain robust construction, with excellent mechanical and electrical properties even after repeatedoperations.

7.3.4 The assembly shall be hermetically sealed with suitable rubber gaskets with effective sealing system arrangement to prevent ingress ofmoisture.

7.3.5 The surge arrestor shall be provided with line and earth terminals of suitable size. The ground side terminal of surge arrestor shall be connected with 25x6 mm galvanized strip, one end connected to the surge arrestor and second end to a separate ground electrode. The bidder shall also recommend the procedure which shall be followed in providing the earthing/system to the SurgeArrestor.

7.3.6 The surge arrestor shall not operate under power frequency and temporary over voltage conditions but under surge conditions, the surge arrestor shall change over to the conductingmode.

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

7.3.8 Surge arrestors shall have a suitable pressure relief system to avoid damage to the porcelain/ silicon polymerichousingandprovidingpathforflowofratedfaultcurrentsintheeventofarrestorfailure.

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

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

7.3.11 The arrestor shall be capable of handling terminal energy for high surges, external pollution and transient over voltage and have low losses at operatingvoltages.

7.4.0 ARRESTORHOUSING

7.4.1 The arrestor housing shall be made up of **polymer** for 220kV and **132kV systems** and porcelain/*polymeric for 66kV & 33kV systems* and shall be homogenous, free from laminations, cavities and other flaws of imperfections that might affect the mechanical and dielectric quality. The housing shall be of uniform brown colour, free from blisters, burrs and other similardefects.

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

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

7.4.4 Sealed housings shall exhibit no measurableleakage.

7.5.0 FITTINGS &ACCESSORIES

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

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

7.5.3 Grading corona control rings if necessary, shall be provided on each complete arrestor pole for proper stressdistribution.

7.6.0 SURGEMONITOR

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

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

7.6.3 The surge counter shall be provided with a potential free contact rated for 220/110 Volt (DC) which shall close whenever a surge is recorded by the surge monitor. Necessary arrangement shall be provided for extending the contact information to Substation AutomationSystem.

7.7.0 TESTS

7.7.1 Test on SurgeArrestors

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

Residual voltagetest
Reference voltage test
Leakage current at
M.C.O.V
P.D. test
Sealing
test
Thermal stability test
Aging and Energy
capability test Watt loss
test
Each metal oxide block shall be tested for guaranteed specific energy capability in addition to routine/acceptance test as per IEC/IS.

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

7.7.3 GalvanizationTest

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

7.8.0 NAMEPLATE

7.8.1 The name plate attached to the arrestor shall carry the followinginformation:

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

7.9.0 PRE-COMMISSIONINGTESTS

7.9.1 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 theequipment

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 forapproval.

(a)Operation check of LAcounters.

(b)Insulation resistancemeasurement.

(c)Capacitance and Tan delta measurement of individualstacks.

(d)Third harmonic resistive current measurement (to be conducted afterEnergisation.)

7.10.0 TECHNICAL DATA SHEET FOR SURGE ARRESTOR

Sl. No.	Particulars	Voltage class		
		220 k V	**132 kV**	**33 kV**
1	Rated voltage of arrester, kV	198	120	30
2	Rated frequency, Hz	50 Hz	50 Hz	50 Hz
3	Nominal discharge current of arrester, kA	10	10	10
4	Maximum residual voltage at nominal discharge current, kV (peak)	650	395	108
5	Maximum steep current impulse residual voltage at kV (kVP)	730	440	120
6	One minute power frequency withstand voltage ofarrester insulation, kV (rms)	460	275	70
7	1.2 / 50 μsecond impulse withstand voltage of arrester insulation, kV (peak)	1050	650	170
8	Line discharge class	3	3	2
9	**Insulator Housing**			
	Power frequency withstand test voltage(wet) (kV rms)	460	275	70
	Lightning impulse withstand tests voltage (KVp)	1050	650	170
	Pressure Relief Class	40	40	40
	Creepage distance not less than (mm)	6125	3625	25 mm/kV

SECTION – 8

Technical Specification for Control and Relay Panels (With Automation)

8.1.0 SCOPE

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

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

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

8.2.0 STANDARDS

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

8.3.0 TYPE OFPANEL

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

8.3.2 Simplex Control and Relay Panels shall consist of vertical swing front panels with equipment mounted thereon and having front glass door. Each cubicle assembly shall be provided with doors on the rear having handles with built in locking facility. It shall have double leaf doors with lift off hinges at the back for panels of width more than 800mm.
These panels shall be of the following approximate dimensions:
Height: 2250mm + 15mm anti-vibration pad + 50
mm (base) Depth: 800mm (MAX)
Width: 800 mm to 1000 mm

8.4.0 CONSTRUCTIONALFEATURES

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

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

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

8.4.4 All doors, removable covers and panels shall be sealed all around with synthetic

rubber gaskets Neoprene/EPDM generally conforming to provision of IS 11149. However, XLPE gaskets can also be used for fixing protective toughened glass doors. Ventilating louvers, if provided shall have screens and filters. The screens shall be made of either brass or GI wiremesh.

8.4.5 Panels shall have additional rolled channel plinth at the bottom with smooth bearing surface. The panels shallbefixedontheembeddedfoundationchannelswithinterveninglayersofanti-vibrationstripsmade of shock absorbing materials which shall be supplied by the contractor.

8.5.0 MOUNTING OFEQUIPMENTS

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

8.6.0 INTERNALWIRING

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

8.6.2 Wiring shall be carried out with 1100-Volt grade, single core, stranded copper conductor wires with PVC insulation.Theminimumsizeofstrandedcopperconductorusedforinternalwiringshallbeasfollows:

(a)All circuits except instrument transformerscircuits:	1.5 sq. mm. perlead.
(b)Instrument transformerscircuit:	2.5 sq. mm. perlead.

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

8.6.4 Wire terminals shall be made with solder less clamping type of tinned copper lugs, which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires and shall not fall off when the wire is disconnected fromblocks.

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

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

8.7.0 TERMINALBLOCKS

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

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

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

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

8.8.0 PAINTING

8.8.1 All Sheet steelwork shall be phosphated in accordance with IS6005.

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

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

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

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

8.8.6 The inside of the panels shall be glossywhite.
8.8.7 A small quantity of finishing shall be supplied minor touching up required at site afterinstallation.

8.9.0 NAME PLATES ANDMARKINGS

8.9.1 All equipment mounted on front and rear side as well as equipment mounted inside the panel shall be provided with individual nameplates with equipment designation engraved. Also, on the top of the each panel on front as well as rear side large and bold name plates shall be provided for circuit /feeder designation.
8.9.2 All front mounted equipment shall be also provided at the rear with individual name plates engraved with Tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring. The nameplates shall be mounted directly by the side of the respective equipment and shall not be hidden by the equipmentwiring.
8.9.3 Nameplates shall be made of non-rusting metal or 3 ply lamicord. Nameplates shall be black with white engravedlettering.

8.10.0 MISCELLANEOUSACCESSORIES

8.10.1 A 240 Volts, single-phase plug points shall be provided in the interior of each cubicle with ON-OFF switch for connection ofheadlamp.
8.10.2 Each panel shall be provided with a LED lighting fixtures for the interior illumination of the panel complete with all fittings, i.e., lamp, switch (controlled by paneldoor)
8.10.3 Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of D.C. and A.C. supplies of various control, AC-DC super vision, signaling, lighting and space heater circuits. MCBs of requisite capacity with fail indicators shall be used, HRC fuse is not acceptable.ThemaininputA.C.andD.C.circuitswillbeprotectedwithminiaturecircuitbreakers.

8.11.0 EARTHING

8.11.1 All panels shall be equipped with an earth bus securely fixed along with inside base of the panels. The materials and the sizes of the bus bar shall be at least 25X4 mm copper. When several panels are mounted joining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply. Provisions shall be made for extending the earth bus bar to future adjoining panels on eitherside.
8.11.2 All metallic cases of equipment shall be connected to the earth bus by independent copper wires of size not less than 2.5 sq. mm. Earthing wire shall be connected on terminals with suitable clamp connectors and soldering shall not bepermitted.
8.11.3 PT and CT secondary neutrals or common lead shall be earthed at one place only at the terminal blocks, where they enter thepanels.

8.12.0 RECORDING METERS SAMAST(ABT COMPLIANT TRIVECTORMETERS)

8.12.1 Basic Features of Interface Energy Meters

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

b) Each meter shall have a unique identification code, which shall be marked permanently on its front, as well as in its memory. All meters supplied to as per this specification shall have their identification code starting with “IEM”, which shall not be used for any other supplies. “IEM” shall be an eight digit running serial number, further followed by “A” and

"B" for the use with CT secondary of 1A and 5A respectively. This shall be mutually agreed between the buyer and the vendor. Note: The secondaries of all the CT cores will be 1A.

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

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

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

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

g) The total burden imposed by a meter for measurement and operation shall be defined as per IS 14697. An automatic backup for continued operation of the meter's calendar-clock, and for retaining all data stored in its memory, shall be provided through a long-life battery, which shall be capable of supplying the required power for at least 2 years. The meters shall be supplied duly fitted with the batteries, which shall not require to be changed for at least 10 years, as long as total VT supply interruption does not exceed two years. The battery mounting shall be designed to facilitate easy battery replacement without affecting PCB of the meter.

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

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

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

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

subsequent time blocks shall be contracted or elongated by five seconds each. All clock corrections shall be registered in the meter's memory and suitably shown on print out of collected data.

