BIDDING DOCUMENT

FOR

"Turnkey Construction of 02 Nos of 33kV Medical Bays, one each at 132kV Nalbari GSS and 132kV Kokrajhar GSS, AEGCL respectively"

FUND: "Deposit Scheme"

(E-Tender)

(VOL – II: Technical Specifications)

BID IDENTIFICATION NO:

AEGCL/MD/Tech-1059/Deposit/33KV Nalbari & 33KV Kokrajhar Medical Bay/2022/BID

ASSAM ELECTRICITY GRID CORPORATION LIMITED

Rs.1000

Section - 4

Technical Specification

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

4.1.0 SCOPE AND GENERAL TECHNICAL CONDITIONS

4.1.1 INTENT OF THE SPECIFICATION

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

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

4.1.1.1 SCOPE

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

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

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

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

  Note: All the SAS integration works should be carried out in presence of authorised O.E.M representative of existing SAS of GE make at Kokrajhar GSS. For Nalbari GSS, all the SAS integration works should be carried out in presence of any representative who have experience of SAS integration of existing SAS of ERL make.

- Any upgradation of hardware and software for above integration shall be in the scope of contractor including license upgradation (if any). The validity of the license upgraded should be minimum for 10years.

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

The bidder is required to fill up the BOQ/price schedule as given in the e-tendering portal.

4.1.2 SUPPLIER TO INFORM HIMSELF FULLY

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

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

4.1.3 SERVICE CONDITIONS

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

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

4.1.4 CONFORMITY WITH INDIAN ELECTRICITY RULES & OTHER LOCAL REGULATIONS:

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

4.1.5 STANDARDS

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

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

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

4.1.6 ENGINEERING DATA

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

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

4.1.7 DRAWINGS AND DOCUMENTS FOR APPROVAL

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

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

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

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

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

4.1.8 INSPECTION & INSPECTION CERTIFICATE

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

4.1.8.2 All routine and acceptance tests whether at the premises or work of, the Supplier or of any Sub-Supplier, the Supplier except where otherwise specified shall carry out such tests free of charge. Items such as labour, materials, electricity, fuel, water, stores apparatus and instruments as may be reasonably demanded

by the Purchaser/inspector or his authorized representative to carry out effectively such tests in accordance with the Contract shall be provided by the Supplier free of charge.

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

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

4.1.8.5 Tests

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

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

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

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

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

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

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

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

4.1.9 EMPLOYER'S SUPERVISION

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

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

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

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

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

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

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

4.1.10 GUARANTEED TECHNICAL PARTICULARS

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

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

4.1.11 PACKING

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

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

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

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

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

4.1.12 CONSTRUCTION TOOLS, EQUIPMENTS ETC.

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

4.1.13 MATERIALS HANDLING AND STORAGE

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

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

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

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

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

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

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

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

4.1.14 CONTRACTOR'S MATERIALS BROUGHT ON TO SITE

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

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

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

4.1.15 COMMISSIONING SPARES

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

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

4.2.0 SPECIFICATION FOR DESIGN AND FABRICATION OF SUBSTATION STEEL STRUCTURES

4.2.1 SCOPE

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

4.2.2 MATERIALS

4.2.2.1 Structural Steel

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

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

4.2.2.2 Bolts

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

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

Foundation Bolts shall conform to IS 5624.

Step bolts shall conform to IS 10238

4.2.2.3 Nuts

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

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

4.2.2.4 Washers

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

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

4.2.2.5 Galvanization

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

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

4.2.2.6 Other Materials

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

4.2.3 DESIGN PARAMETERS

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

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

4.2.3.2 Spans

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

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

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

b). All other Structures

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

4.2.4 Deviation Angle

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

4.2.5 Conductors and Shield Wires

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

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

	DESCRIPTION	ACSR 'MOOSE'	ACSR 'ZEBRA'	ACSR 'PANTHER'
1	Code name	MOOSE	ZEBRA	PANTHER
2	Number of strands & size	Al: 54/ 3.53 mm	Al: 54/ 3.18 mm	Al: 30/ 3.00 mm
		St: 7/ 3.53 mm	St: 7/ 3.18 mm	St: 7/ 3.00 mm
3	Overall diameter	35.05 MM	28.62 mm	21.00 mm
4	Breaking load	136.38 KN	130.32 kN	130.32 kN
5	Weight of conductor	2004 Kg/KM	1621 kg / km	974 kg / km
6	Co-efficient Of Linear Expansion	23x10-6 /0C	19.35x10-6 /0C	19.35x10-6 /0C
7	Number of strands			
	Steel 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	0.05552 ohm/km	0.06869 ohm/km	0.1400 ohm/km
11	Ultimate tensile strength	161.2 kN	130.32 kN	89.67 kN

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

4.2.6 DESIGN DRAWINGS

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

4.2.6.2 The structural drawings, Bill of materials and shop fabrication drawings for all the structures shall be submitted in four copies and will be finally approved by the Purchaser.
The fabrication shall be taken up from the approved shop drawings.
The overall responsibility of fabricating structure members correctly lies with the Supplier only and the Supplier shall ensure that all the members can be fitted while erecting without any undue strain on them.

4.2.7 ACCESSORIES

4.2.7.1 Step Bolts

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

4.2.7.2 Insulator Strings and Conductor Clamps Attachments

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

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

4.2.7.3 Earth wire Clamps Attachment

i. **Suspension Clamp**

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

a) **Tension Clamps**

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

4.2.8 FABRICATION

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

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

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

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

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

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

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

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

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

4.2.9 Drilling and Punching

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

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

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

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

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

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

4.2.10 Erection mark

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

4.2.11 GALVANIZING AND PAINTING

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

4.2.11.2 All assembly bolts shall be thoroughly hot dip galvanised after threading. Threads shall be of a depth sufficient to allow for the galvanized coating, which must not be excessive at the root of the threads, so that

the nut shall turn easily on the completed bolts without excessive looseness. The nut threads shall not be galvanised, but oiled only.

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

4.2.12 EARTHING

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

4.2.13 TEST AND TEST CERTFICATE

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

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

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

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

4.2.14 TEST AT SUPPLIER'S PREMISES

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

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

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

4.3.0 TECHNICAL SPECIFICATION OF 132 KV and 33 KV OUTDOOR SF6 CIRCUIT BREAKERS

4.3.1. SCOPE

4.3.1.1 The intention of this Section of the Specification is to cover design, manufacture, testing at manufacturer's works and of 132KV and 33 KV Circuit Breakers with all fittings and accessories including mounting structures as specified hereunder.

