BIDDING DOCUMENT
FOR

"Supply of 132KV Circuit Breaker, 132kV CT, 120KV Lightning Arrestor, 132kV Potential Transformer and Control Cable at Srikona GSS"

(E-Tender)

VOLUME -2
BID IDENTIFICATION NO: AEGCL/MD/CGM/O&M/CAR/Srikona/AP/2025

https://assamtenders.gov.in

Fund: Annual Plan fund received from Govt of assam for Augmentation of Transformer capacity of 132/33kV Srikona GSS from 2X25 MVA to 2X40MVA

ASSAM ELECTRICITY GRID CORPORATION LIMITED

Section-1
SCOPE AND GENERAL TECHNICAL CONDITIONS

1.1.0 INTENT OF THE SPECIFICATION

1.1.1 This volume of the specification deals with the general technical information & criteria for design, manufacture, supply & delivery of equipment/material as defined in Volume-1.

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

1.2.0 SCOPE

1.2.1 The work involves design, engineering, manufacture, assembly, inspection, testing at manufacturer's works before dispatch, packing, supply, including insurance during transit, delivery at site **(as per Annexure-I)** of various equipment and materials as specified in subsequent Clauses and Sections.

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

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

i) Design, engineering, manufacture, assembly and testing at manufacturer's works of 145kV Circuit Breaker, 145kV CT, 120kV LA, 132kV PT, Control Cable as specified in the BoQ.

ii) Loading at manufacturer's works, transportation and delivery to site, including unloading at destination site.

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

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

1.3.0 DESIGN IMPROVEMENTS

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

1.4.0 DESIGN CO-ORDINATION

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

1.5.0 DESIGN REVIEW MEETING

1.5.1 The contractor will be called upon to attend design review meetings with the Employer, and the consultants of the Employer during the period of Contract. The contractor shall attend such meetings at his own cost at

Assam or at mutually agreed venue as and when required. Such review meeting will be held generally minimum once a month or the frequency of these meeting shall be mutually agreed between the Employer and the Contractor. Frequency of Design Review Meetings shall depend upon the project requirement to ensure project implementation as per the Master Programme.

1.6.0 PACKING

1.6.1 All the materials shall be suitably protected, coated, covered or boxed and crated to prevent damage or

deterioration during transit, handling and storage at Site till the time of erection. The CONTRACTOR shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.

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

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

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

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

SECTION-2 TECHNICAL SPECIFICATION: 132kV CB

CHAPTER 02: TECHNICAL SPECIFICATION FOR 132KV, 66kV & 33KV CIRCUIT BREAKER (AIS)

2.1.0 SCOPE

2.1.1 The intention of this Section of the Specification is to cover design, manufacture, testing at manufacturer's works and of 132kV, 66kV and 33 KV Circuit Breakers with all fittings and accessories including mounting structures as specified hereunder.

2.2.0 GENERAL REQUIREMENTS

2.2.1 The circuit breaker shall be of three phase unit (gang operated) (or) three identical single-phase units (as said in data sheet), outdoor**, SF6 gas filled** single pressure puffer type (132kV and 66kV) and VCB for 33kV. 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 **and capacitor banks as applicable.**

2.2.2 The circuit breaker shall be capable of 3-ph auto-reclosing.

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

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

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

2.2.6 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.

2.2.7 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**

2.2.8 The support structure of circuit breaker shall be hot dip galvanised. Sufficient galvanizing thickness shall be achieved with 900 **gm/m² (130 micron).** All other parts shall be painted as per painting specification enclosed separately.

2.2.9 All mechanical parts and linkages shall be robust in construction and maintenance free over at least 10,000 switching operations except for lubrication of pins/articulated joints at 5000 operations **and electrical E2 performance**.

2.3.0 OPERATING MECHANISM

2.3.1 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.

2.3.2 Circuit breaker operating mechanism shall be capable of storing energy for at least two complete closing and tripping operations.

2.3.3 Each mechanism shall have an operation counter.

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

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

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

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

2.3.8 **Pole discrepancy** shall be provided which shall detect pole position discrepancy.

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

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

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

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

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

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

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

2.3.16 After failure of power supply to the motor, at least **two close-open** operation of the circuit breaker shall be possible from stored energy.

2.3.17 Spring charging motor shall be standard single phase universal motor suitable for 220 volts supply.

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

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

2.3.20 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.

2.4.0 OPERATING MECHANISM CONTROL

2.4.1 The breaker shall normally be operated by remote electrical control. 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.

2.4.2 Two electrically independent trip circuit including two trip coils per breaker shall be operated from two separate DC sources. First trip coil shall be utilized for tripping the breaker on main protection fault detection. Whereas second trip coil shall be used to trip the breaker when first trip coil fails to trip the breaker and backup protection comes into operation and shall also be used to trip the breaker on command.

2.4.3 The trip coils shal 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.

2.4.4 The auxiliary switch with **12NO+12NC** contacts of the breaker shall be positively driven by the breaker operating rod.

2.4.5 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.

2.4.6 When the spring get fully charged either through motor or hand cranking, the spring charging motor and the hand cranking suitable **mechanical and electrical indication shall be provided for same. On restoration of electrical supply, the mechanical handle shall be automatically disengaged.**

2.5.0 SF6 GAS SYSTEM

2.5.1 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.

2.5.2 The circuit breaker shall be single pressure **puffer** 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.

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

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

2.5.5 Each pole shall form an enclosure filled with SF6 gas independent of two other poles (145 and 66 kV CBs) and the SF6 density of each pole shall be monitored.

