



ODISHA POWER TRANSMISSION CORPORATION LIMITED

TECHNICAL SPECIFICATION

FOR

420, 245, 145, & 36 KV

CIRCUIT BREAKERS

- i. 420 KV SF6 CIRCUIT BREAKER
- ii. 245KV SF6 CIRCUIT BREAKER
- iii. 145 KV SF6 CIRCUIT BREAKER
- iv. 36 KV VCB

420/245/145 KV CIRCUIT BREAKERS

1.0 SCOPE :

1.1 This specification provides for the design, manufacture, inspection and testing before dispatch, packing and delivery F.O.R. (destination) By Road transport only and supervision of erection, testing and commissioning, of outdoor SF6 circuit breakers along with structures, all the accessories and auxiliary equipment and mandatory spares, described herein, required for their satisfactory operation in various substations of the state.

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

2.0 STANDARDS

2.1 Except as modified in this specification, the circuit breakers shall conform to the latest revisions with amendments thereof, of following standards.

SL. NO.	STANDARD	TITLE
1.	IEC-62271-100	High Voltage Alternating Current Circuit-Breaker
2.	IS-12729:2004/IEC-60694	Common Specification for High Voltage Control gear & Switchgear standard
3.	IS-14658/IEC-1633	H.V Alternating Current Ckt Breaker-Guide for Short Ckt & Switching Test Procedures for metal enclosed & dead tank Circuit Breaker
4.	IS-14674:1999/IEC-1166:1993	H.V Alternating Current Ckt Breaker-Guide for Seismic qualification of HV A.C Circuit Breaker
5.	IEC-56 / IS-13118	Specification for alternating current circuit breakers
6.	IS-325	Specification for three phase induction motors
7.	IS-375	Marking and arrangement for switchgear bus-bar, main

		connections and auxiliary wirings.
9.	IS-802 (Part-1)	Code of practice for use of structural steel in overhead trans. Line towers.
10.	IS-2099	High voltage porcelain bushings.
11.	IS-2147	Degree of protection provided for enclosures for low voltage switchgear and control gear.
12.	IS-2629	Recommended practice for hot dip galvanizing of iron and steel.
13.	IS-4379	Identification of the contents of Industrial Gas Cylinders.
14.	IS-7311	Seamless high carbon steel cylinders for permanent and high pressure liquefied gases.

2.2 Equipment meeting with the requirements of any other authoritative standards, which ensures equal or better quality than the standard mentioned above shall also be acceptable. If the equipment offered by the Bidder conforms to other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. Two copies of such standards with authentic English Translations shall be furnished along with the offer.

2.3 The standards mentioned above are available from:

Reference/Abbreviation	Name and address from which the standards are available
IS	Bureau of Indian Standards, Nanak Bhawan, 9-Bahadur Shah Zafar Marg, New Delhi-110 001 INDIA
IEC	International Electrotechnical Commission Bureau Central De la Commission Electro Technique International 1,Rue De Verembe Geneva, Switzerland

3.0 AUXILIARY POWER SUPPLY

Auxiliary electrical equipment shall be suitable for operation on the following supply system.

(a)	Power Devices like drive Motors of rating 1 KW and above.	415 V, 3 phase 4 wire 50Hz, neutral grounded AC supply.
(b)	Lighting, space heaters and Fractional KW motors.	240 V, single phase, 50 Hz neutral grounded AC supply.
(c)	Alarm, control and Protective devices.	220 V DC, 2 wire

Each of the foregoing supplies shall be made available by the Purchaser at the terminal point for each circuit breaker for operation of accessories and auxiliary equipment. Supplier's scope include supply of interconnecting cables, terminal boxes etc. The above supply voltage may vary as below and all devices shall be suitable for continuous operation over entire range of voltages.

i) AC supply : voltage $\pm 10\%$ frequency $\pm 5\%$

i) DC supply : - 15% to + 10%

4.0 PRINCIPAL PARAMETERS

The breakers shall conform to the specific technical requirements specified hereunder:

Sl. No.	Item	Requirements	
		145 KV	245KV/420KV
1.	Rated voltage (KV rms) frequency (Hz)	145 50HZ	245/420 KV 50HZ
2.	Continuous current rating (A) rms	3150	3150/3150

3.	Type	Outdoor SF6	
4.	Mounting	Hot dip galvanized lattice steel support structure to be supplied by the Bidder	
5.	Number of Poles	3	
6.	Type of Operation	Gang Operated	Individually Operated Single poles.
7.	Phase to phase spacing in the switchyard i.e. interpole spacing for breaker (mm)	2150	4500/7000
8.	Required ground clearance from the lowest live terminal (mm):		
	i. If both the terminals are not in the same horizontal plane	-	4800/7000
	ii. If both the terminals are in the same horizontal plane	4600	6500/7000
9.	Height of concrete plinth (to be provided by the Owner) mm.	300	300
10.	Minimum height of the lowest part of the support insulator from ground level (mm)	2550	2550/3500
11.	Operating Mechanism	spring charged(Spring-Spring) FOR 420 KV /SPRING-SPRING/	
12.	Autoreclosing duty	Single Phase	
13.	Rated operating duty cycle	0-0. 3 sec-co-3 min-co	
14.	First pole to clear factor	1.3(As per IEC-62271-100)	
15.	Type of tripping	Trip free	
16.	Max. closing time(ms)	60	

17.	Max. BREAK TIME (ms)		30 ± 4	50/40
18.	1.2/50 microsecond impulse withstand voltage: (dry)			
	i.	To earth(kvp)	650	1050/1550
	ii.	Across the open contacts with impulse on one terminal and power frequency voltage on opposite terminal (kvp/kv rms)	650	1050/1550
19.	1 minute power frequency withstand voltage (kv rms) (wet)		275	460/610
20.	Max. radio interference voltage (micro volts) at 1.1 times maximum phase voltage		500	500/1000
21.	Min. corona extinction voltage (kv rms)		105	176/320
22.	Rated breaking current capacity:			
	i.	Line charging at rated voltage at 90 deg. Leading power factor (A) rms	50	125/600
	ii.	Small inductive current (A) rms	-----0.5 to 10----- without switching o/v exceeding 2.3 p.u.	
	iii.	Short circuit current		
		a)	AC component (kA)	40 or 50/ 63
		b)	% DC component	40%/as per IEC62271-100
23.	Rated short circuit making current capacity (kA)		79	100/125/ 158
24.	Permissible limit of temperature rise		As per Clause 5.29	

25.	Max. acceptable difference in the instant of closing/opening of contacts			
	i)	Within a pole (ms)	5	5/2.5
	ii)	Between poles (ms)	10	10/3.3 for opening & 5 for closing
26.	Min. creepage distance of support insulator(mm)		3,625	6,125/10500
27.	Short time current carrying capability for three second (kA)		40	40/50/63
28.	Rating of auxiliary contacts		----10A at 220 V D.C.----	
29.	Breaking capacity of auxiliary contact		2 A DC with the circuit time constant not less than 20 ms	
30.	Noise level at base and upto 50 metres		-----140 dB (max.)-----	
31.	Seismic acceleration		-----0.3 g -----	

Note:-Purchaser may accept the phase to phase, or phase to earth spacing of the breakers & structure heights basing on the firm's type test reports or he may ask the firm to manufacture the breakers as per the dimensions indicated in this specification. .

5.0 GENERAL TECHNICAL REQUIREMENTS

5.1 Circuit breaker offered shall be sulphur hexafluoride (SF6) type only.

5.2 Any part of the breaker, especially the removable ones, shall be freely interchangeable without the necessity of any modification at site.

5.3 Circuit breaker shall comprise of three identical single pole units. If the circuit breaker not meant for single pole reclosure, these units shall be linked together electrically . Complete circuit breaker with all the necessary items for successful operation shall be supplied, including but not limited to the following:

5.3.1 Breaker assemblies with bases, support structure for circuit breaker as well as for control cabinet, Ladder, central control cabinet and foundation bolts for main structure as well as control cabinet and central control cabinet (except concrete foundations), terminals and operating mechanisms.

5.3.2 Compressed SF6 gas, spring operated systems complete including piping, fittings, valves and controls and etc.

5.3.3 One central control cabinet for each breaker and one control box for each pole with all the required electrical devices mounted therein and the necessary terminal blocks for termination of interpole wiring. The necessary interpole cabling at site shall be done by the Purchaser based on the schematic, wiring diagram and termination schedule to be supplied by the Supplier.

5.3.4 Instruments, pressure gauges and other devices like gas density monitor, temp. monitor & etc. for SF6 gas pressure supervision.

5.3.5 All necessary parts to provide a complete and operable circuit breaker installation such as main equipment, terminal, control parts, connectors and other devices, whether specifically called for herein or not.

5.4 The circuit breaker shall be designed for high speed single and three pole reclosing with and operating sequence and timing as specified in clause 4.0 "Principal Parameters".

5.5 The support structure of circuit breaker as well as that of control cabinet shall be hot dip galvanized. The minimum weight of zinc coating shall be 610 gm/sq.m and minimum thickness of coating shall be 86 microns for all items thicker than 5 mm.

5.6 Circuit breaker shall be suitable for hot line washing.

5.7 All breakers shall be supplied with terminal connectors. The exact requirement of terminal connectors would be intimated to the supplier during the course of detailed engineering(during drawing approval).

5.8 Terminal pads shall have silver plating of atleast 50 microns thickness.

5.9 CONTACTS

5.9.1 All making and breaking contacts shall be sealed free from atmospheric effects. Contacts shall be designed to have adequate thermal and current carrying capacity for the duty specified and to have a life expectancy so that frequent replacements due to excessive burning will not be necessary. Provision shall be made for rapid dissipation of heat generated by the arc on opening.

5.9.2 Main contacts shall be first to open and the last to close so that there will be little contact burning and wear. If arcing contacts are used they shall be first to close and the last to open. Tips of arcing contacts and main contacts shall be silver plated or made of superior material like graphite.

5.9.3 Any device provided for voltage grading to damp oscillations or to prevent restrike prior to the complete interruption of the circuit or to limit over voltages on closing shall have a life expectancy comparable to that of the breaker as a whole.

5.9.4 Breakers shall be so designed that when operated within their specified rating, the temperature of each part will be limited to values consistent with a long life or the material used. The temperature shall not exceed that indicated in IEC-56 under specified ambient conditions.

5.9.5 Contacts shall be kept permanently under pressure of SF₆ gas. The gap between the open contacts shall be such that it can withstand atleast the rated phase to ground voltage continuously at zero gauge pressure of SF₆ gas due to its leakage.

5.9.6 If multibreak interrupters are used these shall be so designed and augmented that a uniform voltage distribution is developed across them. Calculations/test reports in support of the same shall be furnished along with the bid. The thermal and voltage withstands of the grading elements shall be adequate for the service conditions and duty specified.

5.10 PORCELAIN HOUSING

5.10.1 The porcelain housing shall be of single piece construction without any joint or coupling. It shall be made of homogeneous, vitreous porcelain of high mechanical and dielectric strength. Glazing of porcelain shall be uniform brown or dark brown colour with a smooth surface arranged to shed away rain water or condensed water particles (fog). The type and profile of the porcelain insulator sheds shall be in accordance with IEC-815 joints as per IEC-233.

5.11 ADDITIONAL REQUIREMENTS :

a) The circuit breakers shall be single pressure type, the design and construction of the circuit breaker shall be such that there is minimum possibility of gas leakage and entry of

moisture. There should not be any condensation of SF6 gas on the internal insulating surface of the circuit breaker.

- b) All gasketed surfaces shall be smooth, straight and reinforced, if necessary to minimize distortion and to make a tight seal, the operating rod connecting the operating mechanism to the arc chamber (SF6 media) shall have adequate seals, Double –O—ring seals and test holes for leakage test of the internal seal shall be provided on each static joint.
- c) In the interrupter assembly there shall be an absorbing product box to eliminate SF6 decomposition products and moisture. The material used in the construction of the circuit breakers shall be fully compatible with SF6 gas.
- d) Each pole shall form an enclosure filled with SF6 gas independent of two other poles. The SF6 density of each pole shall be monitored and regulated by individual pressure switches.
- e) The SF6 gas density monitor shall be adequately temp. compensated. The density monitor shall meet the following requirements:
 - i) It shall be possible to dismantle the density monitor for checking/replacement without draining the SF6 gas by using suitable interlocked non-return couplings.
 - ii) It shall damp the pressure pulsation while filling the gas in service so that the flickering of the pressure switch contacts does not take place.
 - iii) A pressure indicator (pressure gauge) shall also be supplied.
- f) Means for pressure relief shall be provided in the gas chamber of circuit breaker to avoid the damages or distortion during occurrence of abnormal pressure increase or shock waves generated by internal electric fault occurs. The position of vents, diaphragms and pressure relief devices shall be so arranged as the minimize danger to the operators in the event of gas or vapour escaping under pressure.
- g) Facility shall also be provided to reduce the gas pressure within the breaker to a value not exceeding 8 millibars within 4 hours or less. Each circuit breaker shall be capable of withstanding this degree of vacuum without distortion or failure of any part.
- h) Sufficient SF6 gas shall be provided to fill all the circuit breakers installed. **In addition to this 20% of the total gas requirement shall be supplied in separate cylinders as spare requirement.**
- i) Provisions shall be made for attaching an operation analyzer after installation at site to record contact travel, speed and making measurement of operation timings, pre insertion timing of closing resistor, synchronization of contacts in one pole.

5.12 SULPHUR HEXAFLUORIDE GAS (SF6 GAS) :

- a) The SF6 gas shall comply with IEC-376, 376A and 376B and be suitable in all respects for use in the switchgear under the worst operating conditions.
- b) The high pressure cylinders in which the SF6 gas is shipped and stored at site shall comply with requirements of the following standards and regulations:

IS:4379 Identification of the contents of industrial gas cylinders.

IS: 7311 Seamless high carbon steel cylinders for permanent and high pressure liquifiable gases.

The cylinders shall also meet Indian Boiler regulations.

- c) Test: SF6 gas shall be tested for purity, dew point, break down voltage, water contents as per IEC-376, 376A and 376B and test certificates shall be furnished to owner indicating all the tests as per IEC-376 for each lot of SF6 gas.

5.13 PREINSERTION RESISTOR (PIR)

DELETED

5.14 DUTY REQUIREMENTS

5.14.1 The circuit breaker shall be totally restrike free under all duty conditions. Opening resistors shall not be used.

5.14.2 The circuit breaker shall meet the duty requirements for any type of fault or fault location, for line charging and dropping when used on an effectively grounded system and perform make and break operations as per stipulated duty cycles satisfactorily. It shall withstand the maximum expected dynamic loads (including the seismic) to which the circuit breaker may be subjected during its 45 years service life.

5.14.3 The circuit breaker shall be capable of:

- i) Interrupting the steady and transient magnetizing current corresponding to 420 kv/245 KV and 145 KV class transformers of 100 MVA & 160 MVA ratings respectively.
- ii) Interrupting line charging current as given in clause 4.0, "Principal Parameters" of this specification with a temporary overvoltage as high as 1.5 p.u. without restrikes.
- iii) Clearing short line faults (Kilometric faults) with source impedance behind the bus equivalent to symmetrical fault current specified.
- iv) Breaking inductive currents of 0.5 to 10 A without switching overvoltage exceeding 2.3 p.u.
- v) Breaking 25% of the rated fault current at twice rated voltage under phase opposition condition.

5.14.4 The critical current, which gives the longest arc duration at lockout pressure of extinguishing medium and the arc duration shall be indicated.

5.14.5 The breaker shall satisfactorily withstand the high stresses imposed on them during fault clearing, load rejection and re-energization of lines with trapped charges. The breaker shall ALSO WITHSTAND THE VOLTAGE SPECIFIED IN CLAUSE 4.0 “principal Parameters” of this specification.

5.15 TOTAL BREAK TIME

5.15.1 The “Total Break Time” as specified in clause 4.0, “Principal Parameters” of this section shall not be exceeded under any of the following duties:

i) Test duties 1,2,3,4,5 (with TRV as per IEC-62271-100)/as per related IS.

ii) Short line fault L90, L75 (with TRV as per IEC-62271-100) /as per related IS.

5.15.2 The Bidder may please note that there is only one specified break time of the breaker which shall not be exceeded under any duty conditions specified such as with the combined variation of the trip coil voltage, (70-110%) spring-spring operation and arc extinguishing medium pressure etc. while furnishing the proof for the total break time of complete circuit breaker, the Bidder may specifically bring out the effect of non-simultaneity between contacts within a pole or between poles and show how it is covered in the guaranteed total break time.

5.15.3 The values guaranteed shall be supported with the type test reports.

5.16 OPERATING MECHANISM AND ASSOCIATED EQUIPMENTS

5.16.1 The circuit breaker shall be designed for electrical local as well as remote control. In addition there shall be provision for local mechanical control (emergency trip).

5.16.2 SPRING OPERATED MECHANISM:

The operating mechanism for 420 Kv/245 KV / 145 KV class breakers shall be of **spring –spring type only** operated by electrical control. The mechanism shall be adequately designed for the specified tripping and re closing duty. The entire operating mechanism control circuitry & etc as required, shall be housed in an outdoor type, with **Aluminium alloy enclosure(minimum 3mm thickness)**. This enclosure shall conform to the degree of protection IP-55 of IS- 2147. The enclosure shall be invariably mounted on a separate concrete plinth.

5.16.3 All working parts in the mechanism shall be of corrosion resistant material. All bearings which require greasing, shall be equipped with pressure grease fittings.

5.16.4 The design of the operating mechanism shall be such that it shall be practically maintenance free. The guaranteed years of maintenance free operation, the number of full load and full rated short circuit current breaking/operation without requiring any maintenance or

overhauling, shall be clearly stated in the bid. As far as possible the need for lubricating the operating mechanism shall be kept to the minimum and eliminated altogether if possible.

5.16.5 The operating mechanism shall be non-pumping (and trip free) electrically and mechanically under every method of closing. There shall be no rebounds in the mechanism and it shall not require any critical adjustments at site. Operation of the power operated closing device, when the circuit breaker is already closed, shall not cause damage to the circuit breaker or endanger the operator, provision shall be made for attaching an operation analyzer to facilitate testing of breaker at site.

5.16.6 A mechanical indicator shall be provided to show open and close position of the breaker. It shall be located in a position where it will be visible to a man standing on the ground level with the mechanism housing closed. An operation counter shall also be provided in the central control cabinet.