4.3.2. GENERAL REQUIREMENTS

4.3.2.1. 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 & Lines.

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

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

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

4.3.2.5. 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.

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

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

4.3.3. OPERATING MECHANISM

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

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

4.3.3.3. Each mechanism shall have an operation counter.

4.3.3.4. The operating mechanism shall be mounted and enclosed in a weather proof, vermin-proof, sheet steel cabinet conforming to IP: 55 degrees of protection. Sheet steel thickness shall be as

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

4.3.3.5. 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.

4.3.3.6. Provision shall be made for two sources of DC. The change over from one source to other shall be performed through relay only.

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

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

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

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

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

4.3.3.12. 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.

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

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

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

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

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

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

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

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

4.3.4. OPERATING MECHANISM CONTROL

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

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

4.3.4.3. 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 Supplier.

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

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

4.3.4.6. Necessary platform with Ladder shall be provided for local operation/maintenance to ease out accessible reach.

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

4.3.5.0. SF6 GAS SYSTEM

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

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

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

4.3.5.4. In the interrupter assembly there shall be an absorbing product box to minimize 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 SF6 gas decomposition products.

4.3.5.5. Each pole shall form an enclosure filled with SF6 gas independent of two other poles (for 245 & 145 kV CBs) and the SF6 density of each pole shall be monitored. For CBs of voltage class of 36 kV, a common SF6 scheme/density monitor shall be acceptable.

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

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

4.3.6.0. BUSHINGS AND INSULATORS

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

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

4.3.6.3. Puncture strength of bushings shall be greater than the dry flashover value. When operating at normal voltage, there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of

substances produced by chemical action. No radio interference shall be caused by the bushings when operating at the normal rated voltage.

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

4.3.7. FIXED AND MOVING CONTACTS

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

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

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

4.3.8. INTERLOCKS

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

4.3.9. ADDITIONAL DUTY REQUIREMENTS

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

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

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

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

4.3.10.0. ACCESSORIES

4.3.10.1. **Gas Pressure Detector**

The circuit breaker shall be provided with gas pressure monitor with temperature compensation for initiating alarm and locking the operating mechanism in the event of abnormality. **Gas pressure monitor shall be provided for each pole individually for 132 kV Circuit Breakers.**

4.3.10.2. **Position Indicator**

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

4.3.10.3. **Terminals**

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

4.3.10.4

Auxiliary Switches

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

4.3.10.5. **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 spares.

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

a) Padlocks and duplicate keys.

b) Space heaters equipped with automatic thermostatic control.

c) Local/remote changeover switch.

d) Manually operated tripping push button/lever (mechanical) conveniently located to trip all three phases simultaneously.

e) Control switches to cut off control power supplies.

f) Fuses as required.

g) Two earthing terminals.

h) Auxiliary relays required for satisfactory operation.

i) Motor contactor with thermal release

j) Provision for mechanical interlock with isolator.

k) Readable wiring diagram shall be pasted inside the front cover of the operating mechanism box with indelible ink.

4.3.11. SUPPORT STRUCTURES

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

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

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

4.3.12. NAME PLATES

4.3.12.1. All equipment shall have non-corrosive name plates fix at a suitable position indelibly mark with full particular there on in accordance with the standard adapted. In addition to above, the location shall be engraved along with P.O. nos, date and year.

4.3.13. EARTHING

4.3.13.1. Two earthing pads shall be provided on each supporting structure. Each control cabinet or terminal box mounted on the supporting structure shall also be connected to an earthing pad.

Separately mounted control cabinets shall be provided with two earthing pads adjacent to the base of the cabinet. The earthing connection shall be bolted type and suitable for receiving 65mm x 12mm MS strip.

4.3.14. TERMINAL CONNECTORS

4.3.14.1. 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 Employer, as per installation requirement while approving the equipment drawings.

4.3.15. TESTS

4.3.15.1. All routine tests shall be carried out in accordance with relevant IS. All routine/acceptance tests shall be witnessed by the Employer/his authorised representative. The tests shall include the following:

a) **Routine/Acceptance Tests (all units)**
   - i) Mechanical Operation tests
   - ii) Power frequency voltage withstand test (dry)
   - ii) Tests on auxiliary & control circuits
   - iii) Measurement of resistance of the main circuit.

b) **Type Tests:**

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

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

c) **Special Tests**:

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

d) **Test Certificates**

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

i) Complete identification data, including serial No. of the breaker.

ii) Method of application, where applied, duration and interpretation of results in each test.

4.3.16. PRE-COMMISSIONING TESTS

4.3.16.1. Contractor shall carry out following tests as pre-commissioning tests. Contractor shall also perform any additional test based on specialties of the items as per the field instructions of the equipment Supplier or Employer without any extra cost to the Employer. The Contractor shall

arrange all instruments required for conducting these tests along with calibration certificates and shall furnish the list of instruments to the Employer for approval.

(a) Insulation resistance of each pole.

(b) Check adjustments, if any suggested by manufacturer.

(c) Breaker closing and opening time.

(d) Slow and Power closing operation and opening.

(e) Trip free and anti-pumping operation.

(f) Minimum pick-up voltage of coils.

(g) Dynamic Contact resistance measurement.

(h) Functional checking of control circuits interlocks, tripping through protective relays and auto reclose operation.

(i) Insulation resistance of control circuits, motor etc.

(j) Resistance of closing and tripping coils.

(k) SF6 gas leakage check.

(l) Dew Point Measurement

(m) Verification of pressure switches and gas density monitor.

(n) Checking of mechanical 'CLOSE' interlock, wherever applicable.

(o) Testing of grading capacitor.

(p) Resistance measurement of main circuit.

(q) Checking of operating mechanisms

(r) Check for annunciations in control room.