2.5.6 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.

2.5.7 SF6 gas shall be as per IEC 60376

2.6.0 VACUUM INTERRUPTER ASSEMBLY

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

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

2.7.0 BUSHINGS AND INSULATORS

2.7.1 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.

2.7.2 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.

2.7.3 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.

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

2.8.0 FIXED AND MOVING CONTACTS

2.8.1 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.

2.8.2 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.

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

2.9.0 INTERLOCKS

2.9.1 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.

2.10.0 ADDITIONAL DUTY REQUIREMENTS

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

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

2.10.3 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.

2.11.0 ACCESSORIES

2.11.1 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 combined for all three phases for (145kV and 66kV) Circuit Breakers. Each phase of Circuit Breaker shall be provided with** pressure **gauge with red and green zone and pressure level marked on the dial.**

2.11.2 Position Indicator

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

2.11.3 Terminals

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

2.11.4 Auxiliary Switches

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

2.11.5 Terminal Blocks

All accessories, spare contacts of contactors and control devices shall be completely wired up to terminal block. 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. **Each terminal block shall be suitable to receive two conductors of minimum 2.5sqmm copper.**

2.11.6 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) Indication Lamps for On/OFF operation

2.12.0 SUPPORT STRUCTURES

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

2.12.2 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.

2.12.3 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.

2.12.4 The support structures shall be capable to withstand the minimum seismic acceleration of 0.36 g in horizontal direction and 0.6g in vertical direction.

2.13.0 NAME PLATES

2.13.1 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.

2.14.0 EARTHING

2.14.1 Two earthing pads shall be provided on each supporting structure. Each operating mechanism 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 **75mm x 12mm GS strip.**

2.15.0 TERMINAL CONNECTORS

2.15.1 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.

2.16.0 TESTS

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

a) Routine/Acceptance Tests (all units)

i) Mechanical Operation tests

ii)Power frequency voltage withstand test (dry) iii) Tests on auxiliary & control circuits

iv) Measurement of resistance of the main circuit.

v) Insulation Resistance Test

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 (terminal fault, L90, etc) and making capacity test

ii) Short-time current withstand test

iii) Temperature rise tests

iv) Lightning Impulse voltage test

v) Operating Duty test

vi) Pole Discrepancy test

vii) Power Frequency withstand test

viii) IP degree of protection of operating mechanism enclosure

ix) RIV/PD test

x) Contact Resistance of CB

xi) IR value test for operating mechanism circuits

xii) Creepage distance test

c) **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.

2.17.0 PRE-COMMISSIONING TESTS

2.17.1 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 approved document of the equipment AEGCL without any extra cost to the AEGCL. The Contractor shall arrange all instruments required for conducting these tests along with calibration certificates and shall furnish the list of instruments to AEGCL 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) 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.

(s) **Sniffer test of VCB**

2.18.0 SPECIAL TOOLS AND TACKLES

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

2.19.0 TECHNICAL DATA SHEET FOR CIRCUIT BREAKER

Sl. No.	Particulars	Unit	Data for 132kV CB	Data for 66kV CB	Data for 33 kV CB
I	II	III	IV	V	VI
1	Type		SF_6	SF_6	VCB
2	No of poles		3 (3 Phase Ganged Unit)	3 (3 Phase Ganged Unit)	3 (3 Phase Ganged Unit)
3	Service		Outdoor	Outdoor	Outdoor
4	Rated System Voltage	kV	132	66	33
5	Highest System Voltage	kV	145	72.5	36
6	System earthing		Solidly earthed system	Solidly earthed system	Solidly earthed system
7	Rated Voltage of Breaker	kV	145	72.5	36
8	Rated Continuous Current	Amps	3150	2000	**2500/2000/1600/1250**
9	Rated Frequency	Hz	50	50	50
10	Rated Short Circuit breaking current (I) - 3secs - symmetrical	kA RMS	40	**31.5**	31.5
11	Rated Short Circuit making current	kA PEAK	2.5*I	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	0-0.3 Sec - CO -3 Min -CO
13	First pole to clear factor		1.3	1.3	1.3
14	Operating time				
	i) Opening Time	ms	Not exceeding 50 ms	Not exceeding 50ms	Not exceeding 50 ms
	ii) Closing Time D	ms	**Not exceeding** 100 ms	**Not exceeding 100 ms**	Not exceeding **100 ms**
15	Insulation level i) One minute Power Frequency withstand Voltage (Dry) ii) Full Wave Impulse withstand Voltage (1.2/50 µsec)	 kV RMS kV Peak	 275 650	 140 325	 75 170
16	Minimum clearance between phases	mm	1300	630	320
17	Minimum clearance between phase to earth	mm	1300	630	320
18	Minimum Ground clearance (from bottom most live part to plinth level)	mm	4600	3700	3700
19	Minimum clearance from bottom of support insulator to plinth level	mm	2500	2500	2500
20	i) Minimum Creepage	mm	4495	2247.5	1116