5.16.7 The supplier shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual for the circuit breaker.

5.16.8 The Breaker shall have spare auxiliary switches for Owners use (I.e, for Interlocking, indication, contacts to main and back up relay etc). A minimum of 20 N/O(52a) & 20 N/C (52b) spare auxiliary switch contacts should be provided.

5.17 CONTROL

5.17.1 The close and trip circuits shall be designed to permit use of momentary contact switches and push buttons.

5.17.2 Each breaker pole shall be provided with two (2) independent tripping circuits, valves and coils each connected to a different set of protective relays.

5.17.3 The breaker shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. However, provisions shall be made for local electrical control. For this purpose a local / remote selector switch and close and trip push buttons shall be provided in the breaker central control cabinet. Remote located push buttons and indicating lamps shall be provided by purchaser.

5.17.4 The trip coils shall be suitable for trip circuit supervision. The trip circuit supervision relay would be provided by the purchaser. Necessary terminals shall be provided in the central control cabinet of the circuit breaker by the supplier.

5.17.5 Closing coil shall operate correctly at all values of voltage between 85% and 110% of the rated voltage. Shunt trip shall operate correctly under all operating conditions of the circuit breaker upto the rated breaking capacity of the circuit breaker and at all values of supply voltage between 70% and 110% of rated voltage. However, even at 50% of rated voltage, the breaker shall be able to perform all its duties. If additional elements are introduced in the trip coil circuit their successful operation and reliability for similar applications on outdoor circuit

breakers shall be clearly brought out in the additional information schedules. In the absence of adequate details the offer is likely to be rejected.

5.17.6 Suitable relay for monitoring of DC supply voltage to the control cabinet shall be provided. The pressure switches used for interlock purposes shall have adequate contact ratings to be directly used in the closing and tripping circuits. In case the contacts are not adequately rated and multiplying relays are used then the interlock for closing/opening operation of breaker shall be with No logic of the relay i.e. if the DC supply to the interlock circuit fails then operation lockout shall take place.

5.17.7 For all types of operating mechanism a local manual closing device which can be easily operated by one man standing on the ground shall also be provided for maintenance purposes and direction of motion of handle shall be clearly marked.

5.17.8 The auxiliary switch of the breaker shall be preferably positively driven by the breaker operating rod and where due to construction features, same is not possible a plug in device shall be provided to simulate the opening and closing operations of circuit breaker for the purpose of testing control circuits.

5.18 MOTOR COMPRESSED SPRING CHARGING MECHANISM

Spring operated mechanism shall be complete with motor, **opening spring, closing spring** and all other necessary accessories to make the mechanism a complete unit. Breaker operation shall be independent of motor which shall be used solely for the purpose of charging the closing spring. Motor rating shall be such that it requires only 15 seconds for fully charging the closing spring. Closing operation shall compress the opening spring and keep ready for tripping. The mechanism shall be provided with means for charging the spring by hand. This operation shall be carried out with the doors of the cubicle open. During the process no electrical or mechanical operation of the mechanism shall endanger the operator or damage the equipment. A mechanical indicating device shall be provided to indicate the state of the charge spring and shall be visible with the door of the cubicle closed. An alarm shall be provided for spring failing to be charged within a pre-set time after circuit breaker closing. The spring mechanism shall be fitted with a local manual release, preferably by a push button to avoid inadvertent operation. Means shall be provided for discharging the spring when the circuit breaker is in the open position without circuit breaker attempting to close.

Opening spring and closing spring with limit switches for automotive charging and other necessary accessories to make the mechanism a complete operating unit shall also be provided.

As long as power is available to the motor, a continuous sequence of the closing and opening operations shall be possible. The motor shall have adequate thermal rating for this duty.

After failure of power supply to the motor one close open operation shall be possible with the energy contained in the operating mechanism.

Breaker operations shall be independent of the motor which shall be used solely for compressing the closing spring. Facility for manual charging of the closing spring shall also be provided. The motor rating shall be such that it requires not more than 15 seconds for full charging of the closing spring.

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

When closing spring are discharged after closing a breaker, closing spring shall automatically be charged for the next operation and an indication of this shall be provided in the local and remote control cabinet.

The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current also to provide the required energy for the tripping mechanism in case the tripping energy is derived from the operating mechanism.

Provision shall be made to prevent a closing operation of the breaker when the spring is in the partial charged condition. Mechanical interlocking shall be provided in the operating mechanism to prevent discharging of closing spring when the breaker is already in the closed position.

5.18.1 OPERATED MECHANISM FOR 400 KV BREAKERS.

The operating mechanism for 420 KV circuit breakers shall also be spring operated mechanism.(Closing spring and opening also spring).

5.19 OPERATING MECHANISM HOUSING

The operating mechanism housing/control cabinet shall conform to the requirement specified in clause 5.29. The entire operating mechanism and control mechanism control circuitry & etc as required, shall be housed in an outdoor type, made out of **Aluminium alloy sheet of 3mm thickness** enclosure. This enclosure shall conform to the degree of protection IP-55 of IS-2147.

5.20 INTERLOCKS

It is proposed to electrically interlock the circuit breaker with purchaser's associated air break isolating switches in accordance with switch yard safety interlocking scheme. The details of the scheme will be furnished to the supplier. All accessories required on breaker side for satisfactory operation of the scheme shall be deemed to be included in the scope of supply of this specification.

5.21 SUPPORT STRUCTURE

The supplier shall indicate the price of support structure along with the foundation bolts required separately in the bid proposal sheets and these shall be considered in evaluation. Purchaser reserves the right to procure these from the supplier or through separate contract. However, in case the equipment offered have integral support structure or the specialties of the breaker are such that support structures have to be provided by the supplier, the prices of these support structure shall be included in the price of the equipment and same shall be indicated clearly in the bid proposal sheet. The support structure shall meet the following requirements:

- 1) The minimum vertical clearance from any energized metal part to the bottom of the circuit breaker (structure) base, where it rests on the foundation pad, shall be minimum 8 mtrs for 400 KV, 5.5 mtrs for 245KV & 4.6 mtrs for 145 KV.
- 2) The minimum vertical distance from the bottom of the lowest porcelain part of the bushings, porcelain enclosures or supporting insulators to the bottom of the circuit breaker base, where it rests on the foundation pad shall be 2.55 mtrs. for all voltages.
- 3) The minimum clearance between the live parts and earth shall be 3.5 mtrs for 400 KV, 2.4 mtrs for 245 KV and 1.5 meters for 145 KV.

5.22 FITTINGS AND ACCESSORIES

5.22.1 Following is a partial list of some of the major fittings and accessories to be furnished by supplier in the central control cabinet. Number and exact locations of these parts shall be indicated in the bid.

- a) Central control cabinet in accordance with clause no. 5.29 complete with
 - i) Cable glands.
 - ii) Local/remote changeover switch.
 - iii) Operation counter.
 - iv) SF6 pressure gauges.
 - v) Control switches to cut off control power supply.
 - vi) Fuses as required.
 - vii) The number of terminals provided shall be adequate enough to wire out all contacts and control circuits plus 24 terminals spare for owner's use.

All the terminal blocks to be used in the operating mechanism and control cubicle should be of stud type of Poly-amide/Melamine material of make like Elmex (OAT-6 for non-disconnecting type and OAT 6T for disconnecting type) / Connectwell (Equivalent).

- b) Anti-pumping relay.

c) Rating and diagram plate in accordance with IEC / IS incorporating year of manufacture.

5.23 PAINTING, GALVANISING AND CLIMATE PROOFING

5.23.1 All interiors and exteriors of tanks and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter and the surfaces treated by phosphating (e.g. seven tank phosphating sequence). All steel surfaces in contact with insulating oil, as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paint.

5.23.2 All metal surfaces exposed to atmosphere shall be given, in addition to the treatment described in clause 5.23 two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limits specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external paintings shall be as per shade no. 697 of IS:5.

5.23.3 Paint inside the metallic housing shall be of anti-condensation type and the paint on outside surfaces shall be suitable for outdoor installation.

5.23.4 All components shall be given adequate treatment of climate proofing as per IS:3202 so as to withstand corrosive and serve service conditions.

5.24 GALVANISING

All ferrous parts including all sizes of nuts, bolts, support channels, structures, etc. as also the mechanism housing shall be hot dip galvanized conforming to latest version of IS:2629. Spring washers shall be electro galvanized.

5.25 EARTHING

The operating mechanism housing, control cabinets, dead tanks, support structure etc. shall be provided with two separate earthing terminals suitable for bolted connection to 50X8 mm mild steel flat to be provided by the Purchaser for connection to station earth mat.

5.26 NAME AND RATING PLATES:

Circuit breaker and its operating device shall be provided with a rating plate or plates marked with but not limited to following data:

- a) Manufacturer's name or trade mark.
- b) Serial Number or type designation making it possible to get all the relevant information from the manufacturer.
- c) Year of manufacture.

- d) Rated voltage.
- e) Rated insulation level.
- f) Rated frequency.
- g) Rated normal current.
- h) Rated short circuit breaking current.
- i) First pole to clear factor.
- j) Rated duration of short circuit.
- k) Rated auxiliary D.C. supply voltage of closing and opening devices.
- l) Rated pressure of compressed air gas for operation and interruption.
- m) Rated out of phase breaking current.
- n) Rated supply voltage of auxiliary circuits.
- o) Rated supply frequency of auxiliary circuits.
- p) Number of closing & Tripping coils
- q) Opening time & closing time

Other information are as per IS 12729/IEC 60694.

The coils of operating devices shall have a reference mark permitting the data to be obtained from the manufacturer.

The rating plate shall be visible in position of normal service and installation. The rating plate shall be weather proof and corrosion proof.

5.27 LIMITS OF TEMPERATURE RISE

The temperature rise on any part of equipment shall not exceed the maximum temperature rise specified below under the conditions specified in test clauses. The permissible temperature rise indicated is for a maximum ambient temperature of 50 deg. C. If the maximum ambient temperature rises, permissible values shall be reduced accordingly.

Sl. No.	Nature of the part or of the liquid	Maximum Value of	
		Temp.	Temp. rise at a max. ambient air temp. not exceeding 50 deg. C.
1.	Contacts in air, silver-faced copper, copper alloy or aluminium alloy [see notes (i) and (ii)]	105	55

	Bare copper or tinned aluminium alloy.	75	25
2.	Contacts in oil: Silver-faced copper, copper alloy or aluminium alloy (see note ii) Bare copper or tinned aluminium alloy	90 80	40 30
3.	Terminals to be connected to external conductors by screws or bolts silver faced (see note iii)	105	55
4.	Metal parts acting as springs	See Note iv	See note iv
5.	Metal parts in contact with insulation of the following classes: Class Y: (for non-impregnated materials) Class A: (for materials immersed in oil or impregnated) Class E: in air in oil Class B: in air in oil Class F: in air in oil Enamel: Oil base Synthetic, in air Synthetic, in oil	90 100 120 100 130 100 155 100 100 120 100	40 50 70 50 80 50 105 50 50 70 50
6.	Any part of metal or of insulating material in contact with oil, except contacts	100	50

7.	Oil	90	40
----	-----	----	----

Notes:(i)When applying the temperature rise of 55 deg. C, care should be taken to ensure that no damage is caused to the surrounding insulating materials.

(ii) The quality of the silver facing shall be such that a layer of silver remains at the points of contact after the mechanical endurance test. Otherwise, the contacts shall be regarded as “bare”.

(iii) The values of temperature and temperature rise are valid whether or not the conductor connected to the terminals is silver-faced.

(iv) The temperature shall not reach a value whether the elasticity of the material is impaired. For pure copper, this implies a temperature limit of 80 deg. C.

5.28 TERMINAL CONNECTORS

5.28.1 The terminal connectors shall meet the following requirements:

- a) Terminal connectors shall be manufactured and tested as per IS: 5561.
- b) All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- c) No part of a clamp shall be less than 10 mm thick.
- d) All ferrous parts shall be hot dip galvanized conforming to IS: 2633.
- e) For bimetallic connectors, copper alloy liner of minimum thickness of 2 mm shall be cast integral with aluminium body.
- f) Flexible connectors shall be made from tinned copper.
- g) All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- h) Connectors shall be designed to be corona free in accordance with the requirements stipulated in IS: 5561.

5.29 SPECIFICATION FOR CONTROL CABINETS:

1. Control cabinets shall be of the free standing floor mounting type.
2. Control cabinet of the operating mechanism shall be made out of **Aluminium alloy sheet (minimum 3 mm thickness). The operating mechanism shall be strong,rigid & not subject to rebound.** Hinged door shall be provided with padlocking arrangement. Sloping rain hood shall be provided to cover all sides. 15 mm thick neoprene or better type of gaskets shall be provided to ensure degree of protection of at least IP55 as per IS: 2147.

3. Bus bars shall be of tinned copper of adequate cross-section to carry the normal current, without exceeding the permissible temperature rise over an ambient temperature of 50 deg. C outside the cubicle. The buses shall be braced to withstand forces corresponding to short circuit current of 25 KA.
4. Motors rated 1 kw and above being controlled from the control cabinet would be suitable for operation on a 415 V, 3 phase 50 Hz system. Fractional KW motors would be suitable for operation on a 240 V, 1-phase, 50 Hz supply system.
5. Isolating switches (MCBs) shall be group operated units (3 pole for use on 3-phase supply systems and 2 pole for single phase supply systems) quick make quick break type, capable of breaking safely and without deterioration, the rated current of the associated circuit. Switch handle shall have provision for locking in both fully open and fully closed positions.
6. Push buttons shall be rated for not less than 6 Amps, 415 V A.C. or 2 Amps, 220 V D.C. and shall be flush mounted on the cabinet door and provided with appropriate name plates. Red, Green and Amber indicating lamps shall be flush mounted.
7. For motors up to 5 KW, contactors shall be direct-on-line, air break, single throw type and shall be suitable for making and breaking the stalled current of the associated motor which shall be assumed equal to 6.5 times the full load current of the motor at 0.2 p.f. For motors above 5 KW, automatic star delta type starters shall be provided. 3 pole contactors shall be furnished for 3 phase motors and 2-pole contactors for single phase motors. Reversing contactors shall be provided with electrical interlocks between forward and reverse contactors. If possible, mechanical interlocks shall also be provided. Contactors shall be suitable for uninterrupted duty and shall be of duty category class AC4 as defined in IS: 2959. The main contacts of the contactors shall be silver plated and the insulation class for the coils shall be class E or better. The dropout voltage of the contactors shall not exceed 70% of the rated voltage.
8. Contactors shall be provided with a three element, positive acting, ambient temperature compensated, time lagged, hand reset type thermal overload relay with adjustable setting, hand reset button shall be flush with the front door of the cabinet and suitable for resetting with starter compartment door closed.
9. Single phasing preventer relay shall be provided for 3 phase motors to provide positive protection against single phasing.
10. Mini starters shall be provided with no volt coils whenever required.
11. Purchaser's power cables will be of 1100 volts grade stranded aluminium conductor. PVC insulated, PVC sheathed single steel wire armoured and PVC jacketed. All necessary

cable terminating accessories such as glands, crimp type tinned copper lugs etc. for power as well as control cables shall be included in supplier's scope of supply. Suitable brass cable glands shall be provided for cable entry.

12. Wiring for all control circuits shall be carried out with 1100 volts grade PVC insulated tinned copper stranded conductors of sizes not smaller than 2.5 sq. mm. Atleast 10% spare terminal blocks for control wire terminations shall be provided on each panel. The terminal blocks shall be of non-disconnecting stud type. All terminals shall be provided with ferrules indelibly marked or numbered and these identifications shall correspond to the designations on the relevant wiring diagrams. The terminals shall be rated for adequate capacity which shall not be less than 10 Amps.

13. Separate terminal blocks shall be provided for terminating circuits of various voltage classes. CT loads shall be terminated on a separate block and shall have provision for short circuiting the CT secondary terminals.

14. Control cabinet shall be provided with 240 V, 1-phase 50 Hz, 20 W CFL TUBE light fixture and a suitably rated 240 V, 1-phase, 5 amps, 3 pin socket for hand lamps.

15. Strip heaters shall be provided inside each cabinet complete with thermostat (preferably differential type) to prevent moisture condensation. Heaters shall be controlled by suitably rated double pole miniature Circuit Breakers.

16. Signal lamps provided shall be of neon screw type with series resistors, enclosed in bakelite body. Each signal lamp shall be provided with a fuse integrally mounted in the lamp body.

17. Electric measuring instruments shall be of moving iron type. Ammeters for measuring current upto 30 Amps shall be directly connected while those for measuring above 30 Amps shall be connected through suitable CBs. Ammeters shall be provided with selector switches.

18. Items inside the cabinet made of material shall be coated with a fungus resistant varnish.

5.30 MOTORS :(UNIVERSAL MOTOR)

Motors shall be universal type suitable for operation in AC & DC supply, as per IS:325 of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment.

6.1.1 TESTS

Type Tests

All the equipments offered shall be fully type tested as per the relevant standards(**IEC-62271-100**,IEC-60694/IS-12729 with latest amendments) **& tests as indicated below. The bids offering equipment not type tested will be rejected.** In case, the equipment of the type & design offered has already been type tested, the bidder shall furnish four sets of the type test reports along with the offer. **The test must have been conducted not later than five years from the date of opening of the bids.** The purchaser reserves the right to demand repetition of some or all the type & additional type tests in the presence of his representative. For this purpose, the bidder may quote unit rates for carrying out such type tests. For any change in the design/type already type tested the design/type offered against this specification, the purchaser reserves the right to demand repetition of tests without any extra cost or reject the bid without any intimation.

Type Tests:--(As per IEC-62271-100 with latest amendments)

- 1) Dielectric Test(LI Voltage,PF Voltage Withstand(Dry&Wet)& etc)
- 2) RIV Test
- 3) Measurement of resistance of the main circuit
- 4) Temperature rise Test
- 5)Short Time withstand current & Peak withstand current Test
- 6) Tightness Test
- 7) Mechanical Operation Test, Mechanical endurance test
- 8)Short Circuit making & Breaking Test
- 9) Capacitive Current, Switching Test , Line charging current breaking Test
- 10)Test to verify degree of protection
- 11)EMC Test

Routine Tests:-

- 1) Dielectric Tests on the main Circuit ,auxiliary & control circuits
- 2) Measurement of resistance of the main circuit.
- 3) Tightness Test

4) Design & Visual Checks

5) Mechanical operation Test

6) Operating time of the device, motor Characteristics, measurement of coil current & resistance , Sf6 gas pressure monitoring , control Circuit , anti-pumping, dimensions, nameplate details , contact travel & timing checks & contact speed in m/sec.