4.3.17. SPECIAL TOOLS AND TACKLES

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

4.3.18. TECHNICAL DATA SHEET FOR CIRCUIT BREAKER

Sl. No.	Particulars	Unit	Data for 132kV CB	Data for 33 kV CB
1	Type		SF_6	SF_6
2	No of poles		3	3
			(3 Phase Ganged Unit)	(3 Phase Ganged Unit)
3	Service		Outdoor	Outdoor
4	Rated System Voltage	kV	132	33
5	Highest System Voltage	kV	145	36
6	System earthing		Solidly earthed system	Solidly earthed system
7	Rated Voltage of Breaker	kV	145	36
8	Rated Continuous Current	Amps	3150	1250

9	Rated Frequency	Hz	50	50
10	Rated Short Circuit breaking current (I)	kA RMS	40	31.5
	- 3secs - symmetrical			
11	Rated Short Circuit making current	kA PEAK	2.5*I	2.5*I
12	Duty cycle		0-0.3 Sec - CO -3 Min -CO	0-0.3 Sec - CO -3 Min -CO
13	First pole to clear factor		1.3	1.3
14	Opening time			
	i) Opening Time	ms	Not exceeding	Not exceeding
			50 ms	≤35 ms
	ii) Closing Time	ms	Not exceeding	Not exceeding
			120 ms	≤75 ms
15	Insulation level			
	i) Power Frequency with Stand Voltage	kV RMS	275	70
	ii) Impulse withstand Voltage	kV Peak	650	170
16	Minimum clearance between phases	mm	1300	320
17	Minimum clearance between phase to earth	mm	1300	320
18	Minimum Ground clearance (from bottommost live part to plinth level)	mm	5000	4000
19	Minimum clearance from bottom of support insulator to plinth level	mm	2500	2500
20	Minimum Creepage Distance (Total) (31mm/kV)	mm	4495	1116
21	Arcing horn		No	No

22	Operating mechanism:			
	a) Type		Spring Charged	Spring Charged
	b) Rated 3 Phase, 50Hz Voltage forDrive Motor	V	415	415
	.c) Rated voltage of Shunt trip coil & operating range	V. DC	220 or110[50% - 110%]	220 or 110 [50% - 110%]
	d) Rated voltage of Closing coil & operating range	V. DC	220 or 132 [80% - 110%]	220 or 132 [80% - 110%]
	e) No. of trip coils	No	2 per CB	2 per CB
	f) No. of closing coils	No	1 per CB	1 per CB
	g) No of spare auxiliary contacts & contact rating	Nos	10 N/O+10 N/C	10 N/O+10 N/C (per CB)
		AMPS	(per CB)	10 A at 240V AC
			10 A at 240V AC	& 2A at 220V/ 110V DC
			& 2A at 220V/ 110V DC	
	h) Minimum thickness of sheet steel for control cabinet	mm	3	3
	i) Enclosure Protection		IP55	IP55
23	Reclosing		Three Phase	Three Phase
			auto reclosing	auto reclosing
24	Support structure		Galvanised	Galvanised
	(Painted / Galvanised)			
25	All other parts (Painted / Galvanised)		Synthetic enamel shade	Synthetic enamel shade

			631 of IS5	631 of IS5
			(125 microns)	(125 microns)
26	Minimum size of control wiring (Copper)	Sq. mm	2.5	2.5

4.4.0 TECHNICAL SPECIFICATION OF OUTDOOR CURRENT AND POTENTIAL TRANSFORMERS

4.4.1 SCOPE OF CONTRACT

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

4.4.2 STANDARDS

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

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

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

(i)	IS: 2705(Part-I)	Current transformers: General requirement.
(ii)	IS: 2705(Part-II)	Current transformers: Measuring Current transformers
(iii)	IS: 2705(Part-III)	Current transformers: Protective Current transformers
(iv)	IS: 2705(Part-IV)	Current transformers: Protective Current transformers for special purpose application.
(v)	IS: 3156(Part-I)	Potential transformers: General requirement.
(vi)	IS: 3156 (Part-II)	Potential transformers: Measuring Potential transformers
(vii)	IS: 3156 (Part-III)	Potential transformers: Protective Potential transformers

4.4.3 GENERAL REQUIREMENTS

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

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

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

4.4.3.4 The instrument transformers shall be completely filled with oil.

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

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

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

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

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

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

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

4.4.4 INSULATING OIL

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

4.4.5 COMMON MARSHALLING BOXES

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

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

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

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

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

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

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

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

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

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

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

i) Inside: Glossy White

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

4.4.6 BUSHINGS AND INSULATORS

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

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

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

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

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

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

4.4.7 TESTS

2.4.1.1 Routine/Acceptance Tests (all units)

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

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

2.4.1.4 Type test certificates so furnished shall not be older than 7 (seven) years as on date of Bid opening.

4.4.8 NAME PLATES

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

4.4.9 MOUNTING STRUCTURES

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

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

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

4.4.10 SAFETY EARTHING

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

4.4.11 TERMINAL CONNECTORS

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

4.4.12 TECHNICAL DATA SHEET FOR CURRENT AND POTENTIALTRANSFORMERS

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

4.4.12.2 TYPE AND RATING:

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

Item	**Ratings and Particulars**	
(A) Nominal system voltage	**132kV**	**33 kV**
(B) Highest system voltage, kV	145	36
(C) Rated frequency, HZ	50	50
(D) System earthing	Solidly earth	Solidly earth
(E) Insulation level		
(a) Impulse withstand voltage: kVp	550	170
(b) One-minute p.f. Withstand voltage, kV (r.m.s.)	230	70
(F) Short time current for one second, kA	31.5	20
(G) Minimum creepage distance, mm	As per ISS	As per ISS
(H) Temperature rise		
(I) Feeder/ BYPASS/ Bus Coupler CT		
(i) No. of Cores	3	2
(ii) Transformation Ratio	As per schedule of requirement	
(iii)Rated Output		
(a) Core-1	30 VA	30 VA
(b) Core-2	15 VA	15 VA
(c) Core-3		N.A
(iv) Accuracy Class		
(a) Core-1	0.2	0.2
(b) Core-2	5P	5P
(c) Core-3	PS	N.A
(v) Accuracy Limit Factor		
(a) Core-1	--	-
(b) Core-2	10	10
(c) Core-3	-	-
(vi) Instrument security factor		
(a) Core-1	<5	<5
(b) Core-2	-	-
(c) Core-3	-	-
(vii) Minimum Knee point voltage, Volts		
(a) Core-1	-	-
(b) Core-2	-	-
(c) Core-3	1200	-
(viii) Maximum secondary resistance, ohm		
(a) Core-1	-	-
(b) Core-2	-	-