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

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

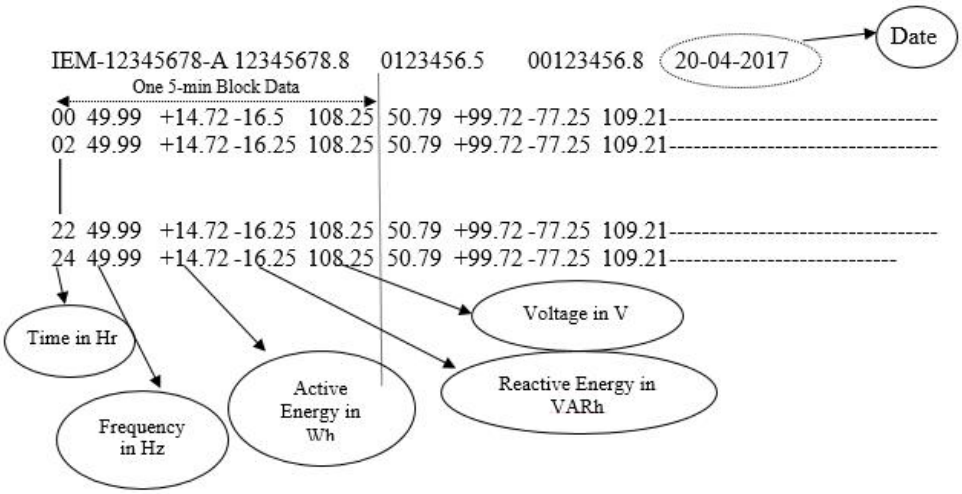

Figure 1:Standard Raw Data Format for IEM

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

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

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

8.12.1 Constructional Features

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

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

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

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

8.12.2 Measurement

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

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

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

iv. The meter shall continuously compute the average of the RMS values of the three line-to-neutral VT secondary voltages as a percentage of 63.51 V, and display the same on demand. The accuracy of the voltage measurement/computation shall be at least 0.5%, a better accuracy such as 0.2% in the 95-105% range being desirable. The voltage data shall be stored in the meter's memory in volts up to third decimal. Further voltage data in.NPC/output report shall be rounded off upto second decimal.

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

vi. The meter shall also integrate the reactive energy (VARh) algebraically into two separate registers, one for the period for which the average RMS voltage is above 103.0%, and the other for the period for which the average RMS voltage is below 97.0 %. The current reactive power (VAR), with a minus sign if negative, and cumulative reactive energy (VARh) readings of the two registers (>103% and <97%) shall be displayed on demand. The readings of the two registers at each midnight shall also be stored in the meter's memory. When reactive power is being sent out from substation bus bars, VAR display shall have a plus sign or no sign and VARh registers shall move forward. When reactive power flow is in the reverse direction, VAR display shall have negative sign and VARh registers shall move backwards. Generally, the standard PT ratios are 33kV/110V, 132kV/110V, 220 kV /110 V, 400 kV /110 V and 765 kV / 110 V. However, at the time of commissioning the vendor may confirm the same from site and configure the meter accordingly to ensure correct recording of reactive energy.

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

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

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

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

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

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

8.12.3 Memory/ Storage

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

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

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

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

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

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

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

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

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

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

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

8.12.4 Display

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

i.	Meter serial no. and model:	IEM12345678A or IEM12345678B
ii.	Date (year month day /yyyy mm dd):	20160311 d
iii.	Time (hour min sec /hh mm ss):	195527 t
iv.	Cumulative Wh reading:	1234567.8 C
v.	Average frequency of the previous block:	49.89 F
vi.	Net Wh transmittal during the previous block:	28.75 E
vii.	Net VARh transmittal during the previous block:	18.75 R
viii.	Average % Voltage:	99.2 U
ix.	Reactive power (VAR):	106.5 r
x.	Voltage - high VARh register reading:	1234567.5 H
xi.	Voltage - low VARh register reading:	1234567.4 L

xii. Low battery indication

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

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

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

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

8.12.5 Communication

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

8.12.5.2 All meters shall be compatible with Optical port, RS-485 port, Ethernet port and USB / RS-232 port all together at a time and communicate independently. It shall also be possible to obtain a print out (hard copy) of all data collected from the meters, using the local PC. Data collection from any local laptop/PC shall be possible by installing data collection software. Entire project has to be based on Optic Fibre/GSM/4G/3G.

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

The operational testing of all the network elements has to be demonstrated by the Tenderer to the satisfaction of the utility.

8.12.5.4 The Tenderer shall provide the necessary software which would enable a local PC/ CDCS to:

i. Accept the data from the Optical/Ethernet/WAN and store it in its memory in user defined formats (text, csv, xls, etc.) in a user-defined file name (file name format must be ddmmyy substation name-utility name).
ii. Polling feature along with a task scheduler to run the data downloading software at a pre-designated date and time repeatedly or by manually selecting a meter. File naming for such downloaded data should also be in user-defined format. A detailed activity log shall also be available for each downloading operation.
iii. Upload/Import meter data (binary files) in the software for further processing. While uploading, there shall be provision to upload all selected files with single key-stroke.
iv. Convert the binary file(s) to text file(s).There should be provision to select multiple files based on filename, convert all selected files with single key-stroke and store the text files in the same location where binary files are stored.
v. Display the collected data on PC's screen in text format, with forward/backward rolling
vi. Print out in text format the data collected from one or more meters, starting from a certain date and time, as per operator's instructions
vii. Transmit the collected data, in binary format, through an appropriate communication link to the central computer, starting from a certain date and time, as per operator's instructions.
viii. Store the collected data in binary format, on a CD/Pen Drive. In addition to above, in general the software shall be able to convert IEMs data to existing format as well as in tabular (.csv) format as applicable.
ix. The above software shall further ensure that absolutely no tampering (except erasing of complete data with password protection) of the collected metering data is possible during its handling by the PC. The software shall be suitable for the commonly available PCs, (Windows) and shall be supplied to Owner in a compatible form to enable its easy loading into the PCs available (or to be installed by the Owner/others) at the various substations.
x. The Tenderer shall ensure data integrity checks on all metered data received from data collection systems.
xi. The quality of installation of the various equipment & power supply wiring to all field equipment shall be as per standards/ regulations/prevailing practices of the utility. The supply of electricity needed for operation and maintenance of entire Metering system shall be provided free of cost by the respective owners of the premises.

8.12.6 Climatic Condition

The meters to be supplied against this specification shall be required to operate satisfactorily and continuously under the following tropical conditions of hot, humid, dusty, rust and fungus prone environment.

Maximum ambient air temperature (°C)	55
Minimum ambient air temperature (°C)	(-) 5
Average Daily ambient air temperature (°C)	32
Maximum Relative Humidity (%)	95
Minimum Relative Humidity (%)	10
Maximum altitude above sea level (m)	1000
Average Annual Rainfall (mm)	1200

Maximum Wind Pressure (Kg/sq.m)	195
Isoceraunic Level (days per year)	50
Seismic Level (Horizontal Accn. In g)	0.3

8.12.7 Quality Assurance

The quality control procedure to be adopted during manufacturing of the specified equipment shall be mutually discussed and finalized in due course, generally based on the established and proven practices of the manufacturer. The software shall be user friendly which can be easily installed in any PC/Laptop irrespective of operating system of the PC/Laptop, and shall be certified for ensuring data handling capabilities. The same shall be demonstrated by the party during technical evaluation. During demonstration party shall bring standard meter. Thereafter software shall be offered for technical compatibility before taking up further necessary action in the procurement process.

8.12.8 Testing

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

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

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

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

8.12.8.5 Downloading meter data through USB port and RS 232.

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

8.12.8.7 Compatibility with PC Software.

8.12.8.8 Functioning of Time synchronisation, advance and retard time commands.

8.12.8.9 Per meter downloading time verification.

8.12.9 Copy of Certificate shall be submitted.

8.12.9.1 Type Tests

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

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

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

Copy of Test certificate shall be submitted to SLDC.

8.12.10 ANOMALY DETECTION FEATURES

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

8.12.10.2 Phase wise Current Circuit Reversal – The meter shall detect reversal of polarity provided the current terminals are reversed. This shall be recorded for 1 or 2 phase CT reversal.

8.12.10.3 Voltage Unbalance – The meter shall detect voltage unbalance if there is unbalance in voltages.

8.12.10.4 Current Unbalance – The meter shall detect current unbalance if there is unbalance in load conditions. Meter should ensure true system conditions before going for current unbalance checks.

8.12.10.5 CT Miss – The meter shall detect current miss if the current is below a defined threshold, provided the phase voltage is above a specified threshold. Snapshots of phase wise voltage, phase wise active current and phase wise power factor shall be provided with above specified anomaly events. Further, each meter module shall record the following events along with total duration:

8.12.10.6 Power On/Off – The meter shall detect power off if both the auxiliary supplies fail. The event shall be recorded on the next power up. At the same time power on event shall be recorded. No snapshot shall be logged with this event.

8.12.10.7 Feeder Supply Fail -This event shall be logged when feeder supply, i.e., all the voltages goes below certain threshold. No snapshot shall be logged with this event.

8.12.10.8 Last three hundred & fifty (350) events (occurrence + restoration), in total, shall be stored in the meter memory on first in first out basis.

8.12.10.9 There shall be five separate compartments for logging of different type of anomalies:

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

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

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

8.12.11 Installation and Commissioning

8.12.11.1 The Tenderer shall be responsible for total installation and commissioning of the meters (along with test blocks, if supplied separately) as per Owner's advice, including unpacking and inspection on receipt at site, mounting the meters on control and relay panels at an appropriate viewing height, connection of CT and VT circuits including any required rewiring, functional testing, commissioning and handing over. The Tenderer's personnel shall procure/carry the necessary tools, equipment, materials and consumables (including insulated wires, lugs, ferrules, hardware etc.)

8.12.11.2 As part of commissioning of DCDs the Tenderer shall load the software specified in clause 5(d) into the PCs at the respective substations, and fully commission the total meter reading scheme. He shall also impart the necessary instructions to substation engineers. At least 2-hour training session shall be arranged for substation staff and SLDCs. Also, an operating manual (pdf as well as hard copy) of the meter containing all details of the meter, various data downloading features, etc. shall be made available at site andSLDC.