The following additional type tests are proposed to be conducted. The type test charges for these tests shall be quoted along with other type tests(AS indicated above) as per IEC/ IS in the relevant schedule & the same shall be indicated in the total bid price.

1) Corona extinction voltage test (As per Annexure-I)

2) Out of phase closing tests per IEC

3) Line charging breaking current test

4) Seismic Withstand test in unpressurised condition (as per Annexure-I)

6.1.2 The prices quoted by the bidder towards conductance of type tests & additional type tests shall be taken in to consideration for bid evaluation.

6.2 TYPE, ACCEPTANCE AND ROUTINE TESTS

6.2.1 All acceptance and routine tests as stipulated in IEC-62271-100,IEC-60694/IS-12729, IS 13118 with its latest amendments & routine tests as indicated above shall be carried out by the supplier in the presence of purchaser's representative. Also type test on one unit may be carried out by the supplier in the presence of purchaser's representative if purchaser decides & if such facility will be available either in the manufacturer's laboratory or in the CPRI. Rates for these tests must be indicated in the Annexure-IV, V, of Section-III of this tender specification. If the manufacturer wants to do the above tests in free of cost, then he may indicate the rates as 'NIL'. Purchaser reserves the right to conduct type test or may not insist for this test.

6.2.2 In addition to the mechanical and electrical tests specified by IEC, the following shall also be performed.

Speed curves for each breaker shall be obtained with the help of a suitable operation analyzer to determine the breaker contact movement during opening, closing, auto-reclosing and trip free operation under normal as well as limiting operating conditions (control voltage, pressure etc.). The tests shall show the speed of contacts directly at various stages of operation, travel of contacts, opening time, closing time, shortest time between separation and meeting of contacts at break/make operation etc. This test shall also be performed at site for which the necessary operation analyzer along with necessary transducers, cables, console, etc. shall be furnished as mandatory maintenance equipment.

6.2.3 Immediately after finalization of the program of type/acceptance/routine testing, the supplier shall give sufficient advance intimation (20 days) to the purchaser to enable him to depute his representative for witnessing the tests.

6.3 ADDITIONAL TESTS

The purchaser reserves the right for carrying out any other tests of a reasonable nature at the works of the supplier/laboratory or at any other recognized laboratory/research institute in addition to the above mentioned type, acceptance and routine tests at the cost of the purchaser to satisfy that the material complies with the intent of this specification.

7.0 INSPECTION

7.1 The inspection may be carried out by the purchaser at any stage of manufacture. The supplier shall grant free access to purchaser's representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective.

The supplier shall keep the purchaser informed in advance, about the manufacturing program so that arrangement can be made for inspection. Before offering for inspection, the supplier shall furnish shop routine test certificates and calibration reports of the equipment/instruments to be used during testing. After acceptance of these calibration reports and shop routine test certificate, inspecting officer of the purchaser will be deputed for witnessing such inspections.

7.2 The purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items.

7.3 No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested or unless the same is waived by the purchaser in writing.

8.0 QUALITY ASSURANCE PLAN:

The bidder shall invariably furnish following information along with his offer, failing which his offer, shall be liable for rejection.

i) Statement giving list of important raw materials including but not limited to:

- (a) Contact Material
- (b) Insulation
- (c) Porcelain

- (d) Oil
- (e) Sealing material
- (f) Contactor, limit switches, etc. in control cabinet.

Names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested, list of test 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 accessories.

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

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

vi) List of testing equipment available with the Bidder for final testing of breakers vis-à-vis, the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in the relevant schedule i.e. schedule of deviations from specified test requirements.

vii) The supplier shall, within 30 days of placement of order, submit following information to the purchaser.

1) List of raw materials as well bought out accessories and the names of sub-suppliers selected from those furnished along with offer.

2) Type test certificates of the raw material and bought out accessories.

3) Quality assurance plan (QAP) with hold points for purchaser's inspection (if purchaser will desires).

The supplier shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembling breaker

9.0 DOCUMENTATION

9.1 All drawings shall conform to relevant International Standards Organization (ISO) Specification/ISS. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. Units.

9.2 List of Drawings and Documents:

The Bidder shall furnish four sets of relevant descriptive and illustrative published literature pamphlets and the following drawings/documents for preliminary study along with the offer.

- a) General outline drawings showing dimensions and shipping weights, quantity of insulating media, air receiver capacity etc.
- b) Sectional views showing the general constructional features of the circuit breaker including operating mechanism, arcing chambers, contacts with lifting dimensions for maintenance.
- c) Schematic diagrams of breaker offered for control supervision and reclosing.
- d) Structural drawing, design calculations and loading data for support structures.
- e) Foundation drilling plan and loading data for foundation design.
- f) Type test reports .

9.3 The supplier shall, within 2 weeks of placement of order submit four sets of final version of all the above drawings for purchaser's approval. The purchaser shall communicate his comments/approval on the drawings to the supplier within reasonable period. The supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for purchaser's approval within two weeks from the date of comments. After receipt of purchaser's approval, the supplier shall, within three weeks, submit 15 prints and one good quality reproducibles of the approved drawings for purchaser's use.

9.4 The supplier shall also furnish fifteen copies of manuals covering erection, commissioning, operation and maintenance instructions and all relevant information and approved drawings pertaining to the main equipment as well as auxiliary devices. Marked erection drawings shall identify the component parts of the equipment as shipped to enable purchaser to carry out erection with his own personnel. Each manual shall also contain one set of all the approved drawings, type test reports as well as acceptance reports of the corresponding consignment dispatched.

9.5 The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the supplier risk.

9.6 TEST REPORTS

i) Four copies of acceptance test reports and type test reports shall be furnished to the purchaser as per the inspection of testing. One copy will be returned, duly certified by the purchaser and only there afterwards shall the material be dispatched.

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

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

10 PACKING AND FORWARDING

The equipment shall be packed in suitable crates so as to withstand handling during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing and handling. The easily damageable materials shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost.

Each consignment shall be accompanied by a detailed packing list containing the following information:

- a) Name of the consignee.
- b) Details of consignment.
- c) Destination.
- d) Total weight of consignment.
- e) Sign showing upper / lower side of the crate.
- f) Handling and unpacking instructions.
- g) Bill of material indicating contents of each package and spare material.
- h) Manuals containing approved drawings & test reports

The supplier shall ensure that the packing list and bill of material are to be supplied in advance to the purchaser & to the consignees before dispatch.

11.0 SUPERVISION OF ERECTION, TESTING AND COMMISSIONING (ET&C)

The erection, testing and commissioning of the breakers shall be supervised, by trained personnel (Engineer) of the supplier who shall direct the sequence of ET&C and make the necessary adjustments to the apparatus and correct in the field any errors or omissions in order to make the equipment and material properly perform in accordance with the intent of this specification. The Engineer shall also instruct fully (up to the satisfaction) to the plant operators, in the operation and maintenance of equipment furnished. The supplier shall be responsible for any damage to the equipment, on commissioning the same, if such damage results from faulty or improper ET&C procedure. Purchaser shall provide adequate number of skilled/semi-skilled workers as well as all ordinary tools and equipment and cranes required for breaker erection, at his own expense. Apart from the above, the purchaser shall not be responsible for any other expenses incurred by the supplier and against personal injuries to the Engineer etc., shall be to supplier's account. Special tools, if required for erection and commissioning shall be arranged by the supplier at his cost and on commissioning these shall be supplied to the purchaser, free of cost, for future use.

12.0 QUANTITY AND DELIVERY RERQUIREMENTS

i)The scope of supply shall include a supply of 25% extra-quantity of bolts, nuts, washers, split pins, cotter pins and such other small loose items free of cost.

SCHEDULE- A

TECHNICAL PARTICULARS AND GUARANTEES

1. Topographical and Meteorological site conditions

Location		State of ODISHA
Altitude	m	1000
Air Temperatures		
Minimum	□C	0
Maximum	□C	55
maximum daily average	□C	32
Humidity variation	per cent	100
Pollution level to IEC 815		Heavy
Airborne contamination, if any		Highly polluted
Isoceraunic level	day/annum	70
Seismic withstand factor (all equipment)	g	0.3
Maximum wind pressure	kg/sq. m	80.84
Wind velocity - (Wind Zone to IS 875)	m/sec	50
Average annual rain fall	cm	150

1	SYSTEM DETAILS	kV	400	220	132
1.1	Rated system voltage	kV	420	245	145
1.2	Earthing of system neutral		solid	solid	solid
1.3	System frequency	Hz	50	50	50
2	INSULATION LEVEL (at site altitude)				
2.1	Lightning impulse voltage withstand level, positive and negative polarity	kVp	1425	1050	650
2.2	Switching impulse voltage withstand level of insulation to ground, positive and negative polarity dry wet	kVp kVp	1050 1050	- -	- -
2.3	Power frequency withstand voltage dry wet	kV kV	520 520	460 460	275 275
2.4	Voltage below which corona shall not be visible	kV	320	176	105
2.5□	Maximum radio interference voltage level measured at 1.1 times $U_s/\sqrt{3}$ at 1 MHz	μV	<1000	<500	<500
2.6□ □	Minimum creepage to earth over insulation on rated service voltage (to IEC 815)	mm/kV	25	25	25

- ☐ **Us is rated system voltage**
- ☐ **Creepage distance across interrupter chambers shall be at least 10 percent greater than the creepage distance to earth and shall comply with the pollution conditions of IEC 815.**

2. - SWITCHGEAR DETAILS

Item No	Description	Particulars
	kV	420 245 145
1	TYPE OF SWITCHGEAR	
1.1	Type of switchgear GIS or Open terminal	Open terminal
1.2	Installation Outdoor	Outdoor Outdoor Outdoor
2	SHORT TIME CURRENT CAPACITY	
2.1	All equipment 3 seconds	kA 50 40 40
2.2	Maintenance earthing devices, 3 seconds	kA 50 40 40
3	CIRCUIT BREAKER	
3.1	Normal current rating	A 3150 3150 3150
3.2	Fault rating	
'3.2.1	Making current	kAp 125 100 100
'3.2.2	Breaking current (symmetrical)	kA 50 40 40
'3.2.3	Breaking current (asymmetrical)	% DC/kAp IEC 56 IEC 56 IEC 56 <50% <50% <50%
'3.2.4	Breaking current under out of phase conditions	kA 10 10 10
'3.2.5	Rated line charging current	A 600 125 50

					as per IEC	as per IEC
'3.2.6	Rated cable charging current	A	600	250 as per IEC	160 as per IEC	
'3.2.7	Rated inductive current	A	1 to 10 - 50 - 100 - 200			
'3.2.8	Maximum overvoltage factor on any switching duty	pu	<2.0	<2.0	<2.0	
3.3	Operating sequence					
'3.3.1	Normal		0-0.3 s - CO-3 min – CO			
'3.3.2	Auto reclosing		0-0.3 s - CO-3 min – CO			
'3.3.3	Delayed three phase auto reclose cycle adjustable dead time range	s	2-30	2-30	2-30	
		kV	420	245	145	
'3.3.4	High speed single phase auto reclose cycle adjustable dead time	s	0.3-20	0.3-20	-	
'3.3.5	Number of closing operations under out of synchronous conditions	(2.0 pu)	2	2	2	
3.4	Transient recovery voltage					
'3.4.1	First phase to clear factor		1.3	1.3	1.5	
'3.4.2	Recovery voltage parameter for 3 phase unearthed terminal fault		IEC 56	IEC 56	IEC 56	
'3.4.3	Short line fault parameter		IEC 56	IEC 56	IEC 56	
'3.4.4	Surge impedance for short line fault test	ohms	450	450	450	
'3.4.5	Minimum voltage to earth when switching capacitive currents, (1.4 times rated phase to earth voltage)	kV	340	198	117	

'3.4.6	Voltage across circuit breaker under out of phase switching conditions	pu	2	2	2
3.5	Electro mechanical performance				
'3.5.1	Maximum total break time throughout complete rating, ie trip coil initiation to final arc extinction	ms	40	50	50
'3.5.2	Maximum time interval between closure of first and last phase of three phase circuit breakers	ms	2	1	1
'3.5.3	Maximum time interval between closure of interrupters of one phase of the circuit breaker	ms	1	-	-
'3.5.4	Maximum time interval between opening of first and last phase of three phase circuit breaker	ms	3.3	3.3	3.3
'3.5.5	Maximum time interval between opening of interrupters of one phase of the circuit breaker	ms	1	-	-
		kV	420	245	145
4	Insulation level (IEC 694)				
41*	Lightning impulse withstand (1.2/50 wave) - positive and negative a. To earth, closed contacts b. Across, open contacts	kVp kVp kVp + kVACp	1425 - 1425 +(240)	1050 1050 -	650 650 -
4.2*+	Switching impulse withstand				

* Biased tests (Impulse + ACp), required on switchgear for 300 kV and above.

+ Wet tests are required on outdoor open-terminal switchgear.

	(250/ 2500 wave) - positive and negative				
	c. To earth, closed contacts	kVp	1050	-	-
	d. Across, open contacts	kVp	1050	-	-
		kVp + kVACp	900 +(345)	-	-
4.3	Power frequency withstand	Dry/wet			
	e. To earth, closed contacts - 1 minute	kV	520	460	275
	f. Across, open contacts - 1 minute	kV	610	530	315
4.4	Ancillary equipment				
4.5	Number of trip coils required		2	2	2
4.6	Number of closing coils required		1	1	1
4.7	Degree of protection		IP 55	IP 55	IP 55

TABLE 1. - 420KV CIRCUIT BREAKERS**(A) TERMINAL FAULT REQUIREMENTS - FOUR PARAMETER TRV**

Fault duty	Current kA (rms)	First test voltage U₁ (kV)	Time co-ord t₁ (μs)	TRV peak value U_c (kV)	Time co-ord t₂ (μs)	Time delay t_d (μs)	Volt co- ord u' (kV)	Time co-ord t' (μs)	Rate of rise U'/t kV (kV/μs)
10% symmetrical	5	-	-	787	88	11	262	4	8.9
30% symmetrical	15	446	89	669	668	5(22)	223	50(67)	5.0
60% symmetrical	30	446	149	669	671	2(37)	223	76(111)	3.0
100% symmetrical	50	446	223	624	669	2	223	113	2.0
100% Asym.	**	446	223	624	669	2	223	113	2.0
Asynchronous	12.5	686	446	857	1338	-	-	-	-
100% closing	125	-	-	-	-	-	-	-	-

** Dependent on circuit breaker opening time

*** 100% Sym and Assym duties shall either include ITRVs of Table III of IEC 56 or the SLF duties have been performed with $t_{dL} = 0$

(B) SHORT LINE FAULT REQUIREMENTS

Source side	50	343	171	480	513	2	171	88	2.0
				U_L	t_L	t_{dL}			U_L/t_L
Line side L90	45	-	-	54.9	6.1	0.5	-	-	9
Line side L75	37.5	-	-	137.3	18.4	0.5	-	-	7.46
Line side L 60	30	-	-	219	36.5	0.5	-	-	6

TABLE 2 - 245 kV CIRCUIT BREAKERS**(A) TERMINAL FAULT REQUIREMENTS - FOUR PARAMETER TRV**

Fault duty	Current kA (rms)	First test voltage U1 (kV)	Time co-ord t1 (μs)	TRV peak value Uc (Kv)	Time co-ordt2 (μs)	Time delay td (μs)	Volt co- ord u' (kV)	Time co-ord t' (μs)	Rate of rise U'/t kV (kV/μs)
10% symmetrical	5	-	-	459	66	8	153	30	7.0
30% symmetrical	15	300	60	450	450	5(15)	150	35(45)	5.0
60% symmetrical	30	260	87	390	392	2(22)	130	45(65)	3.0
100% symmetrical	50	260	130	364	390	2	130	67	2.0
100%	**	260	130	364	390	2	130	67	2.0

asymmetrical									
Asynchronous	12.5	400	260	500	780	-	-	-	1.54
100% closing	125	-	-	-	-	-	-	-	-

** Dependent on circuit breaker opening time

*** 100% Sym and Assym duties shall either include ITRVs of Table III of IEC 56 or the SLF duties have been performed with $t_{dL} = 0$

(B) SHORT LINE FAULT REQUIREMENTS

Source side	50	200	100	280	300	2	100	52	2.0
				U_L	t_L	t_{dL}			U_L/t_L
Line side L 90	45			32	3.6	0.5	-	-	8.9
Line side L 75	37.5			80	10.6	0.5	-	-	7.55
Line side L 60	30			128	21.3	0.5	-	-	6

TABLE 3 - 145 kV CIRCUIT BREAKERS**(A) TERMINAL FAULT REQUIREMENTS - FOUR PARAMETER TRV**

Fault duty	Current kA (rms)	First test voltage U1 (kV)	Time co-ord t1 (μs)	TRV peak value Uc (kV)	Time co-ordt2 (μs)	Time delay td (μs)	Volt co- ord u' (kV)	Time co-ord t' (μs)	Rate of rise U'/t kV (kV/μs)
10% symmetrical	4	-	-	272	45	6	91	21	6.0
30% symmetrical	12	178	36	266	270	5(9)	89	23(27)	5.0
60% symmetrical	24	178	59	266	266	2(15)	89	32(44)	3.0
100% symmetrical	40	178	89	249	267	2	89	46	2.0
100% asymmetrical	**	178	89	249	267	2	89	46	2.0
Asynchronous	10	296	178	370	534	-	-	-	1.67
100% closing	100	-	-	-	-	-	-	-	-

** Dependent on circuit breaker opening time

*** 100% Sym and Assym duties shall either include ITRVs of Table III of IEC 56 or the SLF duties have been performed with $t_{dL} = 0$

(B) SHORT LINE FAULT REQUIREMENTS

Source side	40	118	59	166	177	2	59	32	2.0
				U_L	t_L	t_{dL}			U_L/t_L
Line side L90	36	-	-	18.9	2.6	0.2	-	-	7.3
Line side L75	30	-	-	47.4	7.9	0.2	-	-	6.0
Line side L60	24	-	-	75.9	15.8	0.2	-	-	4.8

Item No	Description	Particulars			
		kV	420	245	145
1	MINIMUM FACTORS OF SAFETY FOR SWITCHGEAR				
1.1	Complete insulators based on electro-mechanical test		2.5	2.5	2.5
1.2	Insulator metal fittings based on elastic limit		2.5	2.5	2.5

1.3	Steel structures based on elastic limit of tension members and on crippling loads of compression members		2.5	2.5	2.5
1.4	Foundations for structures against overturning or uprooting under maximum simultaneous working loadings		2.5	2.5	2.5

8. CLEARANCES*

8.1 Clearances for busbars and connections

RATED SYSTEM VOLTAGE kV					
		36	145	245	420
BIL	kVpK	170	650	1050	1425
SIL	kVpK	-	-	-	1050
Minimum Clearance between Live metal and Earth	m	0.32	1.3	2.0	3.4
Minimum Clearance between Live metal of Different Phases	m	0.43	1.5	2.4	3.9
Safety Working Clearance Horizontal	m	2.3	3.2	3.3	5.4
Safety Working Clearance Vertical	m	2.9	3.7	4.5	6.4
Minimum height to base of insulation	m	2.4	2.4	2.6	2.7

* Based on BS 7354: 1990

Clearances apply only to equipment not subject to impulse voltage type tests.