(c) Core-3	3	N.A
(ix) Maximum exciting current, at Vk/4 mA		
(a) Core-1	-	-
(b) Core-2	-	-
(c) Core-3 (at Vk/4)	30	N.A
(J) Transformer CT		
(i) No. of Cores	3	2
(ii) Transformation Ratio	As per schedule of requirement	
(iii)Rated Output	3	3
(b) Core-1	30 VA	30 VA
(b) Core-2	15 VA	15 VA
(c) Core-3	-	-
(iv) Accuracy Class		
(a) Core-1	0.2	0.2
(b) Core-2	5P	5P
(c) Core-3	PS	PS
(v) Accuracy Limit Factor		
(a) Core-1	--	-
(b) Core-2	10	10
(c) Core-3	-	-
(vi) Instrument security factor		
(a) Core-1	<5	<5
(b) Core-2	-	-
(c) Core-3	-	-
(vii) Minimum Knee point voltage, Volts		
(a) Core-1	-	-
(b) Core-2	-	-
(c) Core-3	1200	600
(viii) Maximum secondary resistance, ohm		
(a) Core-1	-	-
(b) Core-2	-	-
(c) Core-3	3	3
(ix) Maximum exciting current, at Vk/4 mA		
(a) Core-1	-	-
(b) Core-2	-	-
(c) Core-3 (at Vk/4)	30	15
POTENTIAL TRANSFORMER		
(i) No. of secondary windings		2
(ii) Transformation ratio		
(a) Winding I	132kV/√3	33kV/√3
(b) Winding II	/ 110V/√3	/ 110V/√3
(iii) Rated out put		
(a) Winding I	500	200
(b) Winding II	200	100
(vi) Accuracy class		
(a) Winding I	0.2	0.2

(b) Winding II	3P	3P
(v) Rated voltage factor	1.2	1.2

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

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

4.5.0 TECHNICAL SPECIFICATION OF ISOLATORS

4.5.1 SCOPE

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

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

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

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

4.5.2 GENERAL

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

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

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

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

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

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

4.5.3 DUTY REQUIREMENTS

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

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

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

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

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

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

4.5.4 CONSTRUCTIONAL DETAILS

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

4.5.4.2 **Contacts:**

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

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

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

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

4.5.4.7 **Blades:**

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

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

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

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

4.5.4.12 **Insulators:**

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

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

4.5.4.15 **Base:**

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

4.5.5 EARTHING SWITCHES

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

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

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

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

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

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

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

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

4.5.6 OPERATING MECHANISM

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

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

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

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

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

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

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

4.5.7 OPERATION

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

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

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

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

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

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

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

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

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

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

4.5.8 TEST AND INSPECTION

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

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

viii.Mechanical and Electrical Endurance

4.5.8.2 The equipment shall be subjected to the following routine test.
(i)Power frequency voltage dry test
(ii)Measurement of resistance of the main circuit
(iii)Operating test.

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

4.5.9 AUXILIARY SWITCHES

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

4.5.10 CONNECTORS

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

4.5.11 MOUNTING STRUCTURES

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

4.5.12 TECHNICAL DATA SHEET FOR ISOLATORS

No.	Technical Particulars	Isolators class
		33 kV
1	Nominal system voltage, kV	33
2	Highest system voltage, kV	36
3	Rated frequency, Hz.	50
4.	Type of Isolator	Double Break, centre pole rotating
5	Rated continuous current, A	1250
6	Rated short time current, kA	25
7	Rated duration of short time current, (second)	1

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

4.6.0 TECHNICAL SPECIFICATION FOR SURGE ARRESTORS

4.6.1 SCOPE

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

4.6.2 STANDARDS

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

4.6.3 GENERAL REQUIREMENT

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

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

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

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

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

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

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

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

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

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

4.6.4 ARRESTOR HOUSING

4.6.4.1 The arrestor housing shall be made up of porcelain/***silicon polymeric*** housing and shall be homogenous, free from laminations, cavities and other flaws of imperfections that might affect the mechanical and dielectric quality. The housing shall be of uniform brown colour, free from blisters, burrs and other similar defects.

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

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

4.6.4.4 Sealed housings shall exhibit no measurable leakage.

4.6.5 FITTINGS & ACCESSORIES

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

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

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

4.6.6 SURGE MONITOR

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

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

4.6.7 TESTS

4.6.7.1 **Test on Surge Arrestors**

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

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

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

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

4.6.8 NAME PLATE

4.6.8.1 The name plate attached to the arrestor shall carry the following information:
Rated Voltage
Continuous Operation Voltage
Normal discharge current
Pressure relief rated current
Manufacturers Trade Mark
Name of Sub-station
Year of Manufacturer
Name of the manufacture
Purchase Order Number along with date

4.6.9 TECHNICAL DATA SHEET FOR SURGE ARRESTOR

	Particulars	**Voltage class**
		33 kV
1	Rated voltage of arrester, kV	30
2	Rated frequency, Hz	50 Hz
3	Nominal discharge current of arrester, kA	10
4	Maximum residual voltage at nominal discharge current, kV (peak)	108
5	Maximum steep current impulse residual voltage at kV (kVP)	120
6	One minute power frequency withstand voltage of arrester insulation, kV (rms)	70
7	1.2 / 50 □ second impulse withstand voltage of arrester insulation, kV (peak)	170
9	Line discharge class	2
10	**Insulator Housing**	
	Power frequency withstand test voltage(wet) (kV rms)	70
	Lightning impulse withstand tests voltage (KVp)	170
	Pressure Relief Class	40
	Creepage distance not less than (mm)	31mm/kV

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

SCOPE

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

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

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

STANDARDS

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

TYPE OF PANEL

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

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

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

Width: 800 mm to 1000 mm

CONSTRUCTIONAL FEATURES

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

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

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

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

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

MOUNTING OF EQUIPMENTS

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

INTERNAL WIRING

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

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

(a) All circuits except instrument transformers circuits:

(b) Instrument transformers circuit:

1.5 sq. mm. per lead.

2.5 sq. mm. per lead.

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

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

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

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

TERMINAL BLOCKS

All internal wiring to be connected to the external equipment shall terminate on terminal blocks, preferably vertically mounted on the side of each panel. Terminal blocks shall be of 650 volts grade and have 10 amps

continuous rating, moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Terminal block designs include a white fibre-marking strip with clear plastic/silicon chip on terminal covers. Marking on the terminal strips shall correspond to block and terminal number on the wiring diagram.

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

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

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

PAINTING

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

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

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

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

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

The inside of the panels shall be glossy white.

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

NAME PLATES AND MARKINGS

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

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

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

MISCELLANEOUS ACCESSORIES

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

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

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

EARTHING

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

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

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

Technical Specification for SAMAST Compliant Interface Energy Meter (IEM)

1. Interface Energy Meters Technical Specification

The specification covers the design, engineering, manufacturing, assembly and testing of static/electronic Interface Energy Meters) compliant Tri-vector type, Four Quadrant, Bi-Directional Energy Meter, suitable for 3-ph 4wire connections solidly earthed system with balanced and un-balanced loads for a power factor range from zero to unity (lagging & leading), with initial and sustained accuracy of class 0.2s. The energy metering system specified herein shall be used for tariff metering for bulk, inter-utility power flows. Projection mounted type, static composite meter shall be installed for EHV/HV circuit, as a self -contained device for measurement of active energy transmittals in each successive 15 minute or 5-minute block etc. meeting the ABT requirements. These meters shall be integrated in SAMAST framework as an when it goes live so the meter shall comply to SAMAST guidelines. The meter shall also be compatible for integration with SAS system. Necessary isolation and /or suppression shall also be built-in for protecting the meter from surges, voltage spikes, fault-current etc. that occurs in VT and CT circuits of extra high voltage switchyards.