8.12.11.3 At the time of commissioning, the meters lying in stores shall be time synchronized through GPS signal before installation in the panel to avoid the large time mismatch.

8.12.12 General

8.12.12.1 The meter shall be supplied with latest/compatible software (shall be compatible with old & new meters data download handling). Any new software as required to be installed within warranty period are to be done by party or through remote support to client.

8.12.12.2 The total arrangement shall be such that one (1) operation (click on "data down load from meter" button on software) can carry out the whole operation in about five (5) minutes per meter or preferably faster.

8.12.12.3 The layout of software front end/user interface has to be approved by RLDC during technical evaluation/demonstration. However, a standard template sheet will be provided along with TENDER for reference.

8.12.12.4 Software for windows/office/antivirus to be supplied. Antivirus should not slow down processes and same will be demonstrated during technical demonstration.

8.12.12.5 Above specification is minimum only, any higher standard required for the purpose intended (meter data handling) would be assessed by vendor and would be supplied accordingly. The detailed architecture shall be approved during drawing approval stage.

8.12.12.6 Meter shall be accommodated in existing C&R panel of standard size (Alstom/ ER/ABB/Siemens) in kiosk or C&R panel with door closed. If required before Tendering, Tenderer may collect necessary data or else the scope is deemed to be included.

8.12.12.7 Step by Step procedure (on screen shot type and desktop video capture) shall be provided for

- Installation/Re-installation of Database handling software in to Laptop / PC
- Meter maintenance/site-testing procedure as per relevant IS/IEC standard
- Procedure for data downloading from Meter by HHU/Laptop/Desktop PC.

  As on date of delivery, the supplied meters shall comply with all statutory regulation as required under CERC/CEA/IEGC as applicable and the same should be declared by the vendor during delivery along with warranty certificate.

8.12.13 STANDARDS TO BE COMPLIED WITH

Standards to be complied

S.No	Reference	Reference Title
	Detail	
1	IS-15959:2011	Data Exchange for Electricity Meter Reading Tariff &
		Load Control – Companion Specification
2	IS-14697:1999	Specifications for AC Static Transformer operated Watt
		Hour & VAR-Hour meters, class of 0.2S and 0.5S
3	IEEE 830-1998	IEEE Recommended Practice for Software
		Requirements Specifications

8.12.14 SystemSecurity& Cyber Security

8.12.14.1 The Contractor shall document and implement a Cyber Security Policy in line with CERT-In latest guidelines (http://www.cert-in.org.in) to secure the system and the Contractor shall keep updating the Security settings as per the revised guidelines of CERT-In at time to time. Below listed basic strategies shall be followed by the Contractor for making the entire Control Centre immune to Cyber-attacks.

8.12.14.2 All the Hardware, OS and application software shall be hardened.

8.12.14.3 Network partition and DMZ through use of Firewall as required maximizing the security of ABT, OA AND MIS System while facilitating access for data and information to all stake holders.

8.12.14.4 All default user id & passwords shall be changed.

8.12.14.5 All log in/log out and cable plug in/plug out shall also be logged in the System.

8.12.14.6 Prevent unauthorized users from reading or writing data or files, executing programs or performing operations without appropriate privileges

8.12.14.7 Document all user sign on procedure

8.12.14.8 Record all network traffic for detecting unauthorized activity, unusual activity and attempts to defeat system security (Contractor to propose and document what constitutes normal activity/traffic)

8.12.14.9 Vendor has to identify and list the entire network and other protocols that communicate with physical systems and limit what is not required.

8.12.14.10 Network Zoning shall be implemented as per the proposed architecture given in Fig.1. However, the Contractor may suggest other methods of network architecture without compromising the security of the System.

8.12.14.11 No user shall be allowed to access remote network zones other than the adjacent zone.

8.12.14.12 Latest Cyber Security Guidelines of CERT-In specified at (http://www.cert-in.org.in) shall be followed.

8.13.0 RELAYS

8.13.1 GENERAL

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

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

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

8.13.1.4 Relays shall be suitable for flush mounting with connectors fromrear.

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

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

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

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

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

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

8.13.2 GENERAL SPECIFICATION OF NUMERICALRELAYS

8.13.2.1 Numerical Relays shall be provided for the followingapplications:

Distance Protection for 132 kV and 66 kV Lines

As per MoM of 'CEA's third meeting of subgroup for preparation of Reliability Standards for Protection and communication system' and NERPC 47th PCC meeting' for 132kV or above voltage level, transmission line length less than 10ckt.Km, Line Differential Relay (87L) shall be used as main protection instead of distance protection relay (21)

Backup directional over current and earth fault relays for 132 kV and 66 kV Lines

8.13.2.2 All Numerical Relays should have following minimumfeatures.

- Relays shall be communicable on IEC61850 protocol without any protocol converter. Certificates from KEMA confirming interoperability, ***Goose messaging & publishing as per IEC61850*** standard shall be submitted

along with thetender.

- Relays shall have one no. front RJ45 or USB port for Local Relay Parameterization and two nos. rear FO port/ Rear RS485 for connectivity to SAS over IEC61850protocol.
- The relay shall have self-communication port monitoring feature and failure shall generate alarm.
- Relays shall have redundant power supply card i.e. in case of failure of one source fail,the
  redundant shall pick up instantly. Power supply card failure shall generate necessary alarm to local SCADA.
- The relay shall have sufficient battery backup to keep the internal clock running for atleast 2 years in absence of auxiliarysupply.
- Should have minimum 16 configurableLEDs.
- Should have minimum 16 Binary Inputs and 24 Binary Outputs subject to the availability of 6 BI and 10 BO as spares above the systemrequirements.
- All BI/BOs shall beconfigurable
- Shall have front minimum 4 lines LCD display with suitable key pad for HMI operation for setting, configuration changeetc.
- Numerical relays are provided with built in Event / Disturbance / Fault Recorderfeatures.
- The bidder shall bring out in the bid that the Numerical relays providing different protection features / application in a single unit if any one of the application/feature goes out of service the other feature/application (s) will remainun-effected.
- **The relays shall be site configurable (Including logic development) with the help of independent function blocks and Booleanlogic.**
- Configured features & set values shall be in non- volatilememory
- Must have real time clock for time stamping of events/ disturbances with time synchronization inputs (GPRS etc.). Time synchronisation shall be SNTP & IRIG-Bcompatible.
- The relays should have self-diagnostic features identifying area of fault or failure of a particular component orcard.
- Shall have in built Circuit Breaker Failure protection based on undercurrent detection and/or circuit breaker auxiliary contact status. Provision shall be given to initiate the breaker fail logic using a digital input from external protectiondevices.

8.13.2.3 Hardware based measurement shall not beacceptable.

8.13.2.4 The relay should have high immunity to electrical and electromagneticinterference.

8.13.2.5 The same relay shall be provided with both 1A and 5A CT inputs and shall be siteselectable.

8.13.2.6 It shall be possible to energise the relay from either AC or DC auxiliary supply. Auxiliary dc supply shall be suitable for both110 or 220 Volt and shall be siteselectable.

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

8.13.2.8 **Extensive disturbance recording facility shall be available for at least up to 10 seconds** to capture maximum possible information. Necessary software shall be provided for retrieving and analysing the records. Facility for developing customised logic schemes inside the relay based on Boolean logic gates and timers should be available. Facility for renaming the menu texts as required by operating staff at site should beprovided.

8.13.2.9 Must have additional feature of local breaker back upprotection

- The relay shall have built in Circuit Breaker SupervisionFunctions
- The relay shall be able to detect any discrepancy found between NO & NC contacts ofbreaker
- The relay shall monitor number of breaker tripoperations
- The relay shall also monitor the breaker operatingtime

8.13.2.10 The relays shall have the following tools for faultdiagnostics

Fault record – The relay shall have the facility to store fault records with information on cause of trip, date, time, trip values of electrical parameters.

Event record – The relay shall have the facility to store time stamped event records with1ms resolution.

Disturbance records – The relay shall have capacity to store disturbance records of atleast 10 sec. duration and sampling rate per cycle shall be more than 100.

It shall be possible to preserve stored information in the event of an auxiliary supply failure with the help of a battery backup.

The relay settings shall be provided with password protection.

It shall be possible to change the relay setting from the front panel using the key pads/Work station of SAS /Laptop.

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

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

8.14.0 Transmission Line Protection:
8.14.1 DISTANCE PROTECTIONRELAY

8.14.2 The distance protection relay shall be fully numerical using microprocessors and

be based on a non- switchedscheme.

8.14.3 The distance protection relay shall have at least three completely independent non-switched forward directional zones, one extended zone and a reverse directional zoneprotection.

8.14.4 Have non-switched measurement, which implies processing of six possible fault loops (six –loop measurement)

8.14.5 Have polygonal characteristics with independently adjustable reactive and resistive reaches for maximum selectivity and maximum fault resistance coverage. The zones shall have independent settable earth fault compensation factors to cater to adjacent lines with different zero sequence to positive sequenceratios.

8.14.6 Selection shall be so that the first zone of the relay can be set to about 80% - 85% of the protected line without any risk of non-selectivetripping.

8.14.7 The second and third zone elements shall provide backup protection in the event of the carrier protection or the first zone element failing to clear the fault, zone-2 shall cover full protected section plus50 % of the next section zone-3 shall normally cover the two adjacent sections completely. The zones must have independent timesettings.

8.14.8 Have adequate number of forward zones (minimum three) and a reverse zone. The zone reach setting ranges shall be sufficient to cover line lengths appropriate to each zone. Carrier aided scheme options such as permissive under reach, over reach, & blocking and non-carrier aided schemes of zone1

extension and Loss of load accelerated tripping schemes shall be available as standard. Weak in feed logic and current reversal guard also shall be provided.

8.14.9 In case the carrier channel fails, one out of the non-carrier-based schemes cited above should come into operation automatically to ensure high speed and simultaneous opening of breakers at both ends of theline.