They apply to conditions of maximum conductor swing and sag.

Item	Description		Particulars		
9	FINISH OF EQUIPMENT				
9.1	Outdoor equipment		Outdoor	Outdoor	Outdoor
9.1.1	Porcelains		Brown	Brown	Brown
9.1.2	Structures		Hot dip galvanized		
9.1.3	Cubicles and enclosures		As	specified	
10	LVAC EQUIPMENT				
10.1	Rated system voltage	V	415V-30 240V-10	415V-30 240V-10	415V-30 240V-10
10.2	Rated frequency	Hz	50	50	50
10.3	Method of earthing system neutral		Solidly earthed		
10.4	Type of equipment required (switchfuses, MCCBs, air circuit breakers etc)		Air circuit breaker MCCBs		
10.5	Voltage limits for correct operation of circuit breakers	%V %□	□10 □5	□10 □5	□10 □5
11	DC AUXILIARY SUPPLIES				
11.1	Nominal voltage of system	V	220	220	220
11.2	Voltage limits for correct operation of equipment	%	□10 □5	□10 □5	□10 □5
12	NOMINAL VOLTAGE OF AUXILIARY SUPPLIES				
12.1	Supply for electrical operation of circuit				

	breakers				
12.1 .1	Closing initiation	V dc	220	220	220
12.1 .2	Tripping	V dc	220	220	220
12.2	Power supply for compressor equipment		415	415	415
12.3	Power supply for spring and hydraulic charging motors	V ac	240	240	240
12.4	Supply for indication and alarm circuits	V dc	220	220	220

ANNEXURE – I

(CIRCUIT BREAKERS)

CORONA, RIV AND SEISMIC TEST PROCEDURES

Corona and Radio Interference Voltage (RIV) test:

1) General:

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage(RIV).

2) Test Levels:

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3) Test Methods for RIV

3.1 RIV tests shall be made according to measuring circuit as per International Sub-Committee on Radio Interference Publication 1- 1972 second edition. The measuring circuit shall preferably be tuned to frequency of 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used. The measuring frequency shall be recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be conducted in accordance with NEMA standard publication No. 107-1964 except as otherwise noted herein.

3.3 In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 metres of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurement. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, 115% and 130% of the specified RIV test voltage for all equipments unless otherwise specified.

3.5 The metering instruments shall be as per CISPR recommendation or equipment device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a properly tuned noise meter.

4.0 Test Methods for Visible Corona:

4.1 The purpose of this test is to determine the corona extinction voltage of apparatus and connectors, the test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset of extinction voltages, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 130% of RIV test voltage and maintained there for five minutes. The voltage will then be decreased slowly until all visible corona disappears. The voltage will then be raised slowly again to the same maximum voltage. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e., 85%, 100%, 115% and 130%. Additional photographs shall be taken at corona inception and extinction voltages. At least two photographs shall be taken in each case.

4.2 The “test to determine the visible corona extinction voltage” need not be carried out simultaneously with “test to determine RIV levels”. However, both tests shall be carried out with the same test set up and as little time duration between tests as possible. No modifications or treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of owner’s inspector if, the same, in his opinion, will not prejudice other tests.

B. Seismic Withstand Test:

The seismic withstand test on the complete equipment shall be carried out along with the supporting structures etc. The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the terminal pad of the equipment and any other point as agreed by the purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The detailed seismic test procedure shall be furnished for approval to the purchaser ,before offer for inspection.

TECHNICAL SPECIFICATION
FOR
36 KV VACCUM CIRCUIT BREAKERS
(OUT DOOR TYPE)

TECHNICAL SPECIFICATION FOR 36 K.V. VACCUM CIRCUIT BREAKERS
(OUTDOOR TYPE)

1.1 SCOPE:

36 K.V. 1430 MVA Circuit Breakers are intended to be purchased for installation at different Sub-stations. Some of the Sub-stations for which equipment are tendered are situated in coastal areas where saline climate prevails. The base structure of the circuit breakers must be galvanized.

1.2 POWER SUPPLY TO AUXILIARIES :

A.C. supply to auxiliaries will be 3 phase, 3 wire, 430 volt or single phase 250 volts at 50 C/s. The voltage variation will be within 10% and the frequency variation $\pm 5\%$.

1.03 33 K.V. CIRCUIT BREAKERS TYPE AND RATING :

The circuit breakers shall be vacuum type suitable for outdoor operation under the climatic conditions specified without any protection from sun and rain.

The circuit breaker shall have the following ratings :

- | | | | |
|-----|-------------------------------------|---|--|
| 1. | Number of poles | : | 3 (One unit with three phase making and breaking). |
| 2. | Frequency. | : | 50 C/s. |
| 3. | Nominal system voltage | : | 33 KV rms. |
| 4. | Highest system voltage | : | 36.0 KV rms. |
| 5. | Basic insulation level | : | 170 KVP |
| 6. | Power frequency test Voltage (wet). | : | 75 KV (rms.) |
| 7. | <u>Nominal Current.</u> | : | 1250 Amps rms. |
| 7a. | First pole to clear factor | : | 1.5 |
| 8. | Breaking capacity. | | |
| | (a) Symmetrical. | : | 25 KA/1430 MVA. |
| | (b) Asymmetrical. | : | 33 KA Peak. |
| 9. | Making capacity. | : | 62.5 KA Peak. |
| 10. | Continuous current rating. | : | 1600 Amps (RMS) |

- | | | |
|---|---|-------------------------|
| 11. Operating Duty. | : | 0-0.3 Sec-CO-3 Min-CO. |
| 12.(a) Break time | : | 3 Cycles |
| (b)Make time | : | 5 Cycles. |
| (c)Minimum reclosing time | : | 15 Cycle. |
| (d)Minimum dead time for reclosing | : | 15 Cycle |
| 13. Dry one minute power frequency withstand test voltage | | |
| a) Between line terminal | : | 75 KV rms. |
| b)Between line and body | : | 75 KV rms. |
| 14. Impulse withstand test voltage ; | | |
| a)Between terminal
with C.B. open. | : | 170 KV (Peak) |
| b)Between body & terminal | : | 170 KV (Peak) |
| 15. Insulator or bushing | | |
| a)Dry one minute power
Frequency voltage, | : | 75 KV |
| b)Wet one minute power
Frequency withstand Voltage. | : | 75 KV |
| c) Creepage distance | : | 580 mm (Minimum) |
| 16.Short time current
rating for 3 seconds. | : | Not less than 25 KA for |
| 17.Control circuit voltage | : | 220 V D.C |

1.04 **STANDARDS :**

The circuit breakers shall comply with the requirements of latest issue of IEC-62271-100,IEC-60694/IS12729:2004,IS-13118:1991, except wherein specified otherwise. Where the equipment offered confirm to any other standard the silent points of difference between the standard adopted and the IS or IEC recommendations shall be brought out in the tender. Equipment meeting any other authoritative standard which ensures an equal or better quality than the standard mentioned above is also acceptable.

CLIMATIC CONDITIONS :

The climatic conditions at site under which the equipment shall be operated satisfactorily are as follows :

- | | | |
|--|---|-------|
| Peak ambient air temperature | : | 50° C |
| Maximum temperature attainable by
an object exposed to sun. | : | 60°C |
| Minimum temperature of the air
in shade. | : | 0°C |
| Maximum yearly weighted average | : | 32° C |

ambient Temp.

Maximum daily average ambient temp	:	35deg C
Maximum humidity.	:	100%
Average number of thunder storm	:	70 Days per annum.
Average number of rainy days per Annum.	:	120
Average annual rainfall	:	1500 mm
Number of months of tropical Monsoon conditions per annum	:	4
Maximum wind pressure	:	260 kg/Sq.m.
Altitudes not exceeding.	:	1000 M

For the purpose of the specification, the limit of ambient temperature shall be 50° C peak and 45° C average over a 24 hours period.

Some of the breakers to be purchased against this specification are intended to be installed on the sea coast having extremely saline climate. Necessary anti corrosive provisions need be incorporated.

1.5 **GENERAL :**

1.6 The circuit breakers shall be of vacuum type. The breakers shall be furnished as a complete unit with all accessories and equipment in place and all internal wiring installed and terminated in the mechanism.

1.7 The circuit breakers shall provide rapid and smooth interruption of current under all conditions, completely suppressing all undesirable phenomena even under the most severe and persistent short circuit conditions or when interrupting small currents of leading or lagging reactive current. The details of any device incorporated to limit or control the rate of rise of restricting voltages across the circuit breaker contacts shall be stated. The over voltages caused by the circuit breaker switching on inductive or capacitive load shall not exceed, 2.5 times the normal phase to neutral voltage. The total break time for the circuit breakers throughout the range of their operating duty shall be stated in the tender and guaranteed.

1.8 **CONSTRUCTIONAL FEATURES :**

Each circuit breaker shall comprise 3 identical poles complete with a gang operated mechanism for specified duty. All these poles of the C.B. shall be linked together Electrically, Mechanically for specified duty.

The breaker shall be capable of interruptions of low reactive current (lagging/leading) without undue over voltage and restrike.

1.9 **CONTROL CUBICLE :**

A common control cubicle shall be furnished to house electrical controls, monitoring devices and all other accessories. The cubicle shall be of gasketed weather proof construction,

fabricated from sheet **Aluminum alloy / Galvanizing iron sheet having minimum 3 mm thick. The operating mechanism shall be strong, rigid and not subject to rebound.**

1.10 The cubicle shall have front access door with lock and keys and removable gland plate at the bottom for owner's cable entry. Thermostat controlled space heater, internal illumination lamp, 5 A 3 pin socket with individual on off switches shall be provided in the cubicle.

1.11 MOUNTING :

The circuit breakers shall be suitable for mounting on steel galvanized structures. The prices of necessary frames for mounting the circuit breaker shall be included with the offer. A ladder should be provided in the structure for easy access to the operating mechanism house. The ladder shall be of M.S with hot dip galvanised.

1.12 The circuit breakers shall consist of three identical single phase units with a common operating mechanism. All joints shall be welded so as to have adequate mechanical strength. The breaker porcelain shall be capable of withstanding all pressure resulting from any specified performance of the breaker.

The circuit breaker shall be supplied complete with the necessary lifting tools, foundation bolts and other accessories.

1.13 TEMPERATURE RISE :

The maximum temperature attained by any part of the equipment when in-service at site under continuous full load conditions and exposed to direct rays of sun shall not exceed the permissible limits fixed by approved specifications. When the standards specifies the limits of temperature rise these shall not exceed when corrected for the difference between ambient temperature at site and the ambient temperature specified in the approved specification. The corrections proposed shall be stated in the tender and shall be subject to approval of the purchaser.

1.14 INSULATION OF THE CIRCUIT BREAKERS :

1.15 The insulation to ground, the insulation between open contacts, the insulation between phases of the completely assembled circuit breakers, should be capable of withstanding satisfactorily die-electric test voltages corresponding to basic insulation level specified in clause-1.03.

1.16 The clearance in open air shall be as follows, unless the apparatus is impulse tested after complete assembly.

- | | | |
|------|---|---------|
| i) | Minimum clearance between phase : | 505 mm |
| ii) | Phase to Earth. : | 305 mm |
| iii) | Minimum clearance between live :
Parts and grounded objects. | 1400 mm |
| iv) | Minimum ground clearance to live: | 3700 mm |

part.

1.17 BUSHING AND INSULATIONS :

The basic insulation level of the insulating porcelains shall be as specified and shall be suitable for installation in contaminated atmospheres. The porcelains used shall be homogenous and free from cavities and other flaws. They shall be designed to have ample insulation, mechanical strength and rigidity for satisfactory operation under conditions specified above. The puncture strength of the bushings shall be greater than the flashover value. The bushings shall be entirely free from radio disturbance when operating at a voltage 10% above rated voltage and also be free from external corona.

Adequate means shall be provided to accommodate conductor expansion and there should not be any undue stressing of any part due to temperature change.

1.12 OPERATION MECHANISM :

1.12.1 The operating mechanism shall be spring operated type. In case of spring operating mechanism it shall be of motor operated having provision of hand operated spring charging type or by local/remote electric control under normal operation. The mechanism shall be trip from electrically and mechanically. All working parts in the mechanisms shall be corrosion resistant material and all bearings which require greasing shall be equipped with pressure grease fittings. The mechanism shall be strong, positive, quick in action and shall be removable without disturbing the other parts of the circuit breakers. The mechanisms of breaker shall be such that the failure of any spring will not prevent tripping.

1.12.2 The operating mechanism along with its accessories shall be mounted in a weather proof cabinet with hinged doors located near the breakers. A local control switch and the breaker position indicator shall be provided in the cabinet. The circuit breakers shall also be provided with means for manual operation for maintenance purposes.

1.12.3 The control circuits shall be designed to operate on 220V. d.c. It shall be possible to adopt to work on other voltages by simply changing the operating coils. The closing and operating coils shall be designed to operate satisfactorily at any control voltage from 70% to 115% of the normal rated voltage. A heater shall be provided in the cabinet to prevent moisture condensation.

1.12.4 Necessary cable glands for the cables of the operating mechanism shall be provided.

1.12.5 All the terminal blocks to be used in the operating mechanism should be of stud type of Poly-amide/Melamine material of make like Elmex (OAT-6 for non-disconnecting type and OAT 6T for disconnecting type) / Connectwell (Equivalent).

1.12.6 The Motor to be used for spring charging shall be of Universal type and suitable for AC and DC supply(220 V DC).

1.13 TERMINAL CONNECTORS :

Technical connectors suitable for all ACSR Moose/ACSR Zebra Conductor (as per the provision laid down) shall be provided, Suitable terminal earth connector for earthing connections shall also be supplied.

1.14 AUXILIARY SWITCHES :

Spare 10 Nos N/O (normally open) & 10 Nos N/C (normally closed) of auxiliary switches (contacts) shall be provided on each circuit breaker for use in the remote indication and control scheme of the circuit breaker and for providing safety interlocking etc. Special contact for use with trip coil and single short reclosing operation which permits relative adjustment with respect to the travel of the moving contact of the circuit breaker shall also be provided. There shall be provision to add more auxiliary switches at the later date if required.

1.15 COMPLETENESS OF EQUIPMENT :

Any fittings, accessories or apparatus which may not have been specifically mentioned in those specification but which are usual or necessary in the equipment of similar plant shall be deemed to be included in the contract and shall be supplied by the contractor without extra charges. All plant and equipment shall be complete in all details whether such details are mentioned in the specification or not. The detail bill of materials list to be furnished along with the tender.

1.16 AFTER SALES SERVICE :

1.16.1 The supplier should guarantee for after sales service for a minimum period of one and half years from the date of receipt of the equipment or one year from the date of commissioning of the equipment whichever is earlier.

1.16.2 The supplier also should guarantee after sales service beyond the free service period.

1.16.3 Supplier also should provide after sales service within 15 days of receipt of intimation from the field Engineer-in-charge of the equipment or the purchaser.

1.16.4 COMMISSIONING :

The manufacturers shall render all help for commissioning of the breakers. Supervision of erection , testing & Commissioning charges per breaker to be quoted in the schedule of prices (Annexure-v) for evaluation of the Price bid or else it will be presumed that the charges towards Supervision of erection , testing & Commissioning per Breaker are included in the unit price offered.

1.17 EXPERIENCE :

The list of supplies already made by the supplier/manufacturers are to be enclosed along with the tenders.

1.18 RECOMMENDED SPARES AND TOOLS :

For 5 (five) years operation, price are to be enclosed along with the tenders for each item of spares and special tools.

2.0 TEST :

2.1 Type test : - All the equipment offered shall be fully type tested as per the relevant standards. In case the equipment of the type and design offered, has already been type tested in an Govt. 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 bids**. The purchaser reserves the right to demand repetition of some or all the type tests in the presence of owner's representative. For this purpose the bidder may quote unit rates for carrying out each type test. These prices shall be taken into consideration for bid evaluation. For any change in the design/type offered against this specification, if accepted by the purchaser, the purchaser reserves the right to demand repetition of tests without any extra cost. Reports of Type tests as stipulated in relevant IS along with Impulse and short circuit test documents conducted shall be supplied along with the tender. All the test reports should be submitted and shall be approved by the purchaser before dispatch of the material.

Note :- Tender not accompanying with the type test reports along with Impulse and short circuit tests are liable for rejection.

Type Tests:--(As per IEC-62271-100)

- 1) Dielectric Test(LI Voltage,PF Voltage Withstand(Dry&Wet)& etc)
- 2) RIV Test
- 3) Measurement of resistance of the main circuit
- 4) Temperature rise Test
- 5)Basic short circuit duty test ,Short Time withstand current & Peak withstand current Test
- 6) Mechanical Operation Test, Mechanical endurance test
- 7)Out of phase / Short Circuit making & Breaking Test
- 8) Capacitive Current, Switching Test ,a) cable charging current Test b)Single capacitor Bank current switching test
- 9)Test to verify degree of protection

Routine Tests:-

- 1)Dielectric Tests on the main Circuit ,auxiliary & control circuits
- 2)Measurement of resistance of the main circuit.
- 3) Design & Visual Checks(Dimensions,clearances&etc)
- 4) Mechanical operation Test

5) Operating time of the device, motor Characteristics, measurement of coil current & resistance , Sf6 gas pressure monitoring ,electrical scheme,control Circuit,anti-pumping, vaccum interrupter(type,make&etc),dimensions, name plate details , contact travel & timing checks .