2. Basic Features of Interface Energy Meters

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

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

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

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

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

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

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

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

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

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

between 5% to 70% of Vref and if Voltage is less than 5% of Vref, meter should record Zero voltage symbol "Z".

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

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

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

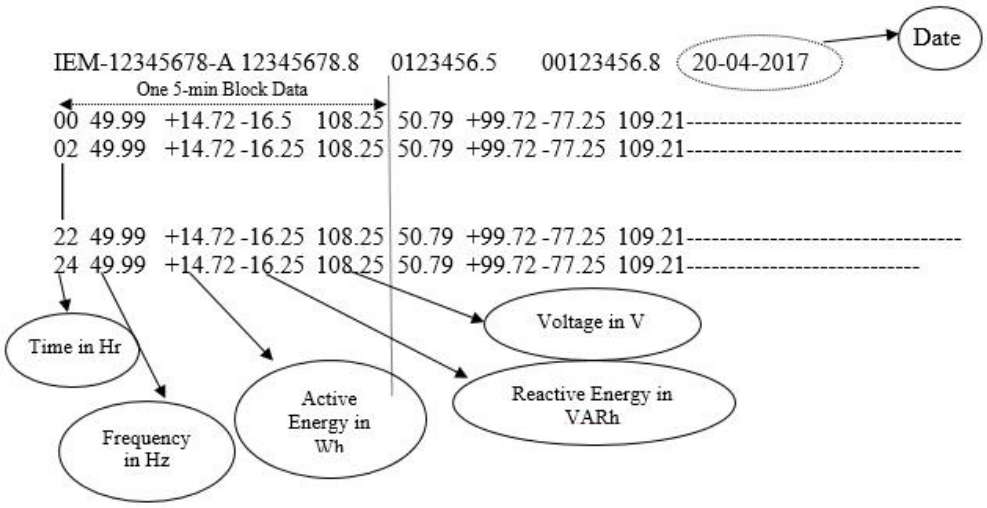

Figure 1: Standard Raw Data Format for IEM

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

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

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

o) **Constructional Features**

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

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

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

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

3. Measurement

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

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

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

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

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

f) The meter shall also integrate the reactive energy (VARh) algebraically into two separate registers, one for the period for which the average RMS voltage is above 103.0%, and the other for the period for which the average RMS voltage is below 97.0 %. The current reactive power (VAR), with a minus sign if negative, and cumulative reactive energy (VARh) readings of the two registers (>103% and <97%) shall be displayed on

demand. The readings of the two registers at each midnight shall also be stored in the meter's memory. When reactive power is being sent out from substation bus bars, VAR display shall have a plus sign or no sign and VARh registers shall move forward. When reactive power flow is in the reverse direction, VAR display shall have negative sign and VARh registers shall move backwards. Generally, the standard PT ratios are 220 kV /110 V, 400 kV /110 V and 765 kV / 110 V. However, at the time of commissioning the vendor may confirm the same from site and configure the meter accordingly to ensure correct recording of reactive energy.

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

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

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

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

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

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

4. Memory/ Storage

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

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

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

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

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

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

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

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

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

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

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

5. Display

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

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

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

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

iv. Cumulative Wh reading: 1234567.8 C

v. Average frequency of the previous block: 49.89 F

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

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

viii. Average % Voltage: 99.2 U

ix. Reactive power (VAR): 106.5 r

x. Voltage - high VARh register reading: 1234567.5 H

xi. Voltage - low VARh register reading: 1234567.4 L

xii. Low battery indication

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

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

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

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

6. Communication

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

USB shall be unidirectional only i.e., from Meter to external storage device in an authentication process. Meter data shall be tamper-proof.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

7. Quality Assurance

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

8. Testing

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

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

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

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

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

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

   iv. Compatibility with PC Software.

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

   vi. Per meter downloading time verification.

d) Copy of Certificate shall be submitted to SLDC

Type Tests

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

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

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

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

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

9. ANOMALY DETECTION FEATURES

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

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

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

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

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

CONTROL & RELAY PANELS

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

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

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

RELAYS

GENERAL

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

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

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

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

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

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

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

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

All relays shall withstand a test voltage of 2.5 kV, 50 Hz r.m.s. voltage for one second. All protective relays and alarm relays shall be provided with two extra isolated pair of contacts wired terminals exclusively for Employer's use.

GENERAL SPECIFICATION OF NUMERICAL RELAYS

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

Distance Protection (Main I¬ & Main II) of different make for 220 kV lines

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

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

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

Hardware based measurement shall not be acceptable.

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

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

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

Be capable of performing basic instrumentation functions and displaying various instantaneous parameters

like Voltage, current, active power, reactive power, phase sequence etc. in primary values. Additionally, all sequence current and voltage values shall be displayed on-line. Also, the direction of power flow shall be displayed.

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

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

Must have additional feature of local breaker back up protection

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

The relays shall have the following tools for fault diagnostics-

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

The relay shall have comprehensive self-diagnostic feature. This feature shall continuously monitor the healthiness of all the hardware and software elements of the relay. Any failure detected shall be annunciated through an output watchdog contact. The fault diagnosis information shall be displayed on the LCD. These records shall also be retrieved / retrievable from local as well as remote terminal through the communication port. The Numerical Relays shall be provided with 2 sets of common support software compatible with, Windows 7 which will allow easy settings of relays in addition to uploading of event, fault, disturbance records, and measurements. The relay settings shall also be change from local or remote using the same software**.**

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

INTEGRATED NUMERICAL TRANSFORMER PROTECTION RELAY

General requirements

a) Shall be stable during magnetising inrush and over fluxing conditions. Stabilization under inrush conditions shall be based on the presence of second harmonic components in the differential currents.
b) Shall have saturation discriminator as an additional safeguard for stability under through fault conditions.

c) Shall have zero sequence current filtering, which may be deactivated separately for each winding, for special applications.
d) Shall have software to take care of the angle & ratio correction of CT inputs.
e) Shall have all output relays suitable for both signals and trip duties

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

a) **Differential protection**

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

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

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

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

b) **Restricted Earth fault Protection**

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

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

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

c) **Over fluxing Protection**

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

d) **Thermal Overload Protection**

Shall have two stages of thermal overload protection for alarm and trip condition with continuously adjustable setting range of 100-400% of rated current and time constant setting range of 1.0 to 1000.0 min continuously. Shall be single pole type.