Sl. No.	Particulars	Unit	Data for 132kV CB	Data for 66kV CB	Data for 33 kV CB
I	II	III	IV	V	VI
	Distance (Total)				
	ii) Minimum Creepage Distance (Protected)	mm	2250		460
21	Operating mechanism a) Type		Spring Charged	Spring Charged	Spring Charged
	b) Rated 3 Phase, 50Hz Voltage for Drive Motor	V	220AC	220AC	220AC
	c) Rated voltage of Shunt trip coil & operating range	V. DC	220 or110[50% - 110%]	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%]	220 or 132 [80% - 110%]
	e) No. of trip coils	No	2 per CB	2 per CB	2 per CB
	f) No. of closing coils	No	1 per CB	1 per CB	1 per CB
	g) No of spare auxiliary contacts & contact rating	Nos AMPS	12 N/O+12 N/C (per CB) 10 A at 240V AC & 4A at 220V/ 110V DC	12 N/O+12 N/C (per CB) 10 A at 240V AC & 4A at 220V/ 110V DC	12 N/O+12 N/C (per CB) 10 A at 240V AC & 2A at 220V/ 110V DC
	h) Minimum thickness of steel sheet for control cabinet	mm	3	3	3
	i) Enclosure Protection		IP55	IP55	IP55
22	Reclosing		Three Phase auto reclosing	Three Phase auto reclosing	Three Phase auto reclosing
23	Support structure (Painted / Galvanised)		Galvanised	Galvanised	Galvanised
24	All other parts (Painted / Galvanised)		Synthetic enamel shade 631 of IS5 (125 microns)	Synthetic enamel shade 631 of IS5 (125 microns)	Synthetic enamel shade 631 of IS5 (125 microns)
25	Minimum size of control wiring (Copper)	Sq. mm	2.5	2.5	2.5
26	ITRV and TRV of CB interrupter		IEC	IEC	IEC

3.1.0 SCOPE OF CONTRACT

This Section of the Specification covers general requirements for design, engineering, manufacture, assembly and testing at manufacturer's works of 132kV, 66kV and 33 kV outdoor Current Transformers.

3.2.0 STANDARDS

3.2.1 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.

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

3.2.3 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)	**All relevant IEC**	

3.3.0 GENERAL REQUIREMENTS

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

3.3.2 Current transformers shall be of Live Tank design.

3.3.3 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 is requested to quote the current transformers with stainless steel diaphragm (bellow).

3.3.4 The instrument transformers shall be completely filled with oil.

3.3.5 A complete leak proof shrouded secondary terminal arrangement shall be provided with instrument transformers, secondary terminals shall be brought into weather, dust and vermin proof terminal box. Secondary terminal boxes shall be provided with facilities for easy earthing, shorting, insulating and testing of secondary circuits. The terminal boxes shall be suitable for connection of control cable gland. IP rating of terminal box shall be IP 55. Spare terminals shall be provided. **CT secondary shorting links shall be provided along with one terminal earthing arrangement of CT winding. All doors and removable covers and plates shall be sealed all around with neoprene gaskets or similar arrangement**.

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

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

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

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

3.3.10 The instrument transformers housing shall be porcelain.

3.3.11 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.

3.3.12 Test terminal for tan-delta/capacitance shall be provided for 132kV CT's.

3.3.13 Accuracy specified shall be maintained at 25% of rated burden.

3.3.14 All winding (Primary/Secondary) shall be of copper. Aluminium is not acceptable

3.4.0 INSULATING OIL

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

3.5.0 COMMON MARSHALLING BOXES (shall be supplied by CT manufacturer)

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

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

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

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

3.5.5 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.

3.5.6 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.

3.5.7 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. All terminals of control circuits shall be wired up to marshalling box including spare terminals evenly distributed on all TB's.

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

3.5.9 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.

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

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

i) Inside: Glossy White

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

3.6.0 BUSHINGS AND INSULATORS

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 **and shall conform to IEC 60135, 60168/IS.**

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.

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

3.6.4 The design of bushing shall be such that the complete bushing is a self-contained unit and no audible discharge shall be detected at a voltage up to a working voltage (Phase Voltage) plus 10%. The minimum creepage distance for severely polluted atmosphere shall be 31 mm/KV.

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

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

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

3.6.8 Bellow level indicator shall be present in CT.

3.6.9 Nitrite butyl rubber/Neoprene gaskets shall be used.

3.6.10 Critical flashover voltage of insulator and bushing shall be provided.

3.7.0 TESTS

3.7.1 Routine/Acceptance Tests (all units)

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

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

3.7.3 **QAP:** QAP indicating all brought out materials tests shall be submitted.

3.8.0 NAME PLATES

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

3.9.0 MOUNTING STRUCTURES

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

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

3.10.0 SAFETY EARTHING

3.10.1 The non-current carrying metallic parts and equipment shall be connected to station earthing grid with two terminals.

3.11.0 TERMINAL CONNECTORS (Shall be under manufacturer scope)

3.11.1 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 AEGCL, as per installation requirement while approving the equipment drawings. No part of a clamp shall be less than 12mm. thick. All connectors shall be of Aluminium Alloy and type tested as per IEC/IS including RIV and short circuit.

3.12.0 PRE-COMMISSIONING TESTS

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

(a) **Current Transformers**

(i) Insulation Resistance Test for primary and secondary.

(ii) Polarity test.

(iii) Ratio identification test - checking of all ratios on all cores by primary injection of current.

(iv) Dielectric test of oil (wherever applicable).

(V) Magnetising characteristics test.

(VI) Tan delta and capacitance measurement

(VII) Secondary winding resistance measurement

(VIII) Contact resistance measurement (wherever possible/accessible).

(IX) Knee-point voltage measurement

3.13.0 TECHNICAL DATA SHEET FOR CURRENT

3.13.1 For **145/72.5/**36 kV CTs the instrument security factor at all ratios shall be less than five (5) for metering core. If any auxiliary CTs/reactor are used in the current transformers then all parameters specified shall have to be met treating auxiliary CTs as an integral part of the current transformer. The auxiliary CTs/reactor shall preferably be inbuilt construction of the CTs. In case these are to be mounted separately these shall be mounted in the central marshalling box suitably wired upto the terminal blocks.