8.14.10 Have a maximum operating time up to trip impulse to circuit breaker (complete protection time including applicable carrier and trip relay time) for SIR 0.01-4: as 40ms at the nearest end and 60ms at the other end of line & for SIR 4-15: as 45ms at the nearest end and 65ms at the other end of line with carrier transmission time taken as20ms.

8.14.11 Have a secure directional response under all conditions, achieved by memory voltage polarising and /or healthy phase voltage polarising asappropriate.

8.14.12 Shall have an independent Directional Earth Fault (DEF) protection element to detect highly resistive faults. This element shall have an inverse time/definite timecharacteristic.

8.14.13 Has logic to detect loss of single /two-phase voltage input as well as three-phase voltage loss during Energisation and normal load conditions. The voltage circuit monitoring logic in addition to blocking the distance protection element, enable an emergency over current element to provide a standby protection to the feeder until the re-appearance of voltagesignal.

8.14.14 The VT fuse failure function shall function properly irrespective of the loading on the line. In other words, the function shall not be inhibited during operation of line under very low loadconditions.

8.14.15 Have necessary logic to take care of switch-on-to-fault condition. Energisation of transformers at remote lineendsandtheaccompanyinginrushcurrentshallnotcauseanyinstabilitytotheoperation ofrelay.

8.14.16 Have power swing blocking feature, with facilities for fast detection of power swing selective blocking of zones settable unblocking criteria for earth faults, phase faults and three phasefaults

8.14.17 Be suitable for single pole or three poletripping.

8.14.18 Be suitable for both bus PT or Line PT/ CVTsupply.

8.14.19 Shall have in built Trip circuit supervision facility to monitor both pre- and post-close supervision facilities. An alarm shall begenerated.

8.14.20 Shall have in built broken conductordetection

8.14.21 The sensitivity of the logic shall not be affected during operation under lowload.

8.14.22 Shall have a fault locator with an accuracy of ±3%. The display shall be in kilometres or percentage impedance. The fault locator should have built in mutual compensation for parallelcircuit.

8.14.23 **The relay shall have a built-in auto-reclose function with facilities for single pole/ three pole / single and three pole tripping. It shall be possible to trigger the A/R function from an external protection**. A voltage check function which can be programmed for dead line charging/dead bus charging / check synchronising shall beincluded.

8.14.24 Shall have additional features to provide under/ over voltageprotection

8.14.25 Shall have additional features to provide under frequencyprotection

Technical Parameters

Power supply module

a) Aux. DC Voltage - 110/220 VDC
b) Permissible tolerance - +20%
c) Power consumption - 15 to 40W

Analog inputs

a) Current - 1A CT <0.5VA
b) AC voltage - 110V PT, <0.5VA

c) Permissible overload - CT 4A cont. PT 230VCont.
d) Frequency - 50 Hz, +5%

Distance protection Zones

a) No. of zones - Five, selectabledirection
b) Characteristic - Quadrilateral and/ or mho(selectable)
c) Minimum operate current - (10-30) % ofIn
d) Xp Setting Range - 0.5 to250_/Ph
e) Rp Setting Range - 0.1 to250_/Ph
f) Xo Setting Range - 0.5 to250_/Ph
g) Ro Setting Range - 0.5 to250_/Ph
h) Angle - 100 to850
i) Zone timers - 0 – 30 s, + 10ms
j) Operate time - @ 25ms
k) Reset ratio - 105% for DPR 95% forSOTF
l) Reset time - 40ms

Binary inputs Module

a) Binary inputs - 24 (freely assignable to anyfunction)
b) DC Voltage - 110/125 V DC,
+ 20% 220/250V, +20%
c) Power consumption - Max 0.2W/Input-110V

8.14.26 Line Differential Protection Relay (If Applicable)

***NOTE: the 'Main I and Main II Line Differential Protection scheme (with Distance protection function as back up) is applicable for 220 kV voltage level only. For 132 kV voltage level only 'Main I Differential Protection scheme (with Distance protection function as back up)' is envisaged.**

Main I and Main II Line Differential Protection shall be of two different make (i.e. from different manufacturers) or of same make with two different platforms with same specifications.

The relay shall have all the features as per Distance protection relay over and above following features

1. It shall be working on phase segregated Current Differential protection principle.
2. It shall have multiple slope characteristic (preferably) to have stability against CT saturation and heavy through faults as well as sensitivity for internal faults.
3. It shall measure Differential as well as restrain current continuously and shall display the same as measurement.
5. It shall communicate to remote end through IEEE C37.94 format.
6. It shall have redundant communication channels for protection communication.
7. It shall communicate analogue as well as digital signals to remote end.
8. It shall have various communication options for remote communication i.e. mono-mode / multi-mode for direct communication / communication through multiplexer.
9. It shall have Line charging current compensation feature for better sensitivity.
10. Distance protection function can be utilized as independent or as back up of Differential protection in case of failure of remote communication. .It shall have a full scheme distance protection scheme to provide independent protection in parallel with the differential scheme in case of a communication channel failure for the differential scheme. The distance protection then provide protection for the entire line including the remote end back up capability either in case of a communications failure or via use of an independent communication channel to provide a fully redundant scheme of protection (that is a second main protection scheme). Eight channels for intertrip and other binary signals are available in the communication between the IEDs.The auto-reclose for single-, two- and/or three phase reclosing includes priority circuits for multi-breaker arrangements. It co-operates with the synchronism check.

11. It shall communicate time coordinated current signals for remote communication to execute Line differential protection algorithm accurately. Time synchronization through GPS shall also be possible.
12. It shall monitor individual communication links continuously and switchover to standby link after preset time in case of failure of one link.
13. It shall supervise individual telegrams.
14. It shall detect reflected telegrams.
15. It shall detect change in communication It shall measure delay time for remote end along with dynamic compensation of the same in differential protection algorithm.
17. It shall also supervise maximum permissible delay time.
18. It shall generate alarm for heavily disturbed communication link. Technical Parameters

A. Line Differential Protection setting:

1. Minimum operating current - 20 to 200% of In
2. Slope (Single/dual) - 10 to 100%
3. End section (Single/dual) - 20 to1000% of In
4. Highset operating current - 100 to 5000% of In
5. 2 nd Harmonic blocking - 5 to100 %
6. Typical operating time - 25 ms
7. Operating time for high set - 15 to 20 ms
8. Charging current comp. – Selectable

B. Remote communication:

9. Analogue signal transfer – Minimum 3 Nos.
10. Binary signal transfer - Minimum 8 Nos
11. Remote Communication module
    Dual modules suitable for
    a) 1300 nm - multi-mode
    OR
    b) 1300 / 1550 nm – mono-mode
    (finalized during detailed engineering)
12. Synchronization mode - GPS / Echo (finalized during detailed engineering)
13. Time delay alarm - 5 to 500 ms, step 5 ms (for communication fail)
14. Time delay - 5 to 500 ms, step 5 ms (for switching to redundant channel)
15. Asymmetric delay - - 20 to +20 ms, step 1 ms (When echo mode is used)
16. Max. Transmission delay – 0 to 40 ms, step 1 ms.

8.15.0 OVER CURRENT AND EARTH FAULTRELAYS

8.15.1 These relays shall be of numeric, single/multi pole, directional /non-directional type with or without high set element as specified. These relays shall have the followingfeatures/characteristics:

IDMT characteristic with definite minimum time of 3 second at 10 times setting. Other operating curves such as inverse, very inverse shall be selectable

Adjustable setting range of 50-200 % and 20-80% of rated current for over current and earth fault relays respectively.

The directional relays shall have a Maximum torque angle of 45°current leading for directional over current unit & 30 lag for directional earth fault.

Other MTAs should be settable

Voltage polarizing coil: 63.5 or 110 volts

Must have faulty phase, type of fault identification

The directional relays shall have over voltage/ under voltage & under frequency built

in protection shall be draw out type.

Directional O/C & E/F PROTECTION

(A)Features:

a) Shall be Numerical type.
b) Shall have 2 over current and 1 Earth Faultelement.
c) TRUE RMSMeasurement.
d) Have selectable and front panel programmable normal inverse, very inverse, extremely inverse & long inverse IEC/ANSICharacteristic.
e) Selectable CT Secondary. I.e. 1A /5A
f) High set over current with selectable timedelay.
g) High set Earth fault with selectable timedelay
h) Have adjustable characteristic angle, lead/ lag, for Directional over current/ Earth Faultrespectively.
i) Shall decide directionality by internally derived zero sequence quantity throughsoftware.
j) Shall have in built Breaker FailureProtection.
k) Include hand reset Flag/LED indicators forfault.
l) Readable Human Machine Interface with LCDdisplay.
m) Should be able to store at least last 3 fault records viz. Fault current, Faulty Phase etc. withtime-stamp.
n) Shall have Disturbance Recording facility for minimum 3 sec for eachfault.
o) Self-monitoring.
p) Relay offered shall be communicabletype.
q) Be supplied along with all suitable **Original Customized licensed software & communicationcable**forlocalandremotecommunications,analysiso ffaultetc.

(B)TechnicalParameters:

1. Analogueinput:
   Rated Current: 1A / 5A (site selectable), 50 Hz ±2.5 Hz Power consumption: <0.05VA/0.3 VA for 1/5 Amp
   Over load capability: 4xIn continuous 100xIn 1 Sec. 25xIn 3 Sec. 250xIn Dynamic Rated Voltage: 110/63.5V, 50 Hz ±2.5 Hz
   Power consumption: <0.3 VA per phase Over load capability: 2xVn continuous
2. Auxiliary Supply: 110/220 V DC ±15%
   Power consumption: < 15W Ripple (peak to peak): < 12%

8.16.0 TRIP CIRCUIT SUPERVISIONRELAY

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

and be provided with operation indications for eachphase.