Shall have a drop off/pick up ratio greater than 95%
Shall have separately adjustable time delay relays for alarm having a setting range of 1to 10 seconds continuously.

e) **Over Current Protection**

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

OVER CURRENT AND EARTH FAULT RELAYS

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

TRIP CIRCUIT SUPERVISION RELAY

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

MASTER TRIP RELAY
High Speed Tripping Relay shall be instantaneous (operating time not to exceed 10 milli-seconds)
The relays shall reset within 20 milli seconds
The relay shall be re-settable/configurable from local SCADA.
The relays shall be D.C. operated

The relays shall have adequate contacts to meet the requirement of scheme, other functions like auto-reclose relay, LBB relay as well as cater to associated equipment like event logger, Disturbance recorder, fault Locator, etc.
The relays shall be provided with operation indicators for each element/coil.

OTHER TRIP RELAYS

For transformer protection other trip relays for Buchholz, winding & oil temperature high, PRD etc. shall be provided as per requirement.
These High-Speed Tripping Relays shall be instantaneous (operating time not to exceed 10 milli-seconds
The relays shall have adequate contacts to meet the requirement of scheme

DC SUPPLY SUPERVISION RELAY

The relay shall be capable of monitoring the failure of D.C. supply to which, it is connected.
It shall have adequate potential free contacts to meet the scheme requirement.
The relay shall have a 'time delay on drop-off' of not less than 100 milli seconds and
The relays shall be provided with operation indicator/flag.

PROTECTION SCHEME FOR PANELS
33 KV FEEDER PROTECTION PANEL

The 33 kV Feeder Panels shall be provided non directional single/ multi pole relays as specified One triple pole over current relay for phase faults and one Earth Fault Relay for Earth Faults with high set elements shall be provided.

POWER AND AUTO TRANSFORMER PROTECTION PANEL

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

(a) Main Protection

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

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

(b) Backup Protection

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

SWITCHES

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

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

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

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

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

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

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

TESTS

The supplier shall carryout all tests as per relevant standards as all associated equipment including relays, meters, instruments etc. The supplier shall submit all that reports to Employer for approval before 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 IEC 61850 in general and GOOSE messaging and publishing in particular along with the bid.

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

PRE-COMMISSIONING TESTS

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

(i). IR values of all circuits.
(ii). Measurement of burden in CT & PT circuits.
(iii). Primary current injection of CT circuits with connected burden

(iv). Energization of PTs at suitable low voltage and measurement of PT inputs at all measuring points
(v). Secondary ac current injection of relays, dynamic testing of all numeric relays. Tracing of zone curves, limits. Checking of relay timings, inherent or set values. For this testing, the contractor shall bring 'Omicron' or equivalent test kit.
(vi). Testing of voltage related elements like directional element, over fluxing, over/ under frequency, over/ under voltage features, tracing of curves and checking limits of set values and associated timings
(vii). Checking of Boolean logic gates, BI/BO points of the numeric relays, checking conformity to specification and checking of set logics
(viii). Checking of stability and sensitivity of differential zones by suitably applying 3-phase low voltages and shorting of primary circuits. Measurements of voltage and current inputs to all relays.
(ix). Checking stability & sensitivity of bus differential relay zones by suitably injecting current
(x). Primary injection of REF connected CTs, measurements of relay inputs and checking of stability and sensitivity of REF scheme
(xi). Checking registration of event and disturbance records in the numeric relays and downloading
(xii). Testing of carrier aided protection schemes and simulation with regard to transmission and receipt of protection signalling
(xiii). Testing of AR schemes.
(xiv). Checking of healthiness of each dc circuit of panels
(xv). Simulation of faults like Buchholz, OTI, WTI and other relays and checking of tripping of breaker and connected annunciation
(xvi). Operation of master trip relays, tripping of breaker through each trip coil and checking of inter locks
(xvii) Simulation of faults like low gas, air pressure and checking operation of inter locks. Checking anti umping scheme of CB.
(xviii). Simulation to Check Checking of PT selection schemes
(xix). Simulation to Check interlocks of all CB and isolator inter locks
(xx). Simulation to Check annunciation of all events in BCU (Bay control unit) as well as SAS (Substation automation System)
(xxi). Simulation to Check of logic of BCU.
(xxii). Operation of tap changing of transformer through SAS

TECHNICAL DATA SHEET FOR THE RELAY AND CONTROL PANELS

Features to be provided in various Relay and Control panels are indicated below.

Description below is only indicative; the Contractor shall ensure that all items are included in their off to complete the schemes described in the Specification whether such items are specifically mentioned or not.

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

2	**Control/Status indication/annunciation**	
	a) Bay Control Unit (IED with HMI)	1 No (Function of BCU/SAS)
	b) Ethernet switch for connecting to existing ring LAN of SAS	1 No

4.8.0 TECHNICAL SPECIFICATION OF XLPE INSULATED COPPER POWER & CONTROL CABLES

4.8.1 This technical specification intends to cover the following:

1. Technical specifications for design, engineering, manufacturing, inspection, testing at manufacturer's works, packaging and delivery by road (properly packed in non-returnable steel drums), various sizes of copper conductor, XLPE insulated, voltage upto and including 1100 Volts, extruded PVC inner sheathed, extruded FRLS PVC outer sheathed, GI round wire armoured cables, suitable for solidly grounded system. The cables shall confirm to IS 7098-Part 1 with latest amendments. For cable list referTable-1.

2. Technical specifications for design, engineering, manufacturing, inspection, testing at manufacturer's works, packaging and delivery by road (properly packed in non-returnable steel drums), 6.35/11 kV (Uo/U) Voltage Grade, 3-Core, 185 Sq. mm Stranded Compacted Circular Shaped Aluminium Conductor of H4 Grade, shielded with extruded Semi-conducting compound, XLPE insulated, PVC sheathed, GI Round wire armoured Power and Control Cables for effectively grounded system. The cable shall confirm to the latest revisions of IS: 7098 (Part –2). For cable list refer Table-1.