3.14.0 TYPE AND RATING:

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

SL No.	**A. Item**		**Ratings and Particulars**	
I	**II**	**III**	**IV**	
A	Nominal system voltage	132 kV	33 kV	66 kV
B	Highest system voltage, kV	145	36	72.5
C	Rated frequency, HZ	50	50	50
D	System earthing	Solidly earthed	Solidly earthed	Solidly earthed
E	Insulation level			
a)	Full Wave Impulse withstand voltage: kVp (1.2/50)	650	170	325

b)	One-minute p.f. Withstand voltage, kV (r.m.s.) (dry and wet)	275	70	140
F	Short time current for 3 seconds, kA	40	31.5	31.5
G	Minimum creepage distance, mm	4495	1116	2247.5
H	Temperature rise	As per IS	As per IS	As per IS
I	**C.T.**			
	(i) No. of Cores	5	2/5	5
	(ii) Transformation ratio	As per BoQ		
	(iii) Rated out put			
	(a) Core-1	20 VA	20 VA	20 VA
	(b) Core-2	20 VA	20 VA	20 VA
	(c) Core-3	(PX CLASS)	PX (for trafo only)	PX
	(d) Core-4	(PX CLASS)	PX (for trafo only)	PX
	(e) Core-5	(PX CLASS)	PX (for trafo only)	PX
	(iv) Accuracy class			
	(a) Core-1	0.2S	0.2S	0.2S
	(b) Core-2	5P20/PX (trafo)	5P20/PX (trafo)	5P20
	(c) Core-3	PX	PX (for trafo only)	PX
	(d) Core-4	PX	PX (for trafo only)	PX
	(e) Core-5	PX	PX (for trafo only)	PX
	(vi) Instrument security factor			
	(a) Core-1	<5	<5	<5
	(b) Core-2	-	-	-
	(c) Core-3	-	-	-
	(d) Core-4	-	-	-
	(e) Core-5	-	-	-
	(vii) Minimum Knee point voltage, Volts			
	(a) Core-1	-	-	-
	(b) Core-2	-	-	-
	(c) Core-3	1:1 of CT ratio min	1:1 of CT ratio min	1:1 of CT ratio min

	(d) Core-4	1:1 of CT ratio min	1:1 of CT ratio min	1:1 of CT ratio min
	(e) Core-5	1:1 of CT ratio min	1:1 of CT ratio min	1:1 of CT ratio min
	(viii) Maximum secondary resistance, ohm			
	(a) Core-1	-	-	-
	(b) Core-2	-	-	-
	(c) Core-3	<3	<3	<3
	(d) Core-4	<3	<3	<3
	(e) Core-5	<3	<3	<3
	(ix) Maximum exciting current, at Vk/4 mA			
	(a) Core-1	-	-	-
	(b) Core-2	-	-	-
	(c) Core-3	-	-	-
	(d) Core-4	-	-	-
	(e) Core-5	-	-	-
	Tandelta at Um/ root 3	< 3	< 3	< 3
	Rated extended primary current	120%	120%	120%

Note:

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

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

(iii) CT and PT sizing calculations shall be submitted. Burden values and knee point voltage, shall be decided as per the calculations during detailed engineering

(iv) For Station service bay equipment's rated system voltage shall be 33kV and highest system voltage shall be 72.5kV.

Section - 4: TECHNICAL SPECIFICATION FOR 398KV, 198KV, 120KV & 30KV SURGE ARRESTER

4.1.0 SCOPE

4.1.1 This Section covers the specifications for design, manufacture, testing, transportation delivery at site, erection, and commissioning of class heavy duty, gapless metal (zinc) oxide Surge Arrestors complete with fittings & accessories for 400 kV, 220 kV, 132 kV and 33 kV systems.

4.2.0 STANDARDS

4.2.1 The design, manufacture and performance of Surge Arrestors shall comply with IS: 15086 Part-4 / IEC: 60099-4 unless otherwise specifically specified in this Specification

4.3.0 GENERAL REQUIREMENT

4.3.1 The surge arrestor shall draw negligible current at operating voltage and at the same time offer least resistance during the flow of surge current. **The surge arrester shall be used in solidly earthed system**.

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

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

4.3.4 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.

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

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

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

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

4.3.9 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.

4.4.0 ARRESTOR HOUSING

4.4.1 The arrestor housing shall be made up of porcelain 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.

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

4.4.2 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.

4.4.3 Sealed housings shall exhibit no measurable leakage.

4.5.0 FITTINGS & ACCESSORIES

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

4.5.2 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.

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

4.6.0 SURGE MONITOR

4.6.1 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 scale range **of 0 to 5mA peak/root 2 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 non-resettable 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 suitable for communication to SCADA in the control room if the leakage current exceeds the permitted value. Similar provision shall be considered for surge counter also.

4.6.2 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 of **minimum 5kV rating** up to grounding point and bends shall be minimum.

4.7.0 TESTS

4.7.1 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: 15086 (Part-4). 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.

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

4.7.3 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.

4.8.0 NAME PLATE

4.8.1 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.
Energy Absorption Capability

4.9.0 PRE-COMMISSIONING TESTS

4.9.1 Contractor shall carry out following tests as pre-commissioning tests. Contractor shall also perform any additional test based on specialties of the items as per the field instructions of 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) Operation check of LA counters.
(b) Insulation resistance measurement.
(c) Third harmonic resistive current measurement (to be conducted after energisation.)