Acceptance and Routine Tests.

2.1.1 All acceptance and routine tests as stipulated in the relevant standards & above shall be carried out by the supplier in presence of owner's representative.

2.1.2 Immediately after finalization of the programme of type/acceptance/routine testing, the supplier shall give twenty days advance intimation to the purchaser, along with the shop routine test certificate and valid calibration certificates of the equipments/instruments calibrated in a govt. approved test house ,to be used during testing for scrutiny,to enable him to depute his representative for witnessing the tests.

3.0 **INSPECTION** :The inspection may be carried out by the purchaser at any stage of manufacture. The successful tendered shall grant free access to the purchaser's representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipments under this specification by the purchaser, shall not relieve the supplier in his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective.

The supplier shall keep the purchaser informed in advance, about the manufacturing programme so that arrangement can be made for inspection.

The purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items.

4.0 QUALITY ASSURANCE PLAN :

4.1 The tenderer shall invariably furnish following information along with his offer, failing which his offer shall be liable for rejection. Information shall be separately given for individual type of equipment offered.

(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 tenderer's representative, copies of test certificates.

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

(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 inspections.

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

(vii) List of testing equipments available with the tenderer for final testing of equipment specified and test plant limitation. If any, vis-avis the type, special acceptance and routine tests specified in the relevant standard. These limitations shall be very clearly brought out in schedule of deviations from specified test requirements.

4.2 The successful tendered shall within 30 days of placement of order, submit following information to the purchaser.

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

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

(iii) Quality assurance plan (QAP) with hold points for purchaser's inspection. The quality assurance plan and purchasers hold points shall be discussed between the purchaser and supplier before the QAP is finalized.

4.3 The successful bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material viz. oil, copper, aluminum, conductors, insulating materials, core material at the time of routine testing of the fully assembled equipment.

4 .4 DOCUMENTATION :

5.1 All drawing shall conform to International Standards organization (ISO). A series of drawing sheet/Indian standards specification IS.656. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. Units.

4.1 List of drawings and documents.

The bidder shall furnish four sets of following drawings along with his offer.

a) General outline and assembly drawings of the equipment.

b) Graphs showing the performance of equipment

c) Sectional views showing :-

i) General Constructional features.

ii) The materials/gaskets/sealing used.

iii) method of connections.

iv) Porcelain used and its dimensions along with the mechanical and electrical characteristics.

d) Arrangement of terminal's and details of connection studs provided.

e) Name Plate.

f) Schematic drawing :-

g) Type test reports in case the equipment has already been type tested.

h) Test reports, literature, pamphlets of the bought out items, and raw material.

4.2 The successful tender shall, within 2 weeks of placement of order, submit four sets of final version of all above said drawings for purchaser's approval. The purchaser shall communicate his comments/ approval on the drawings to the supplier within four weeks. The supplier shall, if necessary modify the drawings and resubmit three copies of the modified drawings for owner's approval within two weeks from the date of owner's comments. After receipt of owner's approval, the supplier shall within two weeks, submit. 15 prints and two good quality reproducible of the approved drawings for purchaser's use.

4.3 Six sets of the type test reports, duly approved by the purchaser, shall be submitted by the supplier for distribution before commencement of supply. Adequate copies of acceptance and routine test certificates, duly approved by the purchaser, shall accompany the dispatched consignment.

4.4 The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the supplier's risk.

4.5 15 sets of nicely printed and bound volumes of operation, maintenance and erection manuals in English language for each type and rating of equipment supplied shall be submitted by the supplier for distribution, prior to the dispatch of the equipment. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipment. The manual shall also contain a set of all the approved drawings, type test reports etc.

4.6 Approval of drawings/work by purchaser shall not relieve the supplier of his responsibility and liability for ensuring correctness and correct interpretation of the drawings for meeting the requirement of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering design workmanship & latest revisions of relevant standards at the time of ordering & purchaser shall have the power to reject any work or materials which in his judgment is not in full accordance therewith.

5 PACKING AND FORWARDING

5.1 The equipment shall be packed in crates suitable for vertical/horizontal transport as the case may be, and suitable to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbol. Wherever necessary, proper arrangement for lifting, such as lifting books etc. shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.

5.2 Each consignment shall be accompanied with a detailed packing list containing the following information.

a) Name of the consignee.

Details of consignment.

Destination

Total weight of consignment.

Sign showing upper/lower side of the crate.

Handling and unpacking instructions.

Bill of material indicating contents of each package.

The supplier shall ensure that the packing list and bill of material are approved by the purchaser before dispatch.

TOPOGRAPHICAL AND METEOROLOGICAL SITE CONDITIONS

Location of installations	State of ODISHA
Altitude	1000 m
Maximum Temperature	60°C
Minimum Temperature	0°C
Maximum daily average temperature	35°C
Maximum humidity 100%	
Pollution level	Heavy
Airborne contamination, if any	Highly Polluted
Seismic withstand factor	0.3 g
Maximum wind pressure	260 kg/m ²
Wind velocity	50m/sec
Maximum rainfall per annum	2000 mm
Average rainfall per annum	1500 mm
Average no. of thunder-storm days/annum	70
Average no. of dust storm days per annum	20

GUARANTEED TECHNICAL PARTICULARS FOR CIRCUIT BREAKERS

(To be filled in & furnished by the Bidder , separately for 420 Kv, 245 KV & 145 KV SF6 Circuit Breakers)

(a) Maker's name and country of manufacture

(b) Manufacturer's type Designation

2. Applicable technical standards

3. (a) Rated voltage(kV)

(b) Rated frequency(Hz)

4. Number of Poles

5. Class

6. Rated normal current

(a) Under site conditions(Amps)

(b) Rated (Amps)

7. (a) Rated short circuit breaking current

(i) Rms value of AC component of rated short circuit current (KA)

(ii) Percentage DC component

(iii) Asymmetrical Breaking Current at Highest System Voltage

(iv) Certificate or report no

(v) Oscillogram no.

(b) Rated short circuit making current (KA peak)

(i) At Higher rated Voltage

(ii) At Lower rated Voltage

(c) Maximum Breaking capacity Under Phase Opposition(KAP)

(i) Max Pole discrepancy(ms)

(ii) Max arc duration & Corresponding current under lockout pressure

8. First pole to clear factor
 9. Rated transient recovery voltage for terminal faults
(kV peak)
 10. Rated characteristics for short line faults.
 11. Rated operating sequence
 12. Rated duration of short circuit(Sec.)
 13. Rated out of phase making & breaking current (kA)
 14. (a) Opening time (ms)
 - (i) Maximum Opening time under any condition
 - (ii) With limiting Voltage & Pressure.
 - (b) Arcing time (ms)
 - (i) At 100% rated breaking current (ms)
 - (ii) At 50% rated breaking current (ms)
 - (iii) At 25% rated breaking current (ms)
 - (iv) At 10% rated breaking current (ms)
 - (v) Maximum arcing time at lowest
fault current (ms).
 - (c) Break Time (ms)
 - (i) At 100% rated breaking current (ms)
 - (ii) At 50% rated breaking current (ms)
 - (iii) At 25% rated breaking current (ms)
 - (iv) At 10% rated breaking current (ms)
 - (v) Maximum break time at lowest fault current (ms).
 - (i) Maximum Total Break Time under any duty condition
- For any current up to rated breaking current with limiting condition of Voltage & Pressure(ms)
- (d) Closing time (ms)

- (e) Minimum dead time for 3 phase reclosing
- (f) Maximum Close Open Time under any condition
 - With limiting Voltage & Pressure.
- (g) Minimum Time Interval between each make/ Break Operation.
- 15. Rated line charging breaking current (kA)
- 16. Rated small inductive breaking current (kA)
- 17. (i)Max. rise of temperature over ambient for
current rating under sl. 6.
(ii)Max. rise of temperature for
Main contacts over design ambient temperature of 50deg C.
- 18. Interrupting capacity based on duty cycle as per sl. 11.
 - (a) AC ;component (kA)
 - (b) Percentage DC component.
- 19. Latching current (kA)
- 20. No. of breaks in series per pole.
- 21. Length of contact travel (mm)
- 22. Total length of break per pole (mm)
- 23. Rate of contact travel:
 - (a) At tripping (metres/sec.)
 - (b) At closing (metres/sec.)
- 24. Type of devices, if any, used to obtain
uniform voltage distribution between breaks.
- 25. Recovery voltage distribution between
breaks in percent of rated voltage.
 - (a) Single line to ground fault
 - (b) Interruption on short lines.

(c) Switching off an unloaded, transformer

26. (i) Type of main contact.

(i) Number of auxiliary contacts per pole for normal operation(NO & NC)

(ii) Number of auxiliary contacts per pole provided for Owner's use(NO & NC)

(iii) Current rating of Auxiliary contacts

27. Type of arcing-contacts and/or arc

control device

28. Material of contacts:

i. Main

ii. Arcing

iii. Whether contacts are silver plated

iv. Thickness of silver coating mm

v. Contact pressure, kg/sq. mm.

29. Insulation level of the breaker:

(a) 1 minute power frequency withstand

voltage kV rms(Dry & Wet)

(i) Between live terminals & Ground

(ii) Between terminals with Breaker contacts open

(a) Switching surge withstand test

Voltage kV (peak)

- To earth

-Across open contacts

(c) Lightning impulse withstand test voltage, kV(peak)

- To earth

- Across open contacts

(d) Max. dynamic power frequency over voltage

withstand kV (peak)

30.
 - i) RIV level (Max)
 - (viii) Corona inception voltage (kV rms)
 - (ix) Corona extinction voltage (kV rms)
31. Minimum clearances
 - (a) Between phases (live parts)(mm)
 - (b) Between live parts and earth (mm)
 - (c) Total Creepage Distance
 - (i) To ground
 - (ii) Between Terminals
32. Whether the circuit breaker is fixed trip or trip free
33. Method of closing
 - (a) Normal
 - (b) Emergency
34. Type of closing mechanism
35.
 - (a) Normal voltage of closing
 - (b) Pick up range (volts DC)
36.
 - (a) Power at normal voltage of closing mechanism (watts)
 - (b) Power at 85% of normal voltage of closing mechanism(watts)
 - (c) No of closing coils in operation
37. Type of tripping mechanism
Number of Tripping Coil
38.
 - (A) Normal voltage of tripping coils(volts)
 - (a) Power at normal voltage for Tripping coils (watts)
 - (b) Power at 70% normal voltage for Tripping coils (watts).
 - (c) No. of tripping coils in operation
 - (d) Pick up range (V DC)

(B) Number of close open operation

(i) possible after failure of AC supply to motor

(ii) Time required for motor to charge the closing spring(Sec)

(iii) Whether indication of spring charged condition will be provided in control cabinet.

39. Arc duration at 100% (ms)

40. Interruption capacity:

2 Opening

Arcing time no. of loops and time including resistor current duration (cycle)

Resistor current duration (cycle)

Total length of the arc (mm)

Max. length of the arc (mm)

Total interrupting time measured from instant of trip coil energization to arc extinction of resistor current (cycles)

3 Closing time measured from instant of application of power to closing device upto arcing contacts touchings (cycles)

41. Critical current (current giving the longest arc when a break takes place) (kA)

a) Recovery voltage when circuit breaker tested at 100% rated breaking capacity (kV inst.)

b) Rate of rise of restriking voltage at breaking

i) for 30% breaking capacity (kV/microsecs.)

ii) for 100% breaking capacity (kV/microsecs.)

c) Maximum over-voltage factor of the circuit breaker when switching off.

i) Unloaded transformers

ii) Loaded transformer

iii) Open circuited lines

42. When switching of synchronous systems:

- (a) Max. current (kA)
- (b) Max. contacts of 1 pole (kV)

43. No. of openings the circuit breaker is capable of performing without inspection, replacement of contacts or other main parts.

- (a) at 50% rated current
- (b) at 100% rated current
- (c) at current corresponding to 50% rated breaking capacity.
- (d) at current corresponding to 100% rated breaking capacity.

44. (A) a) Weight of complete circuit breaker (Kg).

b) Impact loading for foundation design, to include dead load plus impact value on opening at maximum interrupting ratings, in terms of equivalent static load (Kg.)

c) Overall dimensions:

Height (mm)

Width (mm)

Length (mm)

(B)- Type & Material of Gasket used to ensure gas tight joints for

(i) Metal to Metal Joint

(ii) Metal to Porcelain Joints

(C) Type & Make of

a) Density Monitor

b) Pressure Gauge

(D) Density Monitor Setting

a) Lock Out

b) Alarm

45. Porcelain:

i) Make

j) Type

k) Descriptive pamphlet no.

l) Weight (kg.)

m) Transport dimensions (mm)

n) Height above floor, required to remove porcelain (mm).

o) Insulation class

p) One minute power frequency withstand, kV (rms) (dry & wet)

q) Flash over voltage (kV)

r) Lightning impulse withstand voltage kV (peak) (dry & wet)

s) Switching surge withstand voltage kV (peak) (wet)

t) Corona discharge voltage (kV rms)

u) Creepage distance, total protected (mm)

v) Permissible safe cantilever loading on installed porcelain (Kg.m)

46. (i) Rated pressure of SF₆ gas in the circuit breaker (Kg/sq.cm)

(ii) Rated Pressure of SF₆ in operating Chamber(kg/cm²) at 20deg C

(iii) Limits of Pressure of extinguishing medium

47. Rated pressure of SF₆ gas in the gas cylinders (Kg/sq.cm)

48. (i) Quantity of SF₆ gas required per single pole unit (Kg.) at rated Pressure & at 20 deg C

(ii) Guaranteed Maximum Leakage rate per Year.

49. Quantity of SF₆ gas per cylinder (Kg.)

Standard to which SF₆ Gas Complies.

(i) Weight of empty cylinder (Kg.)

(ii) Whether Breakers are dispatched filled with SF₆ Gas or filled at site.

Quantity of absorbent required per pole (Kg.)⁵².

Recommended interval for renewal of absorbent in case of outdoor circuit breakers operating in tropical conditions.

- iv) Chemical composition of absorbent
- v) Quantity of absorbent covered in the scope of supply
(Including spare quantities)
- vi) Limits of gas pressure for pressure operation of circuit breaker – (Kg/sq.cm)
- vii) Pressure and temperature at which the temperature compensated gas pressure switch will
 - a) give alarm (Kg/sq.cm., deg. C)
 - b) cut off (Kg/sq.cm. deg. C)
- viii) Name of SF₆ supplier and country of origin.
- ix) Quantity of SF₆ gas supplied for
 - a) Actual use in breakers (Kg.)
 - b) As spare (Kg.)
- x) Chemical composition of gas:
 - a) Qty. of air by weight (ppm)
 - b) Qty. of H₂O by weight (ppm)
 - c) Qty. of CF₄ by weight (ppm)
 - d) Qty. of free acid by weight (ppm)
 - e) Density
 - f) Oil Content
 - g) Resistivity
- xi) Motor For Circuit Breaker
 - (a) Manufacture's name & address
 - (b) Equipment driven by motor or not.
 - (c) Motor Type
 - (d) Country of Origin
 - (e) Type of Duty

- (f) Type of Enclosure & Method of Cooling
- (g) Applicable Standard to which motor confirms
- (h) Type of mounting
- (i) Direction of rotations as viewed from non driving end.
- (j) Standard Continuous rating at 50deg C
- (k) Rated Voltage
- (l) Rated Speed at rated Voltage & Frequency(rpm).
- (m) Full Load current at rated voltage & frequency.
- (n) Power Factor at rated load.
- (o) Rating of the Motor.
- (p) Time for fully charging the closing spring

xii) Control Cabinet

- i. Material of enclosure
- ii. Thickness of sheet steel
- iii. Painting for control cubicle
- iv. Paint shade
- v. Degree of protection
- vi. Dimension
- vii. Material of gasket

Name of the firm..... Signature of Bidder.....

Designation & Seal Date

CIRCUIT BREAKERS

- Interrupting MVA from the instant of Trip coil energization.

Withstanding test voltage (KV rms)

Between line terminal and ground objects. - KV rms.

Between terminal with breaker contacts open. -KV rms.

17. 1.2/50micros full wave impulse withstand test voltage for the two cases above.

i) Between line terminal & grounded objects. -KV(Peak)

ii) Between terminal with breaker Contacts open. -

18. **Busing or Insulators :**

i) Type of bushing. -

ii) Dry 1 minute power frequency - KV rms
withstand test voltage.

iii) Dry flashover value. - KV rms.

iv) Wet flashover value. - KV rms.

V) 1.2/50 impulse withstand - KV(Peak)

vi) Creepage distance. - mm

vii) Puncture value of bushing. - KV

viii) Weight of bushing. - Kg.

19. Minimum clearance in air.

i) Between phases. - mm

ii) Live parts to earth. - mm

iii) Live parts to ground level - mm

iv) Between live parts & grounded object. - mm

20. Number of poles of circuit breaker.
21. Number of breaks per phase.
22. Total length of break per phase.
23. Type of main contacts.
24. Type of Aux. Contacts.
25. Materials of auxiliary contacts.
26. Contacts silver plated or not.
27. Thickness of silver plating.
28. Contact pressure.
29. Voltage distribution between breaker.
30. Type of device if any, used to limit
the rate of rise or restricting voltage.
31. Voltage grading device if any used.
32. Number of auxiliary contacts provided.
 - i) Those closed when breaker is closed.
 - ii) These open when breaker is closed.
 - iii) Those adjustable with respect to
the position of main contacts.
33. Type of operating mechanism.
 - i) Opening
 - ii) Closing.
34. Control circuit voltage.
35. Power required for trip coil - Watts

at 220V D.C.