8.17.0 MASTER TRIPRELAY

8.17.1 High Speed Tripping Relay shall be instantaneous (operating time not to exceed 10milli-seconds
8.17.2 The relays shall reset within 20 milliseconds
8.17.3 The relay shall be re-settable/configurable from localSCADA.
8.17.4 The relays shall be D.C.operated
8.17.5 The relays shall have adequate contacts to meet the requirement of scheme, other functions like auto- reclose relay, LBB relay as well as cater to associated equipment like event logger, Disturbance recorder, fault Locator,etc.
8.17.6 The relays shall be provided with operation indicators for eachelement/coil.

8.18.0 DC SUPPLY SUPERVISIONRELAY

8.18.1 The relay shall be capable of monitoring the failure of D.C. supply to which, it isconnected.
8.18.2 It shall have adequate potential free contacts to meet the schemerequirement.
8.18.3 The relay shall have a 'time delay on drop-off' of not less than 100 milli secondsand
8.18.4 The relays shall be provided with operationindicator/flag.

8.19.0 TIME SYNCHRONISATIONEQUIPMENT

8.19.1 The Time synchronisation equipment shall receive the coordinated Universal Time (UTC) transmitted through Geo Positioning Satellite System (GPS) and synchronise equipment to the Indian Standard Time in asubstation.
8.19.2 Time synchronisation equipment shall include antenna, all special cables and processing equipment etc.
8.19.3 It shall be compatible for synchronisation of Event Loggers, Disturbance recorders and SCADA at a substation through individual port or through Ethernet realised through optic fibrebus.
8.19.4 Equipment shall operate up to the ambient temperature of 50 degree centigrade and 100%humidity
8.19.5 The synchronisation equipment shall have 2 micro second accuracy. Equipment shall give real time corresponding to IST (taking into consideration all factors like voltage, & temperaturevariations,
propagation & processing delays etc.) Including communication time for satellite link to achieve real time signal.
8.19.6 Equipment shall meet the requirement of IEC 60255 for storage &operation.
8.19.7 The system shall be able to track the satellites to ensure no interruption of synchronisationsignal.
8.19.8 The output signal from each port shall be programmable at site for either one hour, half hour, minute or second pulse, as perrequirement.
8.19.9 The equipment offered shall have six (6) output ports. Various combinations of output ports shall be selected by the customer, during detailed engineering, from thefollowing:

8.19.10 1) Voltage signal: Normally 0-5V with 50 milli Seconds minimum pulse duration. In case any other voltage signal required, it shall be decided during detailedengineering.
2)Potential free contact (Minimum pulse duration of 50 milliSeconds.)
3)IRIG-B
4)RS232C
8.19.11 The equipment shall have a periodic time correction facility of one-secondperiodicity.

8.19.12 Time synchronisation equipment shall be suitable to operate from 80V-250V DC supply available at the sub-station with voltage variation of + 10% and-15%.

8.19.13 Equipment shall have real time digital display in hour, minute, second (24-hour mode) & have a separate time display unit to be mounted on the top of control panels having display size of approx. 100 Mmheight.

8.19.14 The cable connecting Antenna and Time Synchronising unit should be run through HDPE pipe or GI Pipe from the location of Antenna fixing to Time Synchronising panel with suitable fixtures and no provision to enter rainwater and should not be affected by atmosphericconditions.

8.19.15 The equipment shall also have real time display in hour, minute, second, mili seconds. (24 hours mode) and shall have a separate time display unit to be mounted on the top of control panels having display size of approximately 144 mm height. The equipment shall have periodic time correction facility of 1(one) secondperiodicity.

8.20.0 PROTECTION SCHEME FORPANELS

8.20.1 132 kV LINEPANEL

The following protections scheme shall be provided for Panels for 132 kV Transmission lines:

a) Main Protection Scheme:

Distance protection scheme/Line Differential protection scheme using Numerical Relay as specified in ***Clause 8.14.0***.

The complete scheme shall have following features

I. Permissive under reach transfer tripprinciple.
II. Suitable for single cum three phasetripping.
III. Power swingblocking.
IV. Single shot single-cum-three phase/three phase auto re-closing with check synchronising and dead line chargingfeatures.
V. Fuse failureprotection.

b) BackupProtection:

The backup protection shall be provided with directional single/ multi pole relays as specified in ***Clause 8.15.0***

One triple pole over current relays for phase faults and one Earth Fault Relay for Earth Faults without high set elements shall be provided.

8.21.0 RELAY TESTING SETS & MAINTENANCE TOOLKIT

8.21.1 TESTING SET

8.21.1.1 The bidder shall supply one set of testing set (if specified in the Schedule of Quantity) for dynamic and statictestingofalltherelays,theyintendtosupply.Thetestingsetsalongwithliteratureandb rochure
are to be dispatched to the departmental commissioning authority, Office of the Superintending Engineer, MRT Circle, AEGCL, Narengi, Guwahati - 781026.

8.21.2 The equipment shall be supplied from reputed manufacturer. It should be got approved before inspection. Standard acceptable makes are Freja / Omicron / Doble / MPRT / Manta /EUROSMC
/KOCOS. It shall have provision for energy meter testing capability.

8.21.3 The testing set shall be microprocessor based. It shall have provision for energy meter testing capability. Necessary software, test leads, leads for lap top interface shall be included with the testingset.

8.21.4 The relay testing set shall have Ethernet/ USB interface with Work station/ Laptop

8.22.0 MAINTENANCE TOOLKIT

8.22.1 The bidder shall supply (if specified in the Schedule of Quantity) a complete

maintenance tool kit along with the testing set. The tool kit shall have current jack, card extender, card puller, required crimping tool, screw drivers, pliersetc.

8.22.2 The tool kit shall contain test plugs, test leads, clips for maintenance and testing of relayssupplied.

8.23.0 TESTS

8.23.1 The CONTRACTOR shall carryout all tests as per relevant standards as all associated equipment including relays, meters, instruments etc. The CONTRACTOR shall submit all that reports to Employer for approval before dispatching the control and relay panels. The Bidder shall also submit along with the bid type test reports for relays instruments, meters and other devices of the type and class being offered. Bidder has to submit KEMA test certificate for Numeric relay on interoperability compliance of IEC61850ingeneralandGOOSEmessagingandpublishinginparticularalongwiththebid.

8.23.2 Control and relay panels shall be subjected to the followingtests:

a. Mechanical operation test.
b. Verification of degree ofprotection.
c. High voltage test (2000 volts for 1minute)
d. Electrical control interlock and sequential operationtest.
e. Verification of wiring as per approvedschematic.
f. Interoperability test as per IEC 61850 (interoperability with ABB, AREVA, SIEMENS, GE andSEL)

8.24.0 PRE-COMMISSIONINGTESTS

8.24.1 The contractor shall have to perform following minimum Pre-commissioning tests for commissioning of the C&R panels. For this purpose, the contractor shall arrange all required tools and testing equipment at site:

- IR values of all circuits
- Measurement of burden in CT & PTcircuits.
- Primary current injection of CT circuits with connectedburden
- Energization of PTs at suitable low voltage and measurement of PT inputs at all measuring points
- Secondary ac current injection of relays, dynamic testing of all numeric relays. Tracing of zone curves, limits. Checking of relay timings, inherent or set values. For this testing, the contractor shall bring ‘Omicron’ or equivalent testkit.
- Testing of voltage related elements like directional element, over fluxing, over/ under frequency, over/ under voltage features, tracing of curves and checking limits of set values and associatedtimings
- Checking of Boolean logic gates, BI/BO points of the numeric relays, checking conformity to specification and checking of setlogics
- Checking of stability and sensitivity of differential zones by suitably applying 3-phase low voltages and shorting of primary circuits. Measurements of voltage and current inputs to all relays.
- Checking stability & sensitivity of bus differential relay zones by suitably injectingcurrent
- Checking registration of event and disturbance records in the numeric relays and down loading
- Testing of ARschemes
- Checking of healthiness of each dc circuit ofpanels
- Simulation of faults like Buchholz, OTI, WTI and other relays and checking of tripping of breaker and connectedannunciation
- Operation of master trip relays, tripping of breaker through each trip coil

and checking of interlocks

- Simulation of faults like low gas, air pressure and checking operation of inter locks. Checking anti pumping scheme ofCB
- Simulation to Check Checking of PT selectionschemes
- Simulation to Check interlocks of all CB and isolator interlocks
- Simulation to Check annunciation of all events in BCU (Bay control unit) as well as SAS (Sub-station AutomationSystem)
- Simulation to Check of logic ofBCU

8.24.2 The pre-commissioning checklist will be further developed by the contractor and will seek approval prior to commencement of pre-commissioning tests from the DGM, MRT Circle. The tests will be witnessed and approved by him or by his authorizedofficers.

8.25.0 TECHNICAL DATA SHEET FOR THE RELAY AND CONTROLPANELS

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

Sl. No.	Item	Rating & Particulars
1	**Protection &relays : (for 132 V Panel with single Bus system) : 132 kV LINE PANEL (with automation)**	
	(a) Distance protection scheme as per clause 8.14.0.	1 No
	(b) Back up directional over current and earth fault scheme as per Clause 3.9.13.30	1 No
	(a) LBB Protection Scheme.	Can be a function of BCU/IEDs
	(b) Trip Circuit Supervision Relay for pre and post-closing	Supervision for 2(two) trip coils
	(c) DC Supply healthy monitoring scheme	1 No
	(d) AC Supply healthy monitoring scheme	1 No
	(e) High Speed Trip relay	2 Nos.
	(f) Auxiliary relay, timer relay for healthiness of relays, trip transfer, auto reclose communication link etc.	As required (Can be function of BCU)
	(g) Line CVT-Bus PT selection relay	1 No
	(h) Synchronising Scheme	1 No (Can be function of BCU)
2	(i) Meters	
	(a) ABT compliant tri-vector Meter as per Clause 8.12.0	1 No
3	Control/Status indication/annunciation	

	(a) Bay Control Unit (IED with HMI)	1 No (Function of BCU/SAS)
	(c) Ethernet switch for connecting to existing ring LAN of SAS	1 No

SECTION-9
TECHNICAL SPECIFICATION FOR SUBSTATION AUTOMATION SYSTEM

9.1.0 General

9.1.1 The new bay shall have the provision to integrate with the existing Substation Automation System which is under implementation at 132kV **Bilasipara** S/S to control and monitor all the equipment(s) of the new line bay from remote control centre as well as from local controlcentre.