4.10.0 TYPE AND RATINGS may be read as:

SL No.	Particulars	420 kV	245 kV	145 kV	36 kV
I	**II**	**III**	**IV**	**V**	**VII**
1	Rated voltage of arrester, kV	398	216	120	30
2	Continuous operating voltage, kV	267	168	102	25
2	Rated frequency, Hz	50	50	50	50
3	Nominal discharge current of arrester, kA	20	20/10	10	10
4	(i) Min. switching surge residual voltage (2kA),kVp	IEC	IEC	IEC	IEC
	(i) Max. switching surge residual voltage (500 kA),kVp	IEC	IEC	IEC	IEC
5	Maximum residual voltage at,				
	(i) 5 kA nominal discharge current, kV (peak)	IEC	IEC	IEC	IEC
	(ii) 10kA nominal discharge current, kV (peak)	IEC	IEC	IEC	IEC
	(iii) 20kA nominal discharge current, kV (peak)	IEC	IEC	IEC	IEC
	(iv) Steep fronted wave residual voltage, kV (peak)	IEC	IEC	IEC	IEC
6	One minute power frequency withstand voltage of arrester housing, kV (rms)	650	460	275	70
7	1.2 / 50 □ second impulse withstand voltage of arrester housing, kV (peak)	1425	1050	650	170
8	Switching impulse withstand voltage (250/2500 micro second) of arrester housing dry and wet, kV (peak)	1050	-	-	-
9	Creepage distance of insulator housing (mm)	13020	7595	4495	1116
10	Line discharge class	4	3	3	3
11	Short time current rating, kA for 3 sec	63	50	40	31.5
12	Pressure Relief Class	A	A	A	A
13	Minimum cantilever strength (upright)	10kN	8N	6KN	4KN

Section - 5: TECHNICAL SPECIFICATION FOR 33 KV, 132KV, 220KV & 400 KV IVT

5.1. SCOPE:

5.1.1 This specification provides for the design, manufacture, assembly inspection and testing at the manufacturer's works, packing and delivery at site, erection, testing and commissioning of outdoor mounted type, single phase, oil filled, self-cooled, single unit type Inductive voltage transformers for 33 KV &132KV systems, supply of potential to energy meters, relays for feeder protection in Grid Sub- stations of AEGCL, ASSAM.

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

5.1.3. Bidders are required to quote for 0.2 accuracy class [metering winding] for 33 KV and 132KV IVTs in the following manner.

(a) Guaranteed Technical Particulars.
(b) Technical literatures, brochures and drawings as per this specification.
(c) Type Test reports.
(d) List of orders, executed and Users' certificates with **minimum 5years of field proven experience** failing submission of the above particulars with the offer, the tender may not be considered for evaluation.

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

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

5.3. STANDARDS:

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

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

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

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

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

language shall be furnished along with the offer.

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

5.3.6 Accuracy specified shall be maintained at 25% of rated burden.

5.4. CLIMATIC AND SERVICE CONDITIONS:

5.4.1 Earthquake Incidence:

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

5.5. INSTALLATION:

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

5.6. GENERAL TECHNICAL REQUIREMENTS:

5.6.1. GENERAL TECHNICAL REQUIREMENTS FOR IVT:

5.6.1.1. Each IVT shall be supplied, filled with insulating oil and shall be hermetically sealed to prevent atmospheric **environment** in contact with oil, avoiding filtration and change of oil. Stainless steel diaphragm Bellow with bellow level indicator shall be provided.

5.6.1.2. Secondary Terminal Box:

5.6.1.2.1. The secondary terminals shall be brought out in a weatherproof terminal box with IP-55 **degree of protection enclosure.**

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

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

5.6.1.2.4. The terminal box shall be provided with removable gland plate and glands suitable for 1100 volts grade. PVC insulated, PVC sheathed multi core of **2.5 sq.mm to 4 sq.mm** stranded copper conductor cable.

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

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

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

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

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

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

5.6.1.3 The IVT shall be vacuum filled with oil after processing and thereafter hermetically sealed to eliminate breathing and to prevent air and moisture from entering the tanks. The method adopted for hermetic sealing shall be described in the offer.

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

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

5.6.1.6. Inductive voltage transformers shall be ferro-resonance proof and adequately designed to use in HT cable circuit wherever applicable.

5.6.1.7. Primary Winding:

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

even during short-circuit conditions. Primary Windings shall be made of Copper.

5.6.1.8. Secondary Winding:

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

5.6.1.9. Core:

Core laminations shall be of cold rolled grain-oriented silicon steel to ensure 0.2 accuracy class at both normal and over voltage. The core material, thickness of lamination, the relevant graphs showing the characteristics of the core materials shall be submitted along with the offer.

5.6.1.10. Tank:

5.6.1.10.1. Both expansion chambers and tanks of the IVT shall be made of high-quality steel and shall be able to withstand full vacuum and pressure, and thermal and mechanical stresses resulting from maximum short circuit current during operation. The tanks along with all ferrous parts shall be hot- dip galvanized as per relevant standard.

5.6.1.10.2. The metal tanks shall have bare minimum number of welded joints so as to minimize possible locations of oil leakage. Welding in horizontal plane is to be avoided. Supplier has to obtain specific approval from the purchaser for any horizontal welding, used in the bottom tank

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

5.6.1.11. Porcelain Housing:

5.6.1.11.1. The housing shall be made up of homogeneous, vitreous porcelain of high mechanical and dielectric strength; glazing of porcelain shall be of uniform brown or dark brown colour with a smooth surface, arranged to shed away rainwater or condensed water particles (fog)

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

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

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

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

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

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

5.6.1.12. Insulating Oil:

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

5.6.1.13. Prevention of Oil Leakage and Entry of Moisture:

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

(a) Locations of emergence of primary & secondary terminals.