- | | | | |
|-----|---|---|----------------------|
| 36. | Power required for close coil
At 220V D.C. | - | Watts |
| 37. | Frequency at which contacts are
To be replaced. | | |
| 38. | Nos. of terminal connector. | | |
| 39. | Steel support structure galvanized
With foundation – Nuts & Bolts to be provided | - | Whether
yes or no |
| 40. | Type test certificate Furnished | - | Yes/No |
| 41. | Circuit Breaker weight. | - | Kg. |
| 42. | Quantity. | - | Nos. |

Name of the Firm:-

Signature of the bidder:-

Designation & seal:-

Date:-



ODISHA POWER TRANSMISSION CORPORATION LIMITED

TECHNICAL SPECIFICATION FOR CURRENT TRANSFORMERS

I: - 33KV CT

- a) **RATIO-400-200A-100/1-1-1A**
- b) **RATIO-800-400-200A/1-1-1A &1-1-1-1A**

II: - 132 KV CT

- a) **RATIO-800-400-200A/1-1-1-1A**
- b) **RATIO-600-300-150A/1-1-1-1A**
- c) **RATIO-400-200A-100/1-1-1-1A**
- d) **RATIO-200-100/1-1-1-1A**

III: - 220 KV CT

RATIO-1200-600-300A/1-1-1-1-1A

IV:- 400 KV CT

RATIO:2000-1000-500/1-1-1-1-1A

**TECHNICAL SPECIFICATION FOR 33KV, 132KV,220 KV & 400KV CURRENT TRANSFORMERS WITH
METERING CORES OF ACCURACY CLASS 0.2S for 33 KV & 0.2 Accuracy class for 132, 220 & 400 KV
Current transformers.**

1.0 SCOPE :

- 1.1. The specification covers the design, manufacture, assembly, inspection and testing at the manufacture's work, packing and delivery F.O.R. (destination) of the outdoor mounted dead / live tank type, single phase, single unit type current Transformers for protection and metering services in 33KV, 132KV, 220 KV & 400KV solidly grounded system.
- 1.2. The current transformers shall be of the outdoor type, single phase, 50 C/S, oil immersed, self cooled, hermetically sealed and suitable for operating in the tropical conditions with maximum ambient temperature up to 50°C. The C.Ts should be suitable for use in the areas subject to heavy lightning storms and highly polluted conditions.
- 1.3. Followings are the list of documents constituting this specification.

[i]	Technical specification(TS)	
[ii]	Technical Requirements	Appendix I
[iii]	Quantity and Delivery Schedule (Appendix II)	Appendix II
[iv]	Guaranteed Technical Particulars	Annexure –A
[v]	Calibration Status of testing equipments and meters / Instruments	Annexure – B
[vi]	Check-List towards Type Test Reports	Annexure-C
[vii]	Check-List for Delivery Schedule	Annexure-D
Note :	Annexure- A, B, C & D are to be filled up by the Bidder	

- 1.4 The current transformer shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of offer and purchaser shall have the power to reject any work or material which in his judgment is not in full accordance therewith.

[a] Guaranteed Technical particulars. **Bidders are required to quote for 0.2S for 33 KV & 0.2 Accuracy class for 132, 220 & 400 KV Current transformers of metering cores with the following data / information's etc.**

[b] Technical literatures, brochures and drawings as per this specification.

[c] Type Test Reports.

[d] List of orders, executed and User's certificates, failing submission of the above particulars with the offer, the tender may not be considered for evaluation.

2.0 STANDARDS

2.1 Except to the extent modified in the specification, the C.Ts shall conform to the latest editions and amendments of the standards listed hereunder.

2.2

Sl. No.	Standard Ref. No.	Title
1	IEC-44	Instrument transformer-measurement of PDS
2.	IEC-60	High Voltage Testing Technique.
3.	IEC-171	Insulation co-ordination
4.	IEC-61869-2:2012	Current Transformers.
5.	IEC-270	Partial Discharge Measurement
6.	IEC-8263	Method for RIV Test on High Voltage Insulators.
7.	IS-335	Insulating oil for Transformers
8.	IS:2071	Method of High Voltage Testing
9.	IS:2099	High Voltage porcelain Bushings
10.	IS:2147	Degree of Protection Provided by Enclosures for Low Voltage Switchgear and Control.
11.	IS:2165	Insulation Co-ordination for equipment of 100KV and above
12.	IS:2705 [Part-I to IV)	Current Transformers
13.	IS:3347	Dimensions of Porcelain Transformer Bushing
14.	IS:5621	Specification for Large Hollow Porcelain for use in

		Electrical installation.
15.	IS:4201	Application guide for CTS
16.		Indian Electricity Rules, 1956
17.	IS:13072 of 1991	SF6 gas (for 220KV SF6 gas filled CT only)
18.	IEC: 60376	SF6 gas (for 220KV SF6 gas filled CT only)

2.3 Current 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 equipment, offered by the supplier conforms to other standards, salient points of difference between the standards adopted and specified 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.

2.3 The supplier is to furnish the latest edition of the standards as mentioned above from SI.1 to SI.15 with their amendments, if any, at their own cost, if required by the Purchaser.

2.4 All the above along with 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 specification will prevail.

3.0 CLIMATIC & SERVICE CONDITIONS :

3.1 The current Transformers are required to operate satisfactorily under the following conditions.

[a]	Maximum ambient temperature	50 ⁰ C
[b]	Minimum ambient temperature	0 ⁰ C
[c]	Maximum daily average ambient air temperature	45 ⁰ C
[d]	Maximum relative humidity	100%
[e]	Average no. of rainy days in a year.	120 days
[f]	Average annual rainfall	150 cm
[g]	Maximum wind pressure	260 Kg/Sq.m
[h]	Altitude not exceeding	1000 m

3.2 EARTHQUAKE INCIDENCE

The current Transformers are to be designed to withstand earthquakes of intensity equivalent to seismic acceleration of 0.3g in the horizontal direction and 0.15g in the vertical direction, where 'g' stands for acceleration due to gravity.

3.3 The current Transformers covered under this specification shall be suitable for outdoor installation.

4.0 PURCHASER'S AUXILIARY POWER SUPPLY :

4.1 Following power supplies shall be made available at site.

- (a) A.C. Three phase, 415V, 50HZ earthed
- (b) A.C. Single Phase, 240V, 50HZ earthed.
- (c) 220 V D.C. ungrounded.

4.2 All the equipments and devices shall be capable of continuous satisfactory operation on AC and DC supplies of normal voltage mentioned above with the variation given below.

[a]	AC voltage variation	$\pm 10\%$
[b]	Frequency variation	$\pm 5\%$
[c]	Combined voltage and frequency variation	$\pm 10\%$
[d]	DC Voltage Variation	190V to 240V

4.3 The supplier shall make his own arrangements for the power supplies other than those specified under clause 4.1 above.

5.0 GENERAL TECHNICAL REQUIREMENTS :

5.1 **The C.T. shall be of dead/ live tank design** and shall be so constructed that it can be easily transported to site within the allowable limitation and in horizontal position if the transport limitations so demand.

5.2 For compensation of variation in the oil volume due to ambient variation, nitrogen cushion / metal bellows shall be used. Rubber diaphragms shall not be permitted for this purpose.

5.3 The C.T. secondary terminals shall be brought out in a weather proof terminal box. The terminal box shall be provided with removable gland plate and gland (s) suitable for 1100 volts grade PVC insulated, PVC sheathed, multicore 4 Sq. mm stranded copper conductor cable. The terminal blocks shall be stud-type and provided with ferrules, indelibly marked or numbered. The terminals shall be rated for not less than 10 Amps. The terminal box shall be dust and vermin proof. Suitable arrangements shall be

made for drying of air inside the secondary terminal box. The dimensions of the terminal box and its openings shall be adequate to enable easy access and working space with the use of normal tools.

- 5.4 Polarity shall be indelibly marked on each primary and secondary terminal. Facility shall be provided for short-circuiting and grounding of the C.T. secondary terminals inside the terminal box.
- 5.5 The C.T. shall be provided with non-corrosive, legible nameplate with the information, specified in the relevant standards, duly engraved/punched on it.
- 5.6 The current Transformer shall be vacuum filled with oil after processing and thereafter hermetically sealed to eliminate breathing and to prevent air and moisture from entering the tanks. Oil filling and / or sampling cocks, if provided to facilitate factory processing should be properly sealed before despatching the C.T., The method adopted for hermetic sealing shall be described in the offer
- 5.7 The castings of base, collar etc. shall be die cast and tested before assembly to detect cracks and voids, if any.
- 5.8 The instrument security factor of metering core shall be low enough and not greater than '5'. This shall be demonstrated on all the ratios of the metering core in accordance with procedure, specified in IEC-185 OR IS:2705
- 5.9 Current transformers' guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.
- 5.10 For 420 KV, 245KV, 145KV and 36 KV Current Transformers, characteristics shall be such as to provide satisfactory performance in accordance with latest IS & IEC.
- 5.11 Current Transformers shall be designed so as to achieve the minimum risk of explosion in service. The Bidder shall bring out in his offer, the measures taken to achieve this.

5.12 PRIMARY WINDING

- (I) The rated extended primary current shall be 120% on all cores of the C.Ts, specified in tables. The offered Primary winding type, for 400KV, 220KV, 132KV, and 33KV class C.Ts, should have been type tested.
- (II) The primary windings of current transformers shall be constructed of high purity, annealed, high conductivity electrolytic copper meeting to the requirements of IEC 28/IS:2705.

5.13 SECONDARY WINDINGS:

Suitably insulated copper wire of electrolytic grade shall be used for secondary windings. Type of insulation, used shall be described in the offer. The secondary taps shall be adequately reinforced to withstand handling without damage.

The rating of the Current Transformer's secondary winding shall be 1 (One) Amp. The secondary terminals shall be brought out in a compartment for easy access.

5.14 PRIMARY TERMINALS

The primary terminals shall be heavily tinned electrolytic of 99.9% conductivity. The minimum thickness of tinning shall be 1.5 microns.

5.15 SECONDARY TERMINALS

- (I) Secondary terminal studs shall be provided with at least three nuts and adequate plain and spring washers for fixing the leads. The studs, nuts and washers shall be of brass, duly nickel-plated. The minimum outside diameter of the stud shall be 6 mm. The length of at least 15 mm shall be available on the studs for inserting the leads. The horizontal spacing between the centers of the adjacent studs shall be at least 1.5 times the outside circum-dia of the nuts.
- (II) The current transformer shall be provided with suitable test tap for measurement of capacitance, tan delta as well as partial discharges. Provision shall be made on a screw cap for solid and secured earthing of the test tap connection, when not in use. A suitable caution plate shall be provided duly fixed on the cover of the secondary terminal box indicating the purpose of the test tap and the necessity of its solid earthing as per prescribed method before energizing the Current Transformer.
- (III) The secondary terminals shall be provided with shorting arrangements.

5.16 CORE

Each core of the Current Transformer shall be of torroidal shape. Core laminations shall be of cold rolled grain oriented silicon steel or other equivalent alloys of low hysteresis and eddy current losses, high permeability to ensure high accuracy at both normal and over-current conditions. The cores (Mu metal) used for protection shall produce undistorted secondary current under transient conditions at all ratios, with specified Current Transformer parameters. The core material, thickness of lamination, the relevant graphs showing the characteristics of the core material shall be submitted along with the offer.

5.17 TANK

- (I) Both expansion chambers and the tanks of the Current Transformers shall be made up of high quality steel, which should be able to withstand full vacuums and pressure occurring during transit and thermal and mechanical stresses resulting from maximum short circuit current during operation. The tanks along with all ferrous parts shall be got dip galvanized as per relevant standard.
- (II) The metal tanks shall have bare minimum number of welded joints so as to minimize possible locations of oil leakage. Welding in horizontal plane is to be avoided as welding at this location may give way due to vibrations during transport resulting in oil leakage. Supplier has to obtain specific approval from purchaser for any horizontal welding used in the bottom tank.

5.18 SECONDARY TERMINAL BOX :

- (I) Secondary Terminal Boxes shall be weather proof with a rating not less than IP 55
- (II) All secondary terminals shall be brought out in a compartment on the same side of each current transformer for easy access.
- (III) The exterior of this terminal box shall be hot dip galvanized.

- (IV) A terminal board which shall have arrangement for series / parallel connection and arrangement for shorting of secondary terminals shall be provided. For 400KV and 132KV CTs, at least one of the ratios should be achieved through secondary tapping(s). i.e.

Primary re-connection is allowed for two ratios where as third ratio is to be achieved by provision of secondary tapping or alternatively all the stipulated ratios may be achieved through secondary tapings.

The terminal box shall be provided with a removable cable gland plate at bottom for mounting cable glands for 1.1KV PVC sheathed 4 x 4 Sq. mm stranded copper conductor cables.

- (V) The terminal box shall be provided with a door in front so as to have easy access of secondary terminals. The door shall have a sealing / locking arrangement and shall be suitable to prevent penetration of moisture and rainwater.
- (VI) All terminals shall be clearly marked with identification number to facilitate connection to external wiring.

5.19 PORCELAIN HOUSING

- (I) 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 rain water or condensed water particles (fog.) The details of location and type of joint, if provided on the porcelain, shall be furnished by the Bidder along with the offer.
- (II) The bushings of the Current Transformers shall conform to the latest edition of IS:2099. The hollow porcelain insulator shall conform to the latest edition of IS:5621.
- (III) The insulators shall be cemented with Portland cement to the flanges resulting in high mechanical, tensile and breaking strength.
- (IV) The bushings shall have ample insulation, mechanical strength and rigidity for the condition under which they shall be used and shall be designed to prevent accumulation of explosive gases and provide adequate oil circulation to remove the internal heat.
- (V) Cast metal end 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 ionization.
- (VI) The insulation of bushings shall be coordinated with that of the current transformer such that the flashover, if any, will occur only external to the Current Transformer.
- (VII) Oil level gauge and convenient means of filling, sampling and draining of oil should be provided.
- (VIII) End shields should be provided for distribution of stresses.
- (IX) Corona shields for bushings, if required should be provided.

5.20 INSULATING MEDIUM. (OIL)

The quantity of insulating oil for the filling and the complete specification of the insulating oil shall be stated.

The oil shall comply in all respects with the provisions of latest edition of IS: 335. The current Transformers shall be supplied, filled with purified oil completely.

5.21 PREVENTION OF OIL LEAKAGE AND ENTRY OF MOISTURE:

5.21.1 The supplier shall ensure that the sealing of the Current Transformer 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 and secondary terminals.
- (b) Interface between porcelain housing and metal tank/s
- (c) Cover of the secondary terminal box.

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

5.21.3 For gasketed joints, wherever used, nitrile butyl rubber gaskets shall be used. The gasket shall be fitted in properly machined groove with adequate space for accommodating the gasket under compression.

5.22 FITTINGS AND ACCESSORIES :

Fittings and accessories, listed below shall be supplied with each Current

Transformer. Any fitting, required essential other than those listed below shall also be supplied along with each Current Transformer without any extra cost to the purchaser :

- (a) Oil level gauge.
- (b) Oil filling hole and cap.
- (c) Pressure relieving device.
- (d) Phase terminal connectors.
- (e) Lifting lugs for core and windings, bushings and complete Current Transformers.
- (f) Tank earthing pads/terminals with necessary nuts, bolts and washers for connecting to purchaser's earth strip.
- (g) Name / Rating plate.

5.22.1 (A)OIL LEVEL GAUGE :

An oil level gauge shall be provided to indicate the oil level in the Current Transformer. This gauge shall be mounted in such a way that the oil level can be seen from ground level. If metal bellow is used, a ground glass window shall be provided to monitor the position of the metal bellow. The metal below shall be tested in accordance with relevant standards. The details shall be to the approval of the purchaser.

5.22.2 PRESSURE RELIEVING DEVICE :

Each Current Transformer shall be provided with a pressure relieving device so as to protect bushing of the Current Transformer even under unfavorable

Conditions. In case of non-provision of the PRD, the same should be brought out clearly in the offer with detailed explanation and proof.

5.22.3 (A)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.

5.22.4 EARTHING :

Metal tank of each Current Transformer shall be provided with two separate earthing terminals for bolted connection to 50mm X 6mm flat, to be provided by the purchaser for connection to station earth-mat.

5.22.5 LIFTING ARRANGMENT :

The Current Transformer 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.

5.22.6 NAME PLATE & MARKING :

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

5.22.6.2 A schematic drawing indicating the connections shall be provided in the interior of the Terminal box.

5.22.7 TERMINAL CONNECTORS :

All the Current Transformers shall be provided with bimetallic solderless clamp type, rigid type terminal connectors, suitable for

Sl. No.	CURRENT TRANSFORMER.	Terminal connector.
a)	400kV (0.2class)	
i	2000-1000-500/1-1-1-1-1	ACSR 'TWIN MOOSE' conductor
b)	220kV (0.2class)	
i	1200-600-300/1-1-1-1	ACSR 'TWIN ZEBRA' conductor
ii	600-300-150/1-1-1-1	
c)	132kV (0.2class)	
i	800-400-200/1-1-1	ACSR 'TWIN ZEBRA' conductor
ii	600-300-150/1-1-1	
iii	400-200-100/1-1-1	
d)	33kV(0.2s class)	
i	1200-600-300/1-1-1	ACSR 'TWIN ZEBRA'

ii	800-400-200/1-1-1	conductor
iii	600-300-150/1-1-1	ACSR 'ZEBRA conductor
iii	400-200-100/1-1-1	

Each terminal connector shall be of universal type, suitable for both horizontal and vertical connections to the transmission line conductors / station bus bars.

- 5.22.7.1** Terminal connectors shall be manufactured and tested as per IS: 5561.
- 5.22.7.2** All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- 5.22.7.3** No part of a clamp shall be less than 10mm thick.
- 5.22.7.4** All ferrous parts shall be hot-dip galvanized conforming to relevant standard.
- 5.22.7.5** For bimetallic connectors, copper alloy linear of minimum thickness of 2 mm shall be cast integral with aluminium body.
- 5.22.7.6** All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- 5.22.7.7** Connectors shall be designed to be corona free in accordance with the requirements, stipulated in IS:5561.

6.0 TEST:

6.1 TYPE TESTS & SPECIAL TESTS:- (As per latest IEC & ISS).

The current transformers, offered should have been subjected to the following type tests and Special Tests in Government approved test laboratory. The bidder shall furnish type test and Special Tests reports along with the offer for the offered CTs. These tests should 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 the design/type offered against this specification, the purchaser reserves the right to demand repetition of some or all type & special tests without any extra cost to OPTCL in the presence of OPTCL's representative(s) at the cost of the supplier.

- (a) Lightning Impulse Voltage Test.
- (b) Multiple chopped lightning impulse test.
- (c) High Voltage power frequency wet withstand voltage Test.
- (d) Short time current test.
- (e) Temperature rise test.
- (f) Determination of errors or other characteristics according to the requirements of the appropriate designation and accuracy class as per individual parts of IS: 2705.
- (g) Instrument Security Factor Test.
- (h) IP-55 Test on Secondary Terminal Box.