9.1.2 Bay level intelligent electronic devices (IED) for protection and control and the Managed Ethernet Switch shall be provided in the C&R panels installed in the local control room. Each IED will be directly connected to the Hot-standby Server PC (HMI) of the Sub-Station Automation System through a Double Fault Tolerant Ethernet LAN on fibre optic medium and shall communicate as per the IEC61850 standard.

9.1.3 The bay level intelligent electronic devices (IED) for protection and control shall provide the direct connection to the switchgear without the need of interposing components and perform control, protection, and monitoringfunctions.

9.1.4 All the numerical IEDs must be fully IEC 61850 compliant and must have the followingfeatures.

- Have peer-to-peer communication using GOOSE messages (IEC 61850) for interlocking.
- Should be interoperable with third party IEC 61850 compliantdevices
- Should generate XML file for integration/engineering with vendor independent SCADA systems.
- **Should be directly connected to the inter bay bus on IEC 61850 without the use of any gateways.** Connections of bay protection IEDs to the IEC 61850 bus through the bay control units is notacceptable.

9.2.0 Bay Level Unit / Bay ControlUnit

9.2.1 The bay unit shall use industrial grade components. The bay level unit, based on microprocessor technology, shall use numerical techniques for the calculation and evaluation of externally input analogue signals. These shall incorporate select-before-operate control principles as safety measures for operation via the HMI. These shall perform all bay related functions, such as control commands, bay interlocking, data acquisition, data storage, event recording and shall provide inputs for status indication and outputs for commands. These shall be directly connected to the switchgear. The bay unit shall acquire and process all data for the bay (Equipment status, fault indications, measured values, alarms etc.) and transmit these to the other devices in sub-station automation system. In addition, these shall receive the operation commands from station HMI and SLDC. The bay unit shall have the capability to store all the data for at least 24hours.

9.2.2 One Bay level unit shall be provided for supervision and control of 132 kV OUTDOOR GIS bay (a bay comprises of one circuit breaker and associated disconnectors, earth switches and instrument transformer). The Bay level unit shall be equipped with analogue and binary inputs/outputs for handling the control, status monitoring and analogue measurement functions. All bay level interlocks are to be incorporated in the Bay level unit so as to permit control from the Bay level unit/ local bay mimic panel, with all bay interlocks in place, during maintenance and commissioning or in case of contingencies when the Station HMI is out ofservice.

9.2.3 The Bay level units shall be installed in the control and relay panels located in the controlroom.

9.2.4 The Bay level unit shall meet the requirements for withstanding electromagnetic interference according to relevant parts of IEC 61850. Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete systembreakdown.

9.3.0 Input / Output (I/O) modules

The I/O modules shall form a part of the bay level unit and shall provide coupling to the substation equipment. The I/O modules shall acquire all switchgear information (i.e. data coming directly from the switchgear or from switchgear interlocking devices) and transmit commands for operation of the switchgear.

The measured values of SF6 Gas Pressures, Operating Mechanism Pressures, WTIs, OTI etc. are received through transducers to Bay Level Unit

The digital inputs shall be acquired by exception with 1ms resolution. Contact bouncing in digital inputs shall not be assumed as change ofstate.

SECTION-10
TECHNICAL SPECIFICATION OF POWER AND CONTROL CABLES

10.1.0 GENERALREQUIREMENT

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

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

10.1.3 Cables shall be laid conforming to IS:1255.

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

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

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

10.1.6 Standardtechnicaldatasheetsforcablesizesuptoandincluding1100Vareenclosedat**Clause 10.3.0**. Cable sizes shall be offered /manufactured in accordance with parameters specified in standard technical data sheets. Technical data sheet for any other cores/sizes required during detailed engineering shall be separately offered for Employer's approval by thecontractor/supplier.

10.2.0 TECHNICALREQUIREMENTS

10.2.1 General

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

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

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

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

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

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

10.2.1.7 The cables shall have outer sheath of a material with an oxygen index of not less than 29 and a temperature index of not less than250°C.

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

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

10.2.1.10 Repaired cables shall not beaccepted.

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

10.2.2 XLPE PowerCables

The XLPE (90°C) insulated cables shall be of FR type, C1 category conforming to IS: 7098 (Part-I) and its amendments read along with this specification. The conductor shall be stranded aluminium circular/sector shaped and compacted. In multicore cables, the core shall be identified by red, yellow, blue and black coloured strips or colouring of insulation. A distinct inner sheath shall be provided in all multicore cables. For XLPE cables, the inner sheath shall be of extruded PVC of type ST-2 of IS: 5831. When armouring is specified for single core cables, the same shall consist of aluminium wires/strips. The outer sheath shall be extruded PVC of Type ST-2 of IS: 5831 for all XLPEcables.

10.2.3 PVC PowerCables

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

10.2.4 PVC ControlCables

10.2.4.1 ThePVC(70°C)insulatedcontrolcablesshallbeofFRtypeC1categoryconformingtoIS:1554(Part-1)and its amendments, read along with this specification. The conductor shall be stranded copper. The insulation shall be extruded PVC to type A of IS: 5831. A distinct inner sheath shall be provided in all cables whether armoured or not. The over sheath shall be extruded PVC to type ST-1 of IS: 5831 and shall be grey in colour.

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

10.3 DATA SHEET FOR CABLES

(A) Power Cables

Sl. No.	Description	3 ½ C 300mm$_2$	Other Power Cables	
			70 mm$_2$, 35 mm$_2$, 25mm$_2$, 16 mm$_2$	6 mm$_2$& 4mm$_2$
1	Applicable Standard	IS: 7098/PT-I &its referredstandards	IS: 1554/PT-I&its referred standards	
2	Type Designation	A2XWY	AYFY	AYWY
3	Rated Voltage(volts)	1100	1100	1100
4	Type & Category	FR & C1	FR & C1	FR & C1
5	Suitable for earthed or unearthed system	Suitable for both		
	Conductor			

6	a) Material	Stranded Aluminium as per IS : 8130		
	b) Grade	H 2 (Electrolytic grade)		
	c) Number of wires(No.)	As per IS 8130		
	d) Form of Conductor	Stranded compacted circular/sector shaped	Stranded compacted circular/sector shaped	Non-compacted Stranded circular
	e) Direction of lay of strandedlayers	Outermost layer shall be R.H lay & opposite in successive layers		
7	Insulation			
	a) Composition of insulation	Extruded XLPE as per IS-7098 Part(1)	Extruded PVC type A as per IS-5831	Extruded PVC type A as per IS-5831
	b) Thickness of insulation(mm)	As per applicable Standard		
8	Inner Sheath material	Extruded PVC type ST-2 as per IS-5831	Extruded PVC type ST-1 as per IS-5831	
9	Type and material of armour	Gal. Steel wire	Gal. Steel strip	Gal. Steel wire
10	Outer Sheath (PVC)	ST-1 & FR	ST-2 & FR	ST-2 & FR
11	Overall diameter of cable	As per applicable Standard		

SECTION-11
TECHNICAL SPECIFICATION OF COUPLING CACPACITOR WITH POTENTIAL DEVICE (CVT)

11.1.0 GENERAL

11.1.1 The coupling capacitors shall conform to the following electricalcharacteristics:-

A	Nominalsystemvoltage	132KV
B	Maximumsystemvoltage	145KV
C	Ratedpowerfrequency	50Hz
D	One minute power frequencywithstandtest 275KV voltage	
E	Impulse withstand test voltagewithstandard V (1.2/50/us fullwave	650K
F	Ratedcapacity	4400pF
G	Maximum loss factor at power frequency andrated voltage	0.5%

11.1.2 Coupling capacitors shall be suitable for use with PLC system having frequency range from 80 to 450 KHZ.

11.1.3 The coupling capacitors are required with suitable potential device. The potential device and coupling capacitor will form one unit and the coupling capacitor will be mounted on the top of the potential device. The primary of the potential device shall be connected to tap on the coupling capacitor corresponding to 20/√3kV.

Two secondary windings shall be offered by the Bidder with output of 110/ √3 V. The output of each secondary winding shall be 100 VA. Accuracy class shall be 0.2 and 3P for Winding-I and Winding-II respectively.

Section-12
Technical specification of Battery Bank and Charger

12.1.0. SCOPE

12.1.1. This Section of the Specification covers the design, manufacture, andtesting at manufacturer's work, of stationary type sealed, Valve Regulated Lead Acid Battery Bank, Dual FCBC Battery Charger, DC Distribution Boards and LTAC Panels complete with all required accessories for various Sub-stations.

12.2.0. BATTERY BANK

12.2.1. TYPE AND RATING

A. For Substation with highest voltage of 145 kV (if not specifically mentioned inthe Schedule of Quantities)

For 220 KV, 132 KV & 66 KV sub-stations, DC System shall consist of One (1) float cum-boost charger and one (1) battery set for 220V system. DC scheme shall consists of one (1) battery

i) Stationary type, sealed, valve regulated lead acid battery tank suitable for operation on 110 Volts D.C. system to meet loads like emergency lightning, control and signaling circuits, relays, breaker operations, indicating circuits, etc. shall be required. The stationary battery shall comply with the provisions of IEC 60896.

ii) The Ampere-hour capacity of the battery bank at 27°C at 10 hours discharge rateshall be 300 AH.

iii) The nominal voltage of the battery bank shall be 110 Volts D.C.

iv) The number of cells in a complete battery bank set shall be 55 plus 2 spares.