(b) Interface between porcelain housing and metal tank(s).

(c) Cover of the secondary terminal box.

(d) Sealing around oil level indicator.

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

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

5.6.1.14. Fittings and Accessories:

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

(a) Oil level gauge.

(b) Oil filling hole and cap.
(c) Pressure relieving device.
(d) Lifting lugs.
(e) Phase terminal connectors.
(f) Tank earthing pads/terminals with necessary nuts and bolts and washers for connecting to Purchaser's strip.
(g) Name/Rating plate.
(h) H.R.C. fuse of Adequate rating
i) Bellow

5.6.1.15. Provisions

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

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

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

5.6.1.15.4. Earthing: Metal tank of each IVT shall be provided with two separate earthing terminals for bolted connection to be provided by the Purchaser for connection to station earth-mat.

5.6.1.15.5. Lifting Arrangement:
The IVT shall be provided with suitable lifting arrangement to lift the entire unit. The lifting arrangement shall be clearly shown in the general arrangement drawing.
Lifting arrangement [Lifting eye] shall be positioned in such a way so as to avoid any damage to the porcelain housing or the tanks during lifting for installation/transport. Necessary string guides shall be offered which shall be of removable type.

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

5.6.1.15.7. Gasket Joint:
The manufacturer shall furnish the type of gasket used or setting methods.

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

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

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

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

5.6.1.15.8.4. All ferrous parts shall be hot dip galvanized conforming to IS-2633

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

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

5.6.1.15.9. Secondary Wiring: The Secondary wiring shall be enclosed in conduits and shall be brought to a terminal block ready for external connections. The wiring shall be of adequate cross-section and not less than 2.5 sq.mm copper wire.

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

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

5.7. TESTS:

5.7.1 Type Tests:

The offered 33 KV& 132KV Inductive voltage transformer should have been subjected to the following type tests in a Government approved Test Laboratory. The bidder shall furnish four sets

of type test reports along with the offer. These tests must not have been conducted earlier than five years from the date of opening of the bid. For any change in the design/type already type tested and to the design/type offered against this specification, the purchaser reserves the right to demand repetition of some or all type tests/special tests without any extra cost to AEGCL in the presence of purchaser's representative at the cost of the supplier.

For 33 KV, 132 KV IVT:

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

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

5.7.2 Routine Tests:

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

(a) Verification of terminal markings.
(b) Power frequency withstands tests on primary windings/capacitor voltage divider for CVT
(c) Partial discharge measurement for 400kV, 220kV & 132kV CVT.
(d) Power frequency withstand tests on secondary windings/Low voltage terminal of the capacitor divider for 400kV, 220kV & 132kV CVT.
(e) Determination of errors on complete IVT/CVT.
(f) Measurement of Insulation resistance.
(g) Oil leakage test.
(h) Measurement of capacitance and dielectric dissipation factor before and after dielectric tests (as per IEC-358)
(j) Power frequency tests on electromagnetic unit for 400kV, 220kV & 132kV CVT.
(j) Any other test as per relevant national & international standards.
(k) Creepage distance measurement test.

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

5.8. INSPECTION:

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

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

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

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

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

the testing equipments/meters will be found to be in order.

5.9. QUALITY ASSURANCE PLAN:

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

(i) Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards, according to which the raw materials are tested, list of tests, normally carried out on raw materials in presence of Bidder's representative, copies of test certificates.

(ii) Information and copies of test certificates as in (i) above in respect of bought out items.

(iii) List of manufacturing facilities available.

(iv) Level of automation achieved and list of areas where manual processing exists.

(v) List of areas in manufacturing process where stage inspections are normally carried out for quality control and details of such tests and inspection.

(vi) Special features provided in the equipment to make it maintenance free.

(vii) List of testing equipments, meters and test plant limitation, if any, vis-à-vis the type, acceptance and routine tests, specified in the relevant standards. These limitations shall be very clearly brought out in the offer.

(viii) All the testing equipments, meters etc. should have been calibrated in a Government approved laboratory. The Bidder must submit the list of testing equipments and meters test as per the Technical Specification.

(ix) QAP shall include acceptance criteria against all parameters with relevant clause of standards

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

(i) List of raw materials as well as bought out accessories and the names of the materials as well as bought out accessories and the name of Sub-suppliers selected from those, furnished along with the offer.

(ii) Type test certificates of the raw materials and bought out accessories.

(iii) Quality Assurance Plan (QAP) with hold points for the Purchaser's possible inspection. The QAP and hold points shall be discussed between the Purchaser and the Supplier before the QAP if finalised.

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

5.10. DOCUMENT:

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

(a) General outline and assembly drawings of the Inductive Voltage Transformers/ Capacitive Voltage Transformers.

(b) Sectional views showing:

i) General constructional features.

ii) Materials/gaskets/sealing used.

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

(c) Schematic drawing.

(d) Rating & diagram plate as per relevant IEC/ISS

(e) Secondary Terminal Box.

(f) Assembly Sectional view of Primary terminal/capacitor voltage divider

(g) Assembly drawing for secondary terminal

(h) The detailed dimensional drawing of Porcelain Housing such as ID, OD, thickness and insulator details such as height, profile of petticoats, angle of inclination and gap between successive petticoats, total creepage distance etc.

(i) Sectional view of pressure release device.