(In addition to the above tests, following type tests/special tests should have been conducted exclusively for 220KV & 400 KV C.T)

- (i) Radio Interference voltage test.
- (j) Corona Extinction test.
- (k) Thermal stability test.
- (l) Thermal Co-efficient test.
- (m) Fast transient test.
- (n) Seismic withstand test.
- (o) Mechanical terminal load on bushing.
- (p) Magnetization and internal burden tests..
- (q) Effectiveness of sealing tests.
- (r) Capacitance and dielectric loss angle test. (For both 132KV, 220KV & 400KV CTs.)
- (s) STC Test on primary terminal connector.
- (t) Internal ARC test.

N.B:

- Lightning Impulse Test, switching Impulse Voltage test and High Voltage power frequency wet withstand voltage Tests should have been carried out on the same current transformer.
- After the current transformers have been subjected to lightning Impulse Test, and High Voltage power frequency wet withstand voltage tests, these must have been subjected to all the routine tests as per IS: 2705 (Part-I to IV).

6.2 ROUTINE TESTS:

The following routine tests shall be conducted on each Current Transformer in the presence of OPTCL's representative(s) for which no charges will be payable by OPTCL. No sampling will be allowed.

- (i) Appearance and Dimensional Check.
- (ii) Verification of Terminal Marking and polarity.
- (iii) Verification of all individual parts / components of the Current Transformer so as to ensure to have complied the above specification.
- (iv) Measurement of Insulation Resistance.
- (v) Power Frequency Dry withstanding Test on Primary and Secondary winding including primary intersections.
- (vi) Over – Voltage Interturn test.
- (vii) Partial discharge Test for 400 KV, 220 KV and 132KV C.TS
- (viii) Knee point voltage and Excitation current measurement for 'PS' class cores.
- (ix) Secondary winding resistance measurement.
- (x) Determination of errors.
- (xi) ISF Test.
- (xii) Leakage Test.

- (xiii) Magnetization Characteristics of the Current Transformers.
- (xiv) Turn ratio error on 'PS' class cores.
- (xv) Measurement of capacitance for 400KV, 220KV and 132KV C.TS.
- (xvi) Measurement of tan delta at 0.3, 0.7, 1.0 and $1.0/\sqrt{3}$ for 400KV, 220KV & 132KV C.Ts.

- The Method For Conducting Partial Discharge Test.

The test circuit for the measurement of partial discharge (PD) should have been in accordance with sub-clause 4.2 of IEC-270. The applied voltage should be raised to the rated voltage of the Current Transformers and should have been maintained for a period greater than or equal to 10 seconds. The voltage should have been reduced to measuring voltage of

1.1 X145/420KV rms/phase

$3\frac{1}{2}$

to ground and maintained for a period greater than or equal to 1 minute. The PD should not exceed 10 picco-coulombs.

7.0 INSPECTION :

- 7.1 The purchaser shall have access at all times to the works and all other places of manufacture, where the Current Transformers are being manufactured and the supplier shall provide all facilities for unrestricted inspection of the supplier's works, raw materials, manufacture of all the accessories and for conducting the necessary tests.
- 7.2 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.
- 7.3 No material shall be despatched from its point of manufacture unless the material has been satisfactorily inspected, tested and despatch clearance
Issued. However, the purchaser reserves the right to alter the despatch schedule, attached to this specification without any extra financial liability to OPTCL.
- 7.3.1 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.

8.0 QUALITY ASSURANCE PLAN :

- 8.1 The Bidder shall invariably furnish following information 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 material in presence of Bidders"
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 test and inspections.
- (vi) Special features provided in the equipment to make it maintenance free.
- (vii) List of testing equipments, meters available with the Bidder for final testing of equipment specified 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-wise as per Annexure – B of the Technical Specification.

8.2 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 names of sub-suppliers, selected from those, furnished along with the offer.
- (ii) Type Test Certificates of the raw material and bought out accessories.
- (iii) Quality Assurance plan (QAP) with hold points for the purchaser's inspection. The QAP and hold points shall be discussed between the purchaser and the supplier before the QAP is finalized.

8.3 The supplier shall submit the routine test certificate of bought-out items and raw materials at the time of acceptance testing of the fully assembled equipment.

9.0 **DOCUMENTATION :**

9.1 All drawings shall conform to relevant Indian Standard as per relevant IS. All drawings shall be in ink and suitable for microfilming. All dimensions and data shall be in S.I. units.

9.2 The supplier shall furnish the following drawings/documents along with his offer for 0.2S accuracy class metering core CTs in form of scanned copy.

- (a) General outline and assembly drawings of the Current Transformers.
- (b) Sectional views showing.
 - (i) General constructional features.
 - (ii) Materials / gaskets / sealing used.
 - (iii) The insulation of the winding arrangement, method of connection of the primary / secondary winding to the primary / secondary terminals etc.
- (c) Schematic drawing
- (d) Rating and Diagram plate.
- (e) Secondary Terminal Box.

- (f) Assembly Sectional view of Primary Terminal
- (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 Indicator.
- (k) All type and special test reports relating to tests, as mentioned at Cl. No. 6.1 of this Technical Specification.
- (l) Ratio and phase angle error curves for CTS.
- (m) Magnetization characteristic curves such as B-H curves and sp.loss vs. flux density curves.
- (n) Drawings for Terminal Connector.

10.0 **TEST REPORTS:**

- (i) Four copies of type test and special test reports shall be furnished to the purchaser with the tender offer for 0.2S accuracy class metering core CTs.
- (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.

11.0 **SPARE PARTS**

A list of spare parts recommended for five years operations for each Current Transformer shall be furnished with the tender. The purchaser will decide the actual quantities of spare parts to be ordered on the basis of the list and the item wise price of spare parts.

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

13.0 **PACKING AND FORWARDING :**

13.1 The equipment shall be packed in suitable crates so as to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided. A material found short inside the packing cases shall be supplied by supplier without any extra cost.

13.1.1 Each consignment shall be accompanied by a detailed packing list containing the following informations :-

- (a) Name of the consignee
- (b) Details of consignment
- (c) Destination
- (d) Total weight of consignment
- (e) Sign showing upper / lower side of the crate
- (f) Handling and unpacking instructions
- (g) Bill of materials indicating contents of each package.

13.1.1 The supplier shall ensure that the bills of materials is approved by the purchaser before dispatch.

13.2 Any tender without complete information, as asked for in the above specification, is likely to be rejected.

APPENDIX-I
TECHNICAL REQUIREMENT FOR 33 KV, 132 KV, 220KV & 400KV CT .

The Current Transformers under this specification shall conform to the parameters given below :-

Sl. No.	Item.	Specification			
		36 KV	145 KV	245KV	420KV
1	Type of CT/Installation.	Single phase, Live/dead tank, oil filled, hermetically sealed, outdoor, self-cooled			Single phase, live /dead tank, oil filled, hermetically sealed, outdoor, self-cooled
2	Type of mounting.	Pedestal type			
3	Suitable for system frequency.	50 HZ \pm 5 %			
4	Rated voltage (KV rms)	33	132	220	400
5	Nominal system voltage (KV rms)	33	132	220	400
6	Highest system voltage (KV rms)	36	145	245	420
7	Current ratio (A/A)	a)800-400-200/1-1-1A b)600-300-150/1-1-1A c)400-200-100/1-1-1A d) 1200-600-300/1-1-1.A	a)800-400-200/1-1-1-1A b)400-200-100/1-1-1-1A c)600-300-150/1-1-1-1.A	a) 1200-600-300/ 1-1-1-1-1.A b) 600-300-150/ 1-1-1-1-1.A	2000-1000-500/1-1-1-1-1A
8.	Method of earthing the system where the current transformer will be installed.	Solidly Effectively earthed.			
9	Rated continuous thermal current (A)	120 % of rated primary current			

10	Acceptable limit of temperature rise above 50°C ambient temperature for continuous operation at rated continuous thermal current.			
(a)	Winding	45°C		
(b)	Oil	40°C		
(c)	External surface of the core, metallic parts in contact with or adjacent to, insulation.	45°C		
11	Acceptable partial discharge level	Less than 10 picco coulombs		
12.	Maximum radio interference voltage at 1.1 times the maximum rated voltage.	Less than 500 micro volts		
13.	1.2/50 micro second lightning impulse withstand voltage (KVP) (dry)	170	650	1050 1425
14.	1 minute dry power frequency withstand voltage primary (KV rms)	70	275	460 630
15.	Switching Impulse with stand and voltage (KVP)	--	-	10500
16.	1 Minute dry power frequency withstand voltage secondary (KV rms)	3	3	5 5
17.	Minimum creepage distance of porcelain Housing (mm)	900	3625	10,500 10500

18.	Rated short time withstand current for 1 second at all ratios (KA rms)	25KA 31.5 KA 40KA 50KA
19.	Instrument security factor at all ratios for metering core.	Not more than 5.0
20.	Minimum rated short time thermal current density of the primary winding at all ratios (A/mm ²)	As per clause No9.6.3- Note of IS: 2705 (Part-I)/1992
21.	Application, current ratio, output burden, accuracy class, minimum knee point voltage, secondary winding resistance, maximum excitation current at minimum knee point voltage etc.	Enclosed in separate sheets for each rating of the Current Transformers.
22.	Type of core	Torroidal type
23.	Seismic acceleration	0.15g (Vertical) 0.3g (Horizontal)
24.	Dielectric dissipation factor for 132 KV & higher voltage class C.T. at ambient temperature.	0.005 or less
25.	Accuracy class of standard C.T. to be used during testing towards determination of ratio errors and phase angle errors for metering cores.	0.05 or better.

SPECIFIED PARAMETERS FOR KPV, SEC. WDG. RESISTANCE, EXCITATION

CURRENT FOR PS CLASS CORES

33KV / 132KV/ 220KV /400KV CT

AND

BURDEN, ISF FOR METERING CORES

OF

ACC.CLASS 0.2S for 33 KV CT & 0.2 for 132,220 & 400 KV CT

FOR

33KV, 132KV, 220KV & 400KV CT

REQUIREMENT FOR 36 KV CURRENT TRANSFORMERS

No. of Cores	Core No.	Applic-ation	Current Ratilo	Output burden in VA	Acc: class as per IS: 2705	Minimum knee point voltage (V _k) at all ratios in volts.	Maximum CT resistance RCT in ohms at 75 °C at all ratios	Maximum excitation current at V _k in mA at all ratios.	Instrum-ent security factor at all ratios
1	2	3	4	5	6	7	8	9	10
36 KV CT ; RATIO- 1200-600-300/1-1-1.									
3	1	Protec- tion	1200/1	-	PS	400	5.0	25	-
			600/1	-	PS				
			300/1		PS				
	2.	Meter- ing	1200/1	15	0.2S	-	-	-	5 or less
			600/1	15	0.2S				5 or less
			300/1	15	0.2S				5 or less
	3.	Protec- tion	1200/1	-	PS	400	5.0	25	-
			600/1	-	PS				
			300/1	-	PS				
36 KV CT ; RATIO- 600-300-150/1-1-1									
3	1	Protec- tion	600/ 1	-	PS	450	5	25	
			300/1	-	PS				
			150/1		PS				
	2.	Meter- ing	600/ 1	15	0.2S	-	-	-	5 or less
			300/1	15	0.2S				5 or less
			150/1	15	0.2S				5 or less

	3.	Protection	600/ 1	-	PS	450	5	25	-
			300/1	-	PS				
			150/1	-	PS				

36 KV CT ; RATIO- 800-400-200/1-1-1

3	1	Protection	800/ 1	-	PS	450	10	40	
			400/1	-	PS				
			200/1		PS				
	2.	Metering	800/ 1	15	0.2S	-	-	-	5 or less
			400/1	15	0.2S				5 or less
			200/1	15	0.2S				5 or less
	3.	Protection	800/ 1	-	PS	450	10	40	-
			400/1	-	PS				
			200/1	-	PS				

36 KV CT ; RATIO- 400-200-100/1-1-1

3	1	Protection	400/ 1	-	PS	400	5	25	
			200/1	-	PS				
			100/1		PS				
	2.	Metering	400/ 1	15	0.2S	-	-	-	5 or less
			200/1	15	0.2S				5 or less
			100/1	15	0.2S				5 or less
	3.	Protection	400/ 1	-	PS	400	5	25	-
			200/1	-	PS				
			100/1	-	PS				

REQUIREMENT FOR 145 KV CURRENT TRANSFORMERS

No. of Cores	Core No.	Applic- ation	Current Ratio	Output burden in VA	Acc: class as per IS: 2705	Minimum knee point voltage (V _k) at all ratios in volts.	Maximum CT resistance RCT in ohms at 75 °C at all ratios	Maximum excitation current at V _k in mA at all ratios.	Instrum- ent security factor at all ratios
1	2	3	4	5	6	7	8	9	10
145 KV CT ; RATIO- 800-400-200/1-1-1-1									
4	1.	Protec- tion	800/1	-	PS				
			400/1	-	PS	400	4	30	-
			200/1		PS				
	2.	Meter- ing	800/1	30	0.2	-	-	-	5 or less
			400/1	30	0.2	-	-	-	5 or less
			200/1	30	0.2	-	-	-	5 or less
	3.	Back up	800/1	-	PS				
			400/1	-	PS	400	4	30	-
			200/1		PS				
	4.	For future use.	800/1	-	PS				
			400/1	-	PS	400	4	30	-
			200/1	-	PS				

145 KV CT ; RATIO- 600-300-150/1-1-1-1									
4	1.	Protec- tion	600/1	-	PS	500	5	60	-
			300/1	-	PS				
			150/1		PS				
	2.	Meter- ing	600/1	30	0.2	-	-	-	5 or less
			300/1	30	0.2				5 or less
			150/1	30	0.2				5 or less
	3.	Back up	600/1	-	PS	500	5	60	-
			300/1	-	PS				
			150/1		PS				
	4.	For future use.	600/1	-	PS	500	5	60	-
			300/1	-	PS				
			150/1		PS				

145 KV CT ; RATIO- 400-200-100/1-1-1-1									
4	1.	Protec- tion	400/1	-	PS	800	4	30	-
			200/1	-	PS				
			100/1		PS				
	2.	Meter- ing	400/1	30	0.2	-	-	-	5 or less
			200/1	30	0.2				5 or less
			100/1	30	0.2				5 or less

	3.	Back up	400/1	-	PS	800	4	30	-
			200/1	-	PS				
			100/1	-	PS				
	4.	For future use.	400/1	-	PS	800	4	30	-
			200/1	-	PS				
			100/1	-	PS				

REQUIREMENT FOR 245 KV CURRENT TRANSFORMERS

No. of Cores	Core No.	Applic- ation	Current Ratio	Output burden in VA	Acc: class as per IS: 2705	Minimum knee point voltage (V _k) at all ratios in volts.	Maximum CT resistance RCT in ohms at 75 °C at all ratios	Maximum excitation current at V _k in mA at all ratios.	Instrum- ent security factor at all ratios
1	2	3	4	5	6	7	8	9	10
245 KV CT ; RATIO- 1200-600-300/1-1-1-1-1									
5	1	Bus diff: check	1200/1	-	PS	600	5.0	40	-
			600/1	-	PS				
			300/1	-	PS				
	2.	Bus diff: check	1200/1	-	PS	600	5.0	40	-
			600/1	-	PS				
			300/1	-	PS				

	3.	Metering	1200/1	30	0.2	-		-	5 or less
			600/1	30	0.2				5 or less
			300/1	30	0.2				5 or less
	4.	Trans: back B/U -Line Prot:	1200/1	-	PS	1200	5.0	40	-
			600/1	-	PS				-
			300/1	-	PS				-
	5.	Trans: back B/U -Line Prot:	1200/1	-	PS	1200	5.0	40	-
			600/1	-	PS				-
			300/1	-	PS				-

REQUIREMENT FOR 420 KV CURRENT TRANSFORMERS

No. of Cores	Core No.	Applic- ation	Current Ratio	Output burden in VA	Acc: class as per IS: 2705	Minimum knee point voltage (V _k) at all ratios in volts.	Maximum CT resistance RCT in ohms at 75 °C at all ratios	Maximum excitation current at V _k in mA at all ratios.	Instrum- ent security factor at all ratios
1	2	3	4	5	6	7	8	9	10
420 KV CT ; RATIO- 2000-1000-500/1-1-1-1-1									
5	1	Bus diff: check	2000/1	-	PS	2000	10		
			1000/1	-	PS	1000	05	30	-
			500/1	-	PS	500	2.5	60	
								120	

	2.	Bus diff: check	2000/1	-	PS	2000	10		-
			1000/1	-	PS	1000	05	30	-
			500/1	-	PS	500	2.5	60	-
								120	
	3.	Metering	2000/1	30	0.2		10		
			1000/1	30	0.2	-	05	-	5 or less
			500/1	30	0.2		2.5		5 or less
									5 or less
	4.	Trans: back B/U -Line Prot:	4000/1	-	PS	2000	10		
			2000/1	-	PS	1000	05	30	-
			1000/1	-	PS	500	2.5	60	-
								120	
	5.	Trans: back B/U -Line Prot:	4000/1	-	PS	2000	10		
			2000/1	-	PS	1000	05	30	-
			1000/1	-	PS	500	2.5	60	-
								120	

NEXURE – A

GUARANTEED TECHNICAL PARTICULARS FOR CURRENT TRANSFORMER.