B. For Substation with highest voltage of 245 kV (if not specifically mentioned in the Schedule of Quantities)

(i). Stationary type, sealed, valve regulated lead acid battery tank suitable foroperation on 220 Volts D.C. system to meet loads like emergency lightning, controland signaling circuits, relays, breaker operations, indicating circuits, etc. shall berequired. The stationary battery shall comply with the provisions of IEC 60896.

(ii). The Ampere-hour capacity of the battery bank at 27°C at 10 hours discharge rate shall be 300 AH.

(iii). The nominal voltage of the battery bank shall be 220 Volts D.C.

(iv). The number of cells in a complete battery bank set shall be 110 plus 2 spares.

C. <u>48V Battery Bank</u>

i) Stationary type, sealed, valve regulated lead acid battery tank suitable for operation on 48 Volts D.C. system to meet loads like emergency lightning, control and signaling circuits, relays, breaker operations, indicating circuits, etc. shall be required. The

stationary battery shall comply with the provisions of IEC 896, Part 2 / ANSI T1.330.
ii) The Ampere-hour capacity of the battery bank at 27°C at 10 hours discharge rate shall be 150 AH.
iii) The nominal voltage of the battery bank shall be 48 Volts D.C.
iv) The number of cells in a complete battery bank set shall be 24 plus 2 spares.

12.2.2. PLATES

Positive plates shall be made of flat pasted type using lead-cadmium antimony alloyfor durability, high corrosion resistant, maintenance free, long life both in cyclic as wellas in, float applications.Negative plates shall be heavy duty, durable flat plate using lead calcium alloy pastedbox grid. Negative plates shall be designed to match the life of positive plates andcombination of negative and positive plates shall ensure long life, durability andtrouble-free operation of battery.PLC operated equipment should be deployed for preparation of paste to ensure consistency in paste quality. Conventional / manual type of paste preparation is notallowed.

12.2.3. CONTAINER AND LID

The containers and lids shall be made of a special grade polypropylene copolymerplastic material. They shall be sufficiently robust and not liable lo deformation underinternal operating pressures and within the temperature range naturally encountered,leak proof, non-absorbent and resistant to the acid with low water vapour permeability.

12.2.4. VENT PLUGS

Each cell shall be equipped with one-way safety valve with opening pressure of 5±1psi and closing pressure 4±1 psi. The vent plug shall be made with suitable grade offire retardant plastic material. Each valve opening shall be covered with flame barriercapable in preventing the ingress of flame into the cell interior when the valve opensand hydrogen / oxygen gas mixture is released.

12.2.5. SEPARATORS

Separator shall be made of spun glass, micro porous matrix and shall be resistant toSulphuric Acid. It shall be capable of keeping the entire electrolyte and shall beelectrically insulated. Sufficient separator overlap and PVC shield protection to top andbottom edges of the plates is to be provided to prevent short circuit formation betweenthe edges of adjacent plates.

12.2.6. CONNECTORS

The connectors shall be lead coated copper of suitable size to join the cells. Theconnectors shall be suitably designed and coated to withstand corrosion due tosulphuric acid. The coating should be adequate and tenacious. All the copper inter cellconnectors shall be provided with heal shrinkable sleeves except at the connectingpoints.

12.2.7. ELECTROLYTE:

The electrolyte shall be prepared from the battery grade Sulphuric Acid confirming toISS: 266. The batteries shall be supplied in factory filled and charged condition.

12.2.8. WATER

Water required for preparation of electrolyte shall conform to IS: I069.

12.2.9. PLATE CONNECTION

Lugs of plates of like polarity shall be connected by lead burning to a horizontal straphaving an upstanding terminal post adopted for connection to external circuit. Strapand post shall be caste with lead alloy. The positive and negative terminal posts shallbe clearly marked for unmistakable identification.

12.2.10. BOLTS AND NUTS

Nuts and Bolts for connecting the cells shall be of superior grade passivated Stainlesssteel.

12.2.11. TERMINALS

Terminals shall be of integral lead terminal with solid copper core with M6 threadingfor fastening. The junction between terminal posts and cover and between the coverand container shall be hermetically sealed.

12.2.12. BATTERY RACKS

Batteries shall be installed on MS racks to be supplied by the Contractor to fit in thebattery room. Racks/Trays shall be powder coated with anti-corrosive paint. Rack shallaccommodate 55/110 cells plus 2 spares. Racks/Tray shall be suitably treated beforepainting for protection against fungus growth and other harmful effects due to tropicalenvironment.

The colour of the supporting racks shall conform to shade 631 of IS: 5.

12.3.0. BATTERY CHARGING EQUIPMENTS

12.3.1. GENERAL DESCRIPTION

The battery charging equipment shall have two separate Boost-cum Trickle Chargersections. Each section shall have its own rectifier transformer, rectifier bridge and
other equipment so that each section can operate independent of each other. Thecharger-I shall normally be in float mode and will supply load while Charger-II remainsas hot standby. In case charger in boost mode, the Charger-II shall supply the normalload.

Each section of the battery chargers shall be capable of continuous operation at itsrated load in float charging mode, i.e. Float charging the associated Batteries at 2.13to 2.27 Volts per cell while supplying the DC load. The chargers shall also be capableof Boost charging the associated DC Battery at 2.28 to 2.32 volts per cell at thedesired rate.

Each charger section shall regulate the float/boost voltage in case of prescribedtemperature rise of battery as per manufacturer's recommendation to avoid thermalrunaway. Necessary temperature sensors shall be provided in mid location of batterybanks and shall be wired up to the respective charger for feedback control. Themanufacturer shall demonstrate this feature during testing of each charger.

12.3.2. OPERATION AND CONTROL

During normal operation of the one of the charger sections shall supply the normaldirect current requirements of the substation and the station battery shall be floatingon the other charger section. In the event of failure of A.C. supply or failure of the bothsections of the charger itself the battery shall come automatically across the loadwithout any interruption.Similarly in case of failure of any one section of the charger the DC load or the batteryas the case may be, shall come automatically change over to the healthy chargersection without any interruption.

All Battery Chargers shall be provided with facility for both automatic and manualcontrol of output voltage and current. A selector switch shall be provided for selectingthe mode of output voltage/current control, whether automatic or manual. When onautomatic control mode during Float charging, the Charger output voltage shall remainwithin +1% of the set value, for AC input voltage variation of +10%, frequency
variation of +5%, a combined voltage and frequency variation of +10%, and a DC loadvariation from zero to full load.All battery chargers shall have a constant voltage characteristic throughout the range(from zero to full load) at the floating value of the voltage so as to keep the battery fullycharged but without harmful overcharge.

All chargers shall have load limiters having drooping characteristic, which shall cause,when the voltage control is in automatic mode, a gradual lowering of the outputvoltage when the DC load current exceeds the Load limiter setting of the Charger. TheLoad-limiter characteristics shall be such that any sustained overload or short circuit inDC System shall not damage the Charger, nor shall it cause blowing of any of theCharger fuses. The Charger shall not trip on overload or external short circuit.Uniform and step less adjustments of voltage setting (in both manual and automaticmodes) shall be provided on the front of the Charger panel covering the entire floatcharging output range specified. Step less adjustments of the Load limiter setting shallalso be possible from 80% to 100% of the rated output current for charging mode.During Boost Charging, the Battery Charger shall operate on constant current mode(when automatic regulator is in service). It shall be possible to adjust the Boostcharging current continuously over a range of 50 to 100% of the rated output currentfor Boost charging mode.The Charger output voltage shall automatically go on rising, when it is operating onBoost mode, as the Battery charges up. For limiting the output voltage of the Charger,a potentiometer shall be provided on the front of the panel, whereby it shall bepossible to set the upper limit of this voltage anywhere in the output range specified
for Boost Charging mode.The Charger manufacturer may offer an arrangement in which the voltage settingdevice for Float charging mode is also used as output voltage limit setting device forBoost charging mode and the Load-limiter of Float charging mode is used as currentsetting device in boost charging mode.Suitable filter circuits shall be provided in all the chargers to limit the ripple content(Peak to Peak) in the output voltage to 1%, irrespective of the DC load level, whenthey are not connected to a Battery.

12.3.3. MCCB

All Battery Chargers shall have 2 Nos. MCCBs on the input side to receive cables fortwo charger sections. It shall be of P2 duty and suitable for continuous duty. MCCB'sshould have auxiliary contacts for annunciation.Rectifier TransformerThe rectifier transformer shall be continuously rated, dry air cooled (A.N) and of classF insulation type. The rating of the rectifier transformer shall have 10% overload
capacity.

12.3.5. Rectifier Assembly

The rectifier assembly shall be fully/half controlled bridge type and shall be designedto meet the duty as required by the respective Charger. The rectifier shall be providedwith heat sink having their own heat dissipation arrangements

with natural air cooling.Necessary surge protection devices and rectifier type fast acting HRC fuses shall beprovided in each arm of the rectifier connections.

12.3.6. Instruments

One AC voltmeter and one AC ammeter along with selector switches shall be providedfor each charger sections. One DC voltmeter and DC ammeter (with shunt) shall beprovided for all Charger sections. The instruments shall be flush type, dust proof andmoisture resistant. The instruments shall have easily accessible means for zeroadjustment. The instruments shall be of 1.5 accuracy class. In addition to the above acentre zero voltmeter with selector switch shall also be provided for each chargersections for testing purpose.

12.3.7. Air Break Switches

One DC output switch shall be provided in each charger sections. They shall be airbreak type suitable for 500 volts AC/ 250 DC. The contacts of the switches shall openand close with a snap action. The operating handle of the switch shall be fullyinsulated from circuit. `ON' and `OFF' position on the switch shall be clearly indicated.Rating of switches shall be suitable for their continuous load. Alternatively, MCCB's ofsuitable ratings shall also acceptable in place of Air Break Switch.