Note:

1. Tenders will only be considered from the cable manufacturers and any one supplier to whom manufacturer can authorize. The bidder shall have adequate experience of at least 5 years in manufacturing of LT/MV & HT cables.
2. Copper samples from the finished cable drums shall be tested at any 3rd party NABL accredited lab to ensure its purity.
3. The following document shall be attached with technical part of the bid:

i. Duly filled & Signed copy of Annexure-1,2 and 3

ii. Deviation sheet, if any

Table 1

Sl. no	Power Cable
1	4C X 6 sqmm
2	2CX4 sqmm
	Control Cable
3	2C, 2.5 sq mm
4	4C, 2.5 sq mm
5	5C, 2.5 sq mm
6	7C, 2.5 sq mm
7	10 C, 2.5 sq mm
8	14 C, 2.5 sqmm
9	19 C,2.5 sqmm
10	27C,2.5 sqmm

4.8.2 Technical Specifications for 1.1 kV grade, Copper conductor, Power and Control cables

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

4.8.3 STANDARDS

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

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

4.8.4 SERVICE CONDITION

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

4.8.5. DESIGN AND CONSTRUCTION PERTICULARS

4.8.5.1. General

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

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

4.8.5.2. Technical parameters

i.	Quantity	Refer Table-1
ii.	Packaging	Steel drum packaging, each having single length cable ≥ 500 meters
iii.	Cable Type	2XWY (refer Table-1 for details)
iv.	No. of Cores	Shall be decided during detailed engineering (Cable sizing calculation)
v.	Voltage Level	1.1Kv

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

4.8.6. Conductor

4.8.6.1. COPPER

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

4.8.6.2. Cable Joints

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

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

4.8.7. Insulation

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

3-Core - Red, Yellow & Blue

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

4.8.8. Inner Sheath

The inner sheath shall be extruded FRLS PVC, Type ST2, compatible with thermal rating of insulation conforming to IS-6380-1984. The sheath shall have adequate thickness, mechanical strength and elasticity, as specified in IS 5831. The material shall be soft thermoplastic type, applied by extrusion method. The thickness of the inner sheath shall be as per IS: 7098 (Part I) and the color of the inner

sheath shall be Grey. The inner sheath shall be so formed that it fits closely on the laid up cores and could be easily removed without damaging insulation. One or more layer of proofed plastic tape shall be provided over the laid-up core before extrusion.

4.8.9. Armouring

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

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

4.8.10. Outer Sheath

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

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

3.7.0 TESTS

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

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

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

3.7.4. Pre-Dispatch Inspection

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

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

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

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

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

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

3.7.10. Type Test

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

a. Test on Conductor

Annealing test for copper conductors
Tensile test for aluminium conductor
Wrapping test for aluminium conductor
Conductor Resistance Test

c) Test on Insulation

Physical dimension measurement
Tensile strength and elongation at break
Hot set test
Shrinkage test
Ageing in air oven
Water absorption test

d) Test on round Armour

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

e) Test on Sheath

Physical dimension measurement
Tensile strength & Elongation at break test
Ageing in air oven
Loss of mass in air oven
Shrinkage test
Hot deformation test
Heat shock test
Thermal stability test

f) Insulation Resistance Test
g) High Voltage Test at room temperature
h) Volume resistivity at room temperature & at 90^{o} C. (IS-10810-Part 43)
i) Flammability test

j) *Test requirement of FRLS inner and outer sheath*

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

ii Flame retardant test on single cable.

- Oxygen Index Test

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

h. Temperature index test

Temperature index value shall be minimum 250ºC at oxygen index of 21 when tested as per NES 715.

d) Flammability test

d) Smoke Density Test

The cables shall satisfy the tests conducted to evaluate the percentage obscuration by smoke in an optical system placed in the path of the smoke. The maximum smoke density rating shall not be more than 60% when tested as per ASTM-D-2843.

- Acid Gas Generation test (halogen acid gas evolution)

The hydrochloric acid generation when tested as per IEC 754-1 shall be less than 20% by weight.

- Test for specific optical density of smoke
- Anti termite and rodent property test

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

3.7.11. Routine Test (On each drum)

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

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

3.7.12. Conductor purity test

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

Qualifying Criteria:

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

3.8.0. IDENTIFICATION

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

a. Reference to Indian Standard
b. Name of the manufacturer/ Trade Name
c. Name of the project:

d. Configuration of the cable: viz. Voltage grade, no. of Core, Sq. mm, A2XWY/2XWY/YWY / YY as applicable

e. Year of manufacturing

f. Sequential marking of running meter length

The running length of the cable shall be identified at regular intervals of one meter

(Increasing order from inner end to outer end of the cable)

3.9.0 PACKAGING

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

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

3.10.0 PREFERRED MAKE

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

Preferred make of bought out material:

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

3.11.0. GUARANTEE

All the cables shall be guaranteed against faulty material, defective design & poor workmanship for a period of 60 months from the date of commissioning. The materials becoming defective during the guarantee period shall be replaced free of cost and the defects arising out of the works shall be rectified free of charge without delay.

Annexure - 1

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

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

Sl. No.	Particulars	Details
A	**Cores**	
1	No. of cores	
2	Nom Area of conductor in sq mm.	
3	Voltage Grade	
B	**Conductor**	
1	Standard Applicable	
2	Material Copper Grade	
3	Purity	
4	Nominal Cross Sectional Area	
5	Form of conductor/circular shaped	
6	No. of strands	
7	Nominal dia of each strand	
8	Temperature co-efficient of resistance at 20 degree celsius	
C	**Insulation**	
1	Standard Applicable	
2	Material (Mention Type)	
3	XLPE is cured by steam process or Gas process?	
4	Minimum Average Thickness	
5	Tolerance on the smallest of the measured values of thickness of Insulation	
6	Minimum volume resistivity at 27 deg cel	
7	Minimum volume resistivity at 70 deg cel	
8	Colour Scheme for identification of cores	
9	Average Dielectric Strength	
D	**Inner Sheath**	
1	Standard Applicable	
2	Material for inner sheath	
3	Minimum thickness of inner sheath	
4	Whether extruded	
E	**Armour**	