(j) Drawing showing details of Oil level.

(k) All type test reports relating to the tests as specified in Clause-8.1 of the above.

(l) Ratio and phase angle error curves for IVTS/ CVTS

(m) Magnetization characteristic curves such as B-H curves and Sp. Loss vs. Flux density curves for core material, used for IVT & EMU unit of CVT.

(n) Sectional view of EMU unit of 220KV&132KV CVT.

(o) Schematic diagram showing the working of CVT in PLCC.

5.11. TEST REPORTS:

(i) Four copies of type test/special test reports shall be furnished to the Purchaser with the tender offer.

(ii) Copies of acceptance test reports and routine test reports shall be furnished to the Purchaser. One copy will be returned, duly certified by the Purchaser and only thereafter shall the materials be

despatched.

(iii) All records of routine test reports shall be maintained by the supplier at his works for periodic inspection by the Purchaser.

(iv) All test reports of tests conducted during manufacture shall be maintained by the supplier. These shall be produced for verification as and when required for by the purchaser.

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

5.12 APPENDIX – I.

TECHNICAL REQUIREMENTS FOR 33kV, 132kV INDUCTIVE VOLTAGE TRANSFORMERS

Sl. No	Particulars	33kV IVT	132kV IVT
I	II	III	IV
1	Type	Single phase, 50Hz, oil filled, self-cooled, Hermetically sealed, outdoor porcelain type.	Single phase, 50Hz, oil filled, self-cooled, Hermetically sealed, outdoor porcelain type.
2	Nominal system voltage.	33kV	132kV
3	Highest system voltage.	36kV	145kV.
4	Frequency.	50Hz± 5%	50Hz± 5%
5	System	Effectively	Effectively
	earthing.	solidly earthed	solidly earthed
6	Number of phases.	3 [single phase]	3 [single phase]
7	(i) Number of secondary windings. (ii) Purpose of windings.	3 [three] Protection & metering.	3 [three] Protection & metering.
8	Rated primary voltage.	33/1.732kV	132/1.732kV
9	Rated secondary voltage.	Winding-II &III- 110/1.732V (Protection) Winding-I- 110/1.732V (Metering)	Winding-II &III- 110/1.732V (Protection) Winding-I- 110/1.732V (Metering)
10	Ratio	33kV/1.732: 110V/1.732 110V/1.732	132kV/1.732: 110V/1.732 110V/1.732
11	Rated burden.	Winding-I(M)- 100VA Winding-II(P)- 100VA Winding-III(P)- 100VA	Winding-I(M)- 100VA Winding-II(P)- 100VA Winding-III(P)- 100VA
12	Accuracy class	0.2/3P/3P	0.2/3P/3P
13	Rated voltage factor at rated frequency.	1.2 continuous. 1.5 for 30second.	1.2 continuous. 1.5 for 30second.
14	Temperature rise at 1.2 times the rated primary voltage, rated frequency & rated burdens.	As per IEC- 186.	As per IEC-186.

15	Temperature rise at 1.5 times the rated primary voltage for 30 seconds, rated frequency & rated burden.	As per IEC- 186.	As per IEC-186.
16	One-minute power frequency dry/wet withstands test voltage for primary winding.	70kV[rms]	275kV[rms]
17			
18	1.2/50 micro second impulse withstand test voltage for primary winding	170kV[peak]	650kV[peak]
19 (i) (ii)	One-minute power frequency withstands test voltage for Secondary winding Between LV(HF) terminal & earth terminal	3kV[rms] -	3kV[rms] -
20	Class of insulation.	B	B
21	Material of the conductor of primary and secondary windings.	Copper.	Copper.
22	Fault level	31.5kA [rms] for 3 second.	40 kA [rms] for 3 second.
23	Minimum creepage distance.	1116mm	4495mm
24	Quality of oil.	EHV Grade As per IS-335.	EHV Grade As per IS-335.
25	Radio interference voltage at 1.1 times maximum rated voltage at 1.0 MHZ.	-	500 micro volts.
26	Partial discharge level.	-	Less than 10 piccocoulombs.
27	Seismic acceleration Horizontal – Vertical –	0.5g. 0.6g.	0.5g. 0.6g.
28	Accuracy class of standard V.T. to be used	0.05 or better.	0.05 or better.
	during testing towards determination of ratio errors and phase angle errors for metering windings.		

Note:

(i) For Station service bay equipments rated system voltage shall be 33kV and highest system voltage shall be 72.5kV.

(ii)

Section - 6: TECHNICAL SPECIFICATIONS OF XLPE INSULATED COPPER CONTROL CABLE

This technical specification intends to cover the following:

Technical specifications for design, engineering, manufacturing, inspection, testing at manufacturer's works, packaging and delivery by road (properly packed in non-returnable steel drums), various sizes of copper conductor, XLPE insulated, voltage upto and including 1100 Volts, extruded PVC inner sheathed, extruded FRLS PVC outer sheathed, GI round wire armoured cables, suitable for solidly grounded system. The cables shall confirm to IS 7098-Part 1 with latest amendments. For cable list refer Table-1 (Sl. no. 1.1 to 1.19).

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 and field proven experience of min 5 years.
2. Copper samples from the finished cable drums shall be tested at any 3rd party NABL accredited lab to ensure its purity.