12.3.8. Fuses

All fuses shall be HRC Link type. Fuses shall be mounted on fuse carriers which are inturn mounted on fuse bases. Wherever it is not possible to mount fuses on carriers,fuses shall be directly mounted on plug-in type base. In such case one insulated fusepulling handle shall be supplied for each charger. Fuse rating shall be chosen by theBidder depending on the circuit requirement. All fuses in the chargers shall bemonitored. Fuse failure annunciation shall be provided on the failure of any fuse.

12.3.9. Blocking Diode

Blocking diode shall be provided in the positive pole of the output circuit of eachcharger to prevent current flow from the DC Battery into the Charger.

12.3.10. Annunciation System

Audio-visual indications through bright LEDs shall be provided in each Chargersections for the following abnormalities:

a) AC power failure

b) Rectifier/chargers fuse blown.

c) Over voltage across the battery when boost charging.

d) Abnormal voltage (High/Low)

e) Any other annunciation if required.

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

12.3.11. Charger Construction

The Chargers shall be indoor, floor-mounted, self-supporting sheet metal enclosedcubicle type. The Contractor shall supply all necessary base frames, anchor bolts andhardware. The Chargers shall be fabricated from 2.0mm cold rolled sheet steel andshall have folded type of construction. Removable gland plates for all cables and lugsfor power cables shall be supplied by the Contractor. The lugs for power cables shallbe made of electrolytic copper with tin coat. Power cable sizes shall be advised to the

Contractor at a later date for provision of suitable lugs and drilling of gland plates. TheCharger shall be tropicalised and vermin proof. Ventilation louvers, if provided shall bebacked with screens. All doors and covers shall be fitted with synthetic rubbergaskets. The chargers shall have hinged double leaf doors provided on front and onbackside for adequate access to the Charger's internals. All the charger cubicle doorsshall be properly earthed. The degree of protection of Charger enclosure shall be at

least IP-42 as per IS: 13947 Part I.All indicating instruments, control switches and indicating lamps shall be mounted onthe front side of the Charger.Each Charger shall be furnished completely wired upto power cable lugs and terminalblocks and ready for external connections. The control wiring shall be carried out withPVC insulated, 1.5 sq.mm. stranded copper wires. Control terminals shall be suitablefor connecting two wires, with 2.5 sq.mm stranded copper conductors. All terminalsshall be numbered for ease of connections and identification. Each wire shall bear aferrule or tag on each end for identification. At least 20% spare terminals shall beprovided for control circuits.The insulation of all circuits, except the low voltage electronic circuits shall withstandtest voltage of 2 KV AC for one minute. An air clearance of at least ten (10) mm shallbe maintained throughout for such circuits, right up to the terminal lugs. Whenever thisclearance is not available, the live parts shall be insulated or shrouded.

12.3.12. Painting

All sheet steel work shall be pre-treated, in tanks, in accordance with IS:6005.Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed bypickling with acid. After pickling, the parts shall be washed in running water. Thenthese shall be rinsed in slightly alkaline hot water and dried. The phosphate coatingshall be `Class-C' as specified in IS:6005. Welding shall not be done afterphosphating. The phosphating surfaces shall be rinsed and passivated prior toapplication of stoved leadoxide primer coating. After primer application, two coats offinishing synthetic enamel paint of shade-692 (smoke grey) of IS:5 shall be applied,unless required otherwise by the Employer. The inside of the chargers shall be glossywhite. Each coat of finishing synthetic enamel paint shall be properly staved. The paintthickness shall not be less than fifty (50) microns.

12.3.13. CHARGER RATING

Each charger section shall have the following ratings:

A) For 220 Volt DC System

(i). Input Voltage : 415+/- 10% volts three phase, 4 wire, 50 Hz A.C.

(ii). Output Voltage : 220 Volt (Nominal).

(iii). Output DC Current : 45 A

B) For 110 Volt DC System

(i). Input Voltage : 415+/- 10% volts three phase, 4 wire, 50 Hz A.C.

(ii). Output Voltage : 110 Volt (Nominal).

(iii). Output DC Current : 45 A

C) For 48 Volt DC System

(i). Input Voltage : 415+/- 10% volts three phase, 4 wire, 50 Hz A.C.

(ii). Output Voltage : 48 Volt (Nominal).

(iii). Output DC Current : 50 A

12.3.14. TESTS AND INSPECTION

The battery charger and all the components of the charger shall be routine testedaccordingly to their relevant standard. This shall include the following:

(a) Operational check for boost cum float charger.

(b) Input / Output test of the chargers.

(c) Performance test of the charger.

(d) Temperature rise test of the rectifier transformer.

(e) Power frequency H.V. test / Insulation tests.

The Contractor shall be required to demonstrate to the employer that the Chargersconform to the specification particularly regarding continuous rating, ripple free output,voltage regulation and load limiting characteristic, before despatch as well as afterinstallation at site. At site the following tests shall be carried out:

i) Insulation resistance test

ii) Checking of proper annunciation system operation.

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

Employer

(i) Switches.

(ii) Relays/MCCBs

(iii) Instruments.

(iv) DC fuses.

(v) SCR.

(vi) Diodes.

(vii) Condensers.

(viii) Potentiometers.

(ix) Semiconductor

(x) Annunciator.

(xi) Control wiring

(xii) Push button sand contactors

Makes of above equipment shall be subject to Employer's approval.

12.4.0. DC DISTRIBUTION BOARD

12.4.1. General Features ...

The D.C. distribution boards shall be indoor, floor mounting of self-supporting, sheetmetal clad, and cubicle type. The panels should be totally enclosed, dust tight andvermin proof and shall be made of 2.0 mm cold rolled sheet steel. The boards shall beprovided with double leaf hinged doors at the back. All doors and covers shall be fittedwith rubber gaskets. The doors shall be provided with locks and duplicated covers

12.4.2. Bus bars

The bus bars shall be of electrolytic copper of ample cross-section. The bus bars shallbe insulated from the structure by means of durable, non-hydroscopic, noncombustibleand non-tracking materials.

12.4.3. Detail Requirements

The 110/220 Volts D.C. distribution boards shall be provided with the following:

i. One mains failure alarm relay.

ii. One earth fault alarm relay.

iii. One 110/220 Volts D.C. bell to be operated by the mains failure alarm relay.

iv. One 110/220 Volts D.C. buzzer to be operated by the earth failure alarm relay.

v. One double pole air-break circuit breaker of 400 amp capacity with thermal overloadtripping arrangement to act as incoming breaker of the load bus.

vi. One 0-150/300 volts D.C. moving coil voltmeter to measure the bus-bar voltage.The display is to be in digital.

vii. One pilot lamp to indicate D.C. on conditions.

viii. 250 volts, double pole MCBs of following ratings for outgoing feeders.

a. 16 Amp, 6 Nos.(8 Nos. for 220 V system)

b. 32 Amp, 6 Nos. (8 Nos. for 220 V system).

c. 63 Amp, 2 Nos

ix. One terminal Board/block for all feeder outlets including cable glands.

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DC Distribution Board will have 2 sections, each
section will be fed from independent Battery charger.
Busbar rating 150 A for 48 V DC, 16 kA / for 1 SEC,
AL or Copper, IP 54 , 2 mm COLD ROLLED / 3 mm
HOT ROLLED

12.5.0. LTAC PANEL

12.5.1. General Arrangement

The 415 volts L.T.A.C. panels shall be indoor floor mountings sheet metal clad typecomprising of MCCBs and MCBs and bulbar chambers and equipped with circuits andequipment as specified. The different circuits shall be mounted above and below thebus bar chamber to form a suitable arrangement, except that the incomings will belocated at the front and mounted below the bus bar chamber. All equipment shall besuitable for the reception of the cables rising from the ground level. The switchboardsshall be so designed as to be readily extensible.

12.5.2. Bus bars

The phase and neutral bus bars shall be of high conductivity Aluminium of adequateuniform cross section. The bus bars shall be insulated from the structure by means ofdurable non-hygroscopic, non-combustible and non-tracking materials. Bulbar jointsshall be of bolted type.

12.5.3. Detail Requirements

The 415 Volts, L.T.A.C. Switchgears shall have two Bus Sections with followingcircuits and equipment:

a) INCOMING: Two numbers each fitted with following (for each Bus Section):

i. 630 Amp, Electrically operated, TPN MCCB and cable glands suitable for 4-coreP.V.C. cable labelled as 'INCOMING'.

ii. One Voltmeter with VSS.

iii. One Ammeter with ASS.

iv. One K.W.H. meter with connected C.T.

b) BUS COUPLER: One number fitted with following:

i. 630 Amp, TPN MCCB and cable glands suitable for 4-core P.V.C. cable labelled as'INCOMING'.

ii. One Ammeter with ASS.

c) OUTGOINGS: Each Bus Section shall have following numbers of MCCBs foroutgoing feeders:

i. One number 200 Amps T.P.N. MCCB.

ii. Two number 100 Amps TPN MCCB.

iii. Two numbers 63 Amps TPN MCCB.
iv. Two numbers 32 Amps TPN MCCB.
v. Three numbers 32 Amps SPN MCB.

12.5.4. Automatic AC Source Changeover

Automatic changeover between Incomer I and Incomer II is to be carried out duringthe failure of supply in any one of the incomers. After the restoration of the supply,system shall be restored to normal condition automatically. The requirement ofchangeover under various conditions are as below:

a) Under normal conditions i.e. when supply is available in both the incomers,incomers I & II of 415 V LTAC Panel shall be in closed condition and Bus Couplersbreaker shall be in open condition.

b) In case of failure of either of the sources, the incomer of that source shall trip andBus Coupler shall get closed. On restoration of supply, normal conditions describedabove are to be established automatically.

To avoid unnecessary operation of switchgear for momentary disturbances allchangeovers from one state to another shall be initiated after a time delay, after theconditions warranting such change has been detected.

Any devices required to achieve the requirements above shall deem to be included inthe scope of works.