1	Standard Applicable	
2	Shape	
3	Size	
4	Material for Armour	
F	**Outer Sheath/Overall Covering**	
1	Standard Applicable	
2	Material (type)	
3	Whether extruded	
4	Minimum average thickness	
5	Whether anti-termite treatment has been given in the outer sheath	
6	Whether flame retardant low smoke compound added in the outer sheath	
G	**Electrical Properties**	
1	Maximum DC Resistance of conductor at 20 deg Celsius in ohms/km	
2	Maximum DC Resistance of amour at 20 deg Celsius in ohms/km	
3	Maximum Permissible conductor temperature	
	Under continuous full load	
	Under transient conditions	
4	Loss Tangent at normal frequency	
5	Reactance at maximum operating temperature 50 Hz (ohm/km)	
6	Capacitance at maximum operating temperature 50 Hz (ohm/km)	
7	Total Impedance at maximum operating temperature 50 Hz (ohm/km)	
8	Recommended continuous current rating	
	In Ground at 30 deg C Ground Temperature (A)	
	In Trench/Ducts at 40 deg C (A)	
	In Air at 40 deg C ambient Temperature (A)	
9	Short Ckt Current Rating for 1 sec duration (in KA)	
	Conductor	
	Armour	
10	Minimum volume Resistivity of insulation	
	At 27 °C in Ohm cm	
	At Max operating temperature in Ohm-cm	
11	Approximate AC resistance at max. Operating temperature	
	Phase	
	Neutral	

H	**Mechanical Data**	
1	Overall Dia of the cable	
2	Dia of the cable under the sheath	
3	Diameter under armour	
4	Diameter over the stranded cores	
5	Wight of cable per km.	
6	Drum length	
7	Tolerance on drum length	
8	Total weight of the drum	
9	Dimension of the drum	
10	Recommended minimum installation radius/ bending radius	
11	Maximum safe pulling force	
12	Whether identification as per clause of the specification is being provided	
13	Whether packing has been done as per clause of the specification	

Annexure – 2

Guaranteed and Other Technical Particulars

(Bidder shall furnish this Annexure duly filled up with the Technical Bid)

1.1 kV GRADE XLPE INSULATED POWER CABLES

SN	Description	Particulars
1	Name & add. of manufacturer	
2	Cable Sizes	
3	Manufacturer's type designation	
4	Applicable standard	
5	Rated Voltage(volts)	
6	Type & Category	
7	Suitable for earthed or unearthed system	
8	Continuous current rating when laid in air in a ambient temp. of 50°C and for maximum conductor temp. of 70 °C of PVC Cables (Amps)	
9	Rating factors applicable to the current ratings for various conditions of installation:	
10	Short circuit Capacity	
	a) Short Circuit Amp. (rms) KA for 1 sec duration	
	b) Conductor temp. allowed for the short circuit duty (deg C.)	
11	Conductor	
	a) Material	
	b) Grade	
	c) Cross Section area (Sq.mm.)	
	d) Number of wires (No.)	
	e) Form of Conductor	
	f) Direction of lay of stranded layers	
12	Conductor resistance (DC) at 20°C per km-maximum (Ohms)	
13	Insulation	
	a) Composition of insulation	
	b) Nominal thickness of insulation(mm)	
	c) Minimum thickness of insulation	
14	Inner Sheath	
	a) Material	

	b) Calculated diameter over the laid up cores,(mm)	
	c) Thickness of Sheath (minimum)mm	
15	Armour	
	a) Type and material of armour	
	b) Direction of armouring	
	c) Calculated diameter of cable over inner sheath (under armour), mm	
	d) Nominal diameter of round armour wire/strip	
	e) Number of armour wires/strips	
	f) DC resistance at 20^{o}C (Ω/Km)	
16	Outer Sheath	
	a) Material (PVC Type)	
	b) Calculated diameter under the sheath	
	c) Min.thickness of sheath(mm)	
	d) Guaranteed value of minimum oxygen index of outer sheath at 27^{o}C	
	e) Guranteed value of minimum temperature index at 21 oxygen index	
	f) Colour of sheath	
17	a) Overall diameter of cable	
	b) Tolerance on overall diameter (mm)	
18	Cable Drums	
	a) Max./ Standard length per drum for each size of cable (single length) with ±5% Tolerance (mtrs)	
	b) Non-standard drum lengths	
	c) Type & Standard for sealing of cable ends	
19	Whether progressive sequential marking on outer sheath provided	
20	Identification of cores	
	a) colour of cores	
	b) Numbering	
21	Whether Cables offered are ISI marked	
22	Whether Cables offered are suitable for laying as per IS 1255	

Annexure – 3

Guaranteed and Other Technical Particulars

(Bidder shall furnish this Annexure duly filled up with the Technical Bid)

1.1 kV GRADE XLPE INSULATED CONTROL CABLES

SN	Description	Particulars
1	Name & Add. of manufacturer	
2	Cable Sizes	
3	Manufacturer's type designation	
4	Rated Voltage(volts)	
5	Continuous current rating when laid in air in a ambient temp. of 50°C and for maximum conductor temp. of 70°C of PVC Cables (Amps)	
6	Rating factors applicable to the current ratings for various conditions of installation:	
7	Short circuit Capacity	
8	a) Short Circuit Amp. (rms)KA for 1 sec-for information only	
	b) Conductor temp. allowed for the short circuit duty (deg C.)	
9	Conductor	
	a) Material	
	b) Grade	
	c) Cross Section area (Sq.mm.)	
	d) Number of wires (No.)	
	e) Form of Conductor	
	f) Direction of lay of stranded layers	
10	Conductor resistance (DC) at 20 °C per km (Ohms)	
11	Insulation	
	a) Composition of insulation	
	b) Nominal thickness of insulation(mm)	
	c) Minimum thickness of insulation	
12	Inner Sheath	
	a) Material	

	b) Calculated diameter over the laid-up cores(mm)	
	c) Thickness of Sheath (minimum)mm	
13	Armour	
	a) Type and material of armour	
	b) Direction of armouring	
	c) Calculated diameter of cable over inner sheath (under armour), mm	
	d) Nominal diameter of round armour wire / dimensions of armour strip	
	e) Number of armour wires	
	f) short circuit capacity of the armour and duration	
	g) DC resistance at 20°C (Ω/Km) & Resistivity of armour	
14	Outer Sheath	
	a) Material (PVC Type)	
	b) Calculated diameter under the sheath	
	c) Min.thickness of sheath(mm)	
	d) Guaranteed value of minimum oxygen index of outer sheath	
	e) Guranteed value of minimum temperature index at 21 oxygen index	
	f) Colour of sheath	
15	a) Overall diameter of cable	
	b) Tolerance on overall diameter (mm)	
16	Cable Drums	
	a) Max./ Standard length per drum for each size of cable (single length) with ±5% Tolerance (mtrs)	
	b) Non standard drum lengths	
	c) Type & Standard for sealing of cable ends	
17	Whether progressive sequential marking on outer sheath provided	
18	Identification of cores	
	a) Colour of cores	
	b) Numbering	
19	Whether Cables offered are ISI marked	

20	Whether Cables offered are suitable for laying as per IS 1255	