3. The following document shall be attached with technical part of the bid:

i. Duly filled & Signed copy of Annexure-I, II, III & IV

ii. Deviation sheet, if any

Table 1

1	2 C, 1.5mmsq
2	4C, 2.5 sq mm
3	5C, 2.5 sq mm
4	7C, 1.5 sq mm
5	**7C, 2.5 sq mm**
6	10 C, 2.5 sq mm
7	**12 C, 2.5 sq mm**
8	12 C,1.5 sq mm
9	14 C, 2.5 sqmm
10	17 C,1.5 sqmm
11	19 C,1.5 sqmm
12	**19C,2.5 sqmm**

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

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.

6.1 STANDARDS

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

a. IS-7098, 1998 (Part-I) : Cross linked polyethylene insulated PVC sheathed cables for working voltages upto 1100V.

b. IS-3961 : Recommended current ratings for

			Cables
c.	IS 8130-1984	:	Specification for conductors for insulated electric cables and flexible cords.
d.	IS-3975, 1999	:	Low Carbon galvanized steel wires, formed wires & tapes for armouring of cables
e.	IS-4759	:	Specifications for Hot dipped galvanized coating on round steel Wires
f.	IS-5831	:	PVC insulation and sheath of electric cables.
g.	IS-10418	:	Drums for electric cables.
h.	IS-10810	:	Method of test for cables.

6.2 SERVICE CONDITION

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

6.3 DESIGN AND CONSTRUCTION PERTICULARS

6.3.1. General

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

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

6.3.2. Technical parameters

i.	Quantity	: Refer Table-1
ii.	Packaging	Steel drum packaging, each having single length cable ≥ 500 metres. (for size less than1000sqmm.).
iii.	Cable Type	A2XWY/ 2XWY (refer Table-1 for details)
iv.	No. of Cores	Shall be decided during detailed engineering (Cable sizing calculation)
v.	Voltage Level	1.1Kv
vi.	System Grounding	Solidly Grounded
vii.	Nominal System voltage	: 415V ±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

6.4 Conductor

COPPER
The conductors shall be made from high conductivity copper rods complying with IS: 613-1964. The conductor material used shall be electrolytic grade with high purity. Two sample conductor randomly selected from finished lot of cables, shall be tested for its purity at any 3rd party NABL accredited lab. The conductors shall conform to appropriate dimensions, resistance and number of wire in the conductor (number of strands) as given in IS 8130 (Part I): 1984.

6.5 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

6.6 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.

6.7 Outer Sheath

Extruded outer sheath shall be provided over the armouring. The material used for sheathing shall be FRLS PVC sheath, Type ST-2 base compound conforming to IS 1554/ IS 5831 for power and control cable. The outer sheath shall be so formed that it fits closely on the laid up armour and could be easily removed without damaging the intermediate sheath and insulation. The colour of the outer sheath shall be black. The thickness of outer sheath shall be in accordance with the IS 1554 (Part-I)-1988. Suitable additives shall be added to prevent attack by rodents and termites. All serving must be given anti-termite treatment.
Cables shall have suitable fillers laid up with the conductor to provide a substantially circular cross section before the sheath is applied. Fillers shall be suitable for the temperature of the cable and compatible with the insulating material. The material shall be of the best quality and workmanship. The fillers and sheath material shall be non-hygroscopic. All materials shall be new, unused and of the finest quality.

6.8 TESTS

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

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

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

6.9 Pre Dispatch Inspection

The manufacturer shall be given at least 15 days advance notice prior to the commencement of testing, so that Purchaser's representative can plan to witness the tests.
All the tests indicated in the test clause of this specification shall be carried out in the presence of Purchaser's representative by the manufacturer and shall provide all the facilities and equipment for testing.

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

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

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

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

6.10 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

b. Test on Insulation

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

c. Test on round Armour

- Physical dimension measurement
- Tensile strength

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

d. Test on Sheath

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

e. Insulation Resistance Test

f. High Voltage Test at room temperature

g. Volume resistivity at room temperature & at 90^{o} C. (IS-10810-Part 43)

h. Flammability test

i. *Test requirement of FRLS inner and outer sheath*

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

Flame retardant test on single cable.

- Oxygen Index Test

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

- Temperature index test

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

- Flammability test
- Smoke Density Test

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

· Acid Gas Generation test (halogen acid gas evolution)

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

· Test for specific optical density of smoke

· Anti termite and rodent property test

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

6.11 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

6.12 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.

6.13 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)

9.13 PACKAGING

Each drum shall consist of single length cable ≥ 500 metres (for sizes less than 1000sqmm.).

The cable shall be wound on *non-returnable steel drums* of suitable size, packed and marked.

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

i. Reference to the Indian standard

ii. Manufacturer's name, brand or trade mark

iii. Type of cable and voltage grade

iv. No. of cores

v. Nominal cross-sectional area of conductor

vi. Cable code

vii. Length of cable on drum

viii. No. of lengths on reel, drum or coil (if more than one)

ix. Gross weight

x. Country of manufacture

xi. Year of manufacture

xii. Direction of rotation of drum (an arrow)

xiii. ISI certification mark

6.14 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 any other approved make at the time of detailed engineering.

b.	Copper for Conductor	:	Hindustan Copper/Hindalco or any other approved make at the time of detailed engineering
c.	XLPE compound of Insulator	:	Dow/Borealis at the time of detailed engineering

6.15 **GUARANTEE**

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

ANNEXURE-I

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

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

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

Sl. No.	Particulars	Details
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	

Sl. No.	Particulars	Details
	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	

Section-7

Annexure-I (Destinations for Supply of BoQ Items)

Sl. No.	Item	Item to be delivered at
1	a. 145kV CB b. 145kV CT c. 120kV LA d. 132kV PT e. Control Cable	**132/33kV Srikona GSS**