SL. NO.	DESCRIPTION	LOT-I (33 KV)	LOT-II(132KV)	LOT-III (220 Kv CT)	LOT-IV (400KV)
) RATIO-400-200-100/ 1-1-1A b) RATIO-600-300-150/ 1-1-1A c) RATIO-800-400-200/ 1-1-1A d) RATIO-1200-600-300/ 1-1-1A) RATIO-400-200-100/ 1-1-1A) RATIO-600-300-150/ 1-1-1A) RATIO-800-400-200/ 1-1-1A	a) RATIO-1200-600-300/ 1-1-1-1-1.A b) RATIO-600-300-150/ 1-1-1-1-1.A	RATIO-2000-1000-500/1-1-1-1-1A
1.	Bidder's name and address				
2.	Name and address of the Manufacturer				
3.	Manufacture's type designation				
4.	Standards applicable				
5.	Rated frequency (HZ)				
6.	Rated Voltage (KV)				
7.0	Rated current (A)				

7.1	Rated continuous current (A)				
7.2	Rated extended primary current (A)				
8.	Short time thermal current withstand for stipulated time duration (KA)				
9.	Dynamic current withstand (KAP)				
10.	1.2/50 μ s impulse withstand voltage (KVP)				
11.	One minute dry and wet power frequency withstand voltage (KV-rms)				
12.	No. of cores per CT				
13.	Transformation Ratio				
14.	No. of secondary turns				
15.	Rated output at all ratios for metering core (VA)				
16.	Accuracy class				
17.	Minimum Knee point voltage at different taps for all 'PS' class cores (V)				

18.	Secondary winding resistance at different taps for all cores (Ω) (75°C)				
19.0	Maximum exciting current at all ratios (for all PS class cores)				
19.1	100% KPV (Knee point voltage) (mA)				
19.2	25% KPV (Knee point voltage) (mA)				
19.3	20% KPV (Knee point voltage) (mA)				
19.4	10% KPV (Knee point voltage) (mA)				
20.	Instrument security factor at different ratios.				
21.	Radio interference voltage at $1.1 V_r / 3^{1/2}$ at 1.0 MHZ (Micro volts)				
22.	Whether auxiliary CT provided for metering winding				
23.	Corona extinction voltage (KV rms)				
24.	Partial discharge level (PC)				
25.	Total creepage distance (mm)				
26.	Primary				
26.1	No. of primary turns				

26.2	Material and cross-section of primary (mm ²)				
26.3	Type of primary				
27.	Whether CT is suitable for transportation horizontally.				
28.	Percentage current (ratio) error and phase displacement in minutes at rated burden and at				
28.1	5% rated current				
28.2	10% rated current				
28.3.	20% rated current				
28.4.	120% rated current				
29.	Percentage current (ratio) error and phase displacement in minutes at 25% rated burden and				
29.1	At 5% rated current				
29.2	At 10% rated current				
29.3.	At 20% rated current				
29.4.	At 120% rated current				
30.	Quantity of oil per CT (Litres)				
31.	Standard to which oil conforms generally.				
32.	Characteristics of oil (prior to filling)				

32.1	Breakdown voltage (KVrms)				
32.2	Dielectric dissipation constant (tan delta)				
32.3	Water content (ppm)				
32.4	Gas content				
32.5	Interfacial tension at 27 ⁰ C (N/m)				
32.6	Specific resistance				
32.6. 1	At 90 ⁰ C (Ω cm)				
32.6. 2	At 27 ⁰ C (Ω cm)				
33.	Whether current transformers are hermetically sealed. If so, how ?				
34.	Total weight (Kg)				
35.	Transport weight (Kg)				
36.1	Temperature rise over an ambient temperature of 50 ⁰ C for continuous operation at rated continuous thermal current.				
36.1	Winding				
36.2	Oil				

36.3	External surface of the core, metallic parts in contact with or adjacent to insulation.				
37.	Whether CT characteristic curves enclosed.				
37.1	Ratio and phase angle curve				
37.2	Magnetisation curves				
37.3	Ratio correction factor curves.				
38.	DATA ON PRIMARY WINDING				
38.1	Rated primary current (A)				
38.2	No. of conductors in one turn				
38.3	No. of turns of primary				
38.4	Material of the primary conductors				
38.5	Size of the primary conductor (Bare/ Insulated (mm x mm)				
38.6	Cross-sectional area of each conductor (mm ²)				
38.7	Total cross-sectional area of primary winding (mm ²) conductors				
38.8	Current density(A/mm ²)				
	(i) At highest ratio				

	(ii) At intermediate ratio				
	(iii) At lowest ratio				
38.9	Short circuit current density (A/mm ²)				
	(i) At highest ratio				
	(ii) At intermediate ratio				
	(iii) At lowest ratio				
38.10	Ampere-turn of Primary (AT)				
	(i) At highest ratio				
	(ii) At intermediate ratio				
	(iii) At lowest ratio				
38.11	Length of primary conductor (m)				
38.12	Weight of primary winding (kg.)				
39.	CORE				
39.1	Material and grade of the core				
39.2	Thickness of core (mm)				
39.3	Net Iron cross-sectional area of core (mm ²)				
39.3.1	Core-1				
39.3.2	Core – 2				

39.3. 3	Core – 3				
39.3. 4	Core – 4				
39.3. 5	Core – 5				
39.4	Mean magnetic path length (cm)				
39.4. 1	Core – 1				
39.4. 2	Core – 2				
39.4. 3	Core – 3				
39.4. 4	Core – 4				
39.4. 5	Core – 5				
39.5	Whether B-H curve for the core material, used, furnished ? (B-wb/m ² , H-AT/cm)				
39.6	Whether specific loss vs. flux density graph for the core material used furnished ?				
39.7	Axial length of core (mm)				
39.7. 1	Core – 1				

39.7. 2	Core – 2				
39.7. 3	Core – 3				
39.7. 4	Core – 4				
39.7. 5	Core – 5				
39.8	Inside diameter / outside diameter of the cores (mm)				
39.8. 1	Core – 1				
39.8. 2	Core – 2				
39.8. 3	Core – 3				
39.8. 4	Core – 4				
39.8. 5	Core – 5				
39.9	Weight of the core (kg)				
39.9. 1	Core – 1				
39.9. 2	Core – 2				
39.9. 3	Core – 3				

39.9. 4	Core – 4				
39.9. 5	Core – 5				
40.	SECONDARY WINDINGS				
40.1	Rated secondary current (A)				
40.2	Material of the secondary windings				
40.3.	Size of the secondary conductor [Bare / Insulated] [mm]				
40.3. 1	Core – 1				
40.3. 2	Core – 2				
40.3. 3	Core – 3				
40.3. 4	Core – 4				
40.3. 5	Core – 5				
40.4	Cross sectional area of the secondary conductor (mm ²)				
40.4. 1	Core – 1				
40.4. 2	Core – 2				

40.4. 3	Core – 3				
40.4. 4	Core – 4				
40.4. 5	Core – 5				
40.5	Current density of secondary windings (A/mm ²)				
40.5. 1	Core – 1				
40.5. 2	Core – 2				
40.5. 3	Core – 3				
40.5. 4	Core – 4				
40.5. 5	Core – 5				
40.6	No. of secondary turns				
40.6. 1	Core – 1				
40.6. 2	Core – 2				
40.6. 3	Core – 3				
40.6. 4	Core – 4				

40.6. 5	Core – 5				
40.7	No. of layers				
40.7. 1	Core – 1				
40.7. 2	Core – 2				
40.7. 3	Core – 3				
40.7. 4	Core – 4				
40.7. 5	Core – 5				
40.8	No. of turns / layer				
40.8. 1	Core – 1				
40.8. 2	Core – 2				
40.8. 3	Core – 3				
40.8. 4	Core – 4				
40.8. 5	Core – 5				
40.9	Average length / turn of secondary windings (mm)				
40.9. 1	Core – 1				

40.9. 2	Core – 2				
40.9. 3	Core – 3				
40.9. 4	Core – 4				
40.9. 5	Core – 5				
40.10	Resistance of the conductor used for secondary winding per meter length at 75°C (Ω/M)				
40.11	Weight of secondary windings (kg)				
40.11 .1	Core – 1				
40.11 .2	Core – 2				
40.11 .3	Core – 3				
40.11 .4	Core – 4				
40.11 .5	Core – 5				
41	INSULATION				
41.1	Name and class of insulating material between core and secondary winding.				

41.2	Name/s of Insulating materials between secondary winding and primary windings.				
41.3	Insulating materials used to achieve grading of capacitance.				
42.	DIAMETER OF WINDINGS				
42.1	Inside / outside diameter of secondary windings (mm)				
42.1.1	Inside / outside diameter of secondary windings (mm)				
42.1.1	Core – 1				
42.1.2	Core – 2				
42.1.3	Core – 3				
42.1.4	Core – 4				
42.1.5	Core – 5				
42.2	Inside / outside diameters of primary winding (mm)				
42.3	Minimum clearance from tank (mm)				
42.4	Minimum clearance from secondary to tank (mm)				

43.	TANK AND SECONDARY TERMINAL BOX				
43.1	Material of the CT tank				
43.2	Material of the CT secondary terminal box				
43.3	Thickness of CT tank material (mm)				
43.4	Thickness of CT secondary terminal box material (mm)				
43.5	Zinc coating of the CT tank (gm/m ²) as per relevant upto date ISS				
43.6	Zinc coating of the CT secondary terminal box (gm/m ²) as per the relevant upto date ISS.				
43.7	Ingress protection rating of the secondary terminal box.				
43.8	Weight of the tank, fittings and other accessories (kg)				
44.	TERMINAL CONNECTOR				
44.1	Manufacturer's name				
44.2	Applicable standard				
44.3	Type				
44.4	Material of connector				
44.4. 1	Clamp body				

44.4. 2	Bolts and Nuts				
44.4. 3	Spring washers				
44.5	Rated current (Amp)				
44.6	Rated terminal load (Kg)				
44.7	Factor of safety				
44.8	Minimum thickness of any part (mm)				
44.9	Weight of clamp complete with hardwares (kg)				
44.10	Type test reports as per IS enclosed				
44.11	OGA drawing enclosed				
45.	INSULATOR				
45.1	Manufacturer's name				
45.2	Type				
45.3	Applicable standards				
45.4	Height (mm)				
45.5	Diameter (top) (mm)				
45.7	Total creepage distance (mm)				
45.8.	Rated voltage (KV)				

45.9	Power frequency withstand voltage for 1 min. dry and wet. (KV – rms)				
45.10	1.2/50 micro-sec impulse withstand voltage (KVP)				
45.11	Corona extinction voltage (KV)				
45.12	Weight (Kg)				
45.13	Maximum allowable span (mm)				
45.14	Cantilever strength (Kg)				
45.15	The drawing enclosed.				
46.	Dielectric dissipation factor at 245/1.732KV (for 220KV C.T) and 145/1.732 KV (for 132 kv C.T.) at ambient temperature.				
47.	Accuracy class of standard C.T. to be used towards determination of ratio errors and phase angle errors for metering cores.				

ANNEXTURE – B.

CALLIBRATION STATUS OF TESTING EQUIPMENTS AND INSTRUMENTS / METERS

Name of the Test	Meters & Equipments required for the corresponding test with range accuracy, make & Sl.No.	Date of Calibration	Due Date of Calibration	Name of the Calibrating Agency	Whether Calibrating Agency is Govt. approved	Whether documents relating to Govt. approval of the calibrating Agency furnished	Whether the meters / equipments fulfill the accuracy class as per calibration report	Whether the calibrating agency has put any limitation towards the use of the particular meter / equipment. If yes state the limitations.	Whether green sticker or Blue Sticker or Yellow Sticker has been affixed on the body of the particular equipment / meter. State the colour of the affixed sticker	Inspite of imposed limitations , whether the particular meter / equipment t can still be used ? Justify its use for corresponding test (s)	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

Signature of the tenderer with Seal & date

ANNEXURE – C

CHECK-LIST TOWARDS TYPE TEST & SPECIAL TEST REPORTS

Name of the Type Test & special test	Date of Test.	Name of the Laboratory where the Test has been conducted	Whether the Laboratory is Government approved	Whether the Test report is valid as per Cl.No. 6.1 of TS	Whether the copy of test report in complete shape alongwith drawings etc. furnished or not ?	Whether the tested Current Transformers fulfill the technical requirements as per TS	If the tested Current Transformer does not fulfill the technical requirements as per this specification, whether the bidder agrees to conduct the particular type test again at their own cost without any financial liability to OPTCL in the presence of OPTCL's representative(s) within the specified delivery period.	Remarks
1	2	3	4	5	6	7	8	9

Signature of the Tenderer with seal and date

OUTDOOR TYPE C.T., P.T. & CVT CONSOLES/ MARSHALING BOX:

C.T., P.T. & CVT consoles. Marshalling box shall be of aluminium alloy of 3mm are to be supplied along with the C.T., P.T. & CVT equipments. One console box is required for 3 nos. equipment. Details of quantities required are to be engineered by the contractor. These consoles are suitable for outdoor mounting and shall have proper slope at the top for easy discharge of water.

- (I) Marshalling Boxes shall be weather proof with a rating not less than IP 55
- (II) The CT console shall be of Aluminum alloy sheets having 3 mm thickness.
- (III) The Marshalling box shall be provided with a removable cable gland plate at bottom for mounting cable glands for 1.1KV PVC sheathed 4 x 4 Sq. mm stranded copper conductor cables.
- (IV) The Marshalling box shall be provided with a door in front so as to have easy access of terminals. The door shall have a sealing / locking arrangement and shall be suitable to prevent penetration of moisture and rainwater.
- (V) All terminals shall be clearly marked with identification number to facilitate connection to external wiring.
- (vi) Terminal Block connectors (Reputed make) built from cells of molded dielectric and brass stud inserts shall be provided for terminating the outgoing ends of the wiring and the corresponding incoming tail ends of the control cables. All the terminal connectors shall have de-link(disconnecting) facilities. Provision shall be made on each pillar for holding 20% extra connection (10% incoming + 10% outgoing). All blocks shall be shrouded by easily removable shroud molded of transparent dielectric materials. The terminal blocks shall be suitable for 660 volts service and connection with both aluminum and copper cable.



ODISHA POWER TRANSMISSION CORPORATION LIMITED

TECHNICAL SPECIFICATION FOR ISOLATORS

400KV SINGLE ISOLATOR WITH 1 EARTH SWITCH

400KV SINGLE ISOLATOR WITH 2 EARTH SWITCH

220KV SINGLE ISOLATOR WITHOUT EARTH SWITCH

220KV SINGLE ISOLATOR WITH EARTH SWITCH

220 KV TANDEM ISOLATOR

132 KV DOUBLE ISOLATOR WITH EARTH SWITCH

132 KV SINGLE ISOLATOR WITH EARTH SWITCH

132 KV SINGLE ISOLATOR WITHOUT EARTH SWITCH

132 KV TANDEM ISOLATOR

33 KV DOUBLE ISOLATOR WITH EARTH SWITCH

33 KV SINGLE ISOLATOR WITHOUT EARTH SWITCH

1. TECHNICAL PARTICULARS OF 400 kV,220 kV,132 kV & 33 KV ISOLATOR

	Type:	400 kV	220 kV	132 kV	33 kV
1	Main switch	Double end break centre post rotating, gang operated			
2	Service	Outdoor			
3	Applicable standard	IS : 9921 / IEC-62271-102			
4	No. of Phases	3 phase			
5	Design Ambient temperature	50°C			
6	Type of operation	Electrically Ganged	Mechanically Ganged		
7	Rated voltage (kV)	In KV	In KV	In KV	In KV
	a) Nominal	400	220	132	33
	b) Maximum	420	245	145	36
8	Rated current (Amps)	3150	2000	1250	1250
9	Short time current for 3 sec. (kA)	63	40	31.5	25
10	Rated requeency	50 HZ \pm 5%			
11	System earthing	Effectively earthed			
12	Temperature rise	As per relevant IS/IEC standards			
13	Lightening Impulse withstand voltage (kVp)				
	(a) Across Isolating distance	1425(+240)	1200	750	195
	(b) To earth	1425	1050	650	170
14	1 minute power frequency withstand voltage				
	a) Across Isolating distance	610	530	315	80
	b) To earth	520	460	275	70
15	Switching Impulse withstand voltage (kVp)				
	a) Across Isolating distance	900(+345)	-	-	-
	b) To earth	1050	-	-	-
16	Max. RIV for frequency between 0.5 MHz and 2 MHz (micro-volt)	1000 at 267kV	1000 at 156kV	500 at 92kV	-
17	Corona Extinction Voltage (kV)	320	-	-	-

	Type	400 kV	220 kV	132 kV	33 kV
18	Operating mechanism				
	a) Isolator	Motor	Motor	Motor	Motor
	b) Earth switch	Motor	Motor	Motor	Manual
19	Auxiliary voltage				
	a) Control & Inter lock	220V DC 80% to 110%			
	b) Motor voltage	3 Phase 415V AC 50Hz			
	c) Heater, lamp & socket	Single phase 240 V 50HZ			
20	Safe duration of overload				
	150% of rated current	5 minute			
	120% of rated current	30 minute			
21	Minimum creepage distance of insulator (mm)				
22	Mounting structure	Tubular	Tubular / Lattice	Lattice	Lattice
23	Operating time	Less than 12 secs			
24	Insulator Data				
	a) Bending Strength (kgf)	800	800	800	600
	b) Height (mm)	3650	2300	1500	508
	c) Bottom PCD (mm)	300	254	184	76
	d) No. of holes & hole dia	8x18	8x18	4x18	4xM12
	e) Top PCD	127	127	127	76
	f) No. of holes & hole dia	4xM16	4xM16	4xM16	4xM12
	g) Minimum creepage distance (mm) 25mm/kV	10500	6125	3625	900
25	Bus Bar height from Plinth level (mm)	8000	5900	4600	3700
26	Phase Spacing (mm)	7000	4500	3000	1500
27	Minimum clearances (mm)				
	a) Phase to Phase	4000	2100	1300	320
	b) Phase to earth	3500	2100	1300	320
	c) Sectional clearance	6500	5000	4000	3000

SCOPE

This specification provides for design, manufacturer, testing at manufacturer's Works and delivery ,supervision of erection, commissioning(if required)of outdoor station type 220KV /132KV /33KV, 3 phase triple pole double break gang operated centre rotating type (Single / Double) Isolator with / without earth switches, with electrical inter lock, insulators and complete in all respect with bimetallic connectors arcing horns operating mechanism, auxiliary switches, indicating devices, fixing detail etc. as described hereinafter.

1. STANDARDS

Disconnecting switches covered by this specification shall conform to latest edition IEC-129/IEC 62271-102 I.S.1813 and IS: 9921,IS-325 and unless specifically stated otherwise in this specification.

2. TYPE

The 220&132 KV Isolators shall be outdoor type with three phase double break centre rotating type [Single(SI) / Double(DI)] Isolators suitable for electrical as well as manual operation and local/remote operation ; but 33 KV isolators (SI or DI)shall be outdoor type with three phase double break center rotating manual type with local operation. They shall have crank and reduction gear mechanism.

All Isolators offered shall be suitable for horizontal upright mounting on steel structures. Each pole unit of the multiple Isolators shall be of identical construction and mechanically linked for gang operation.

Each pole of the Isolator shall be provided with two sets of contacts to be operated in series and the moving contact blades shall rotate in horizontal plane.

The design shall be such that the operating mechanism with the linkages shall be suitable for mounting on any of the outer pole ends without much difficulty and with minimum shifting of parts.

Moving contacts of all isolators shall rotate through 90 deg from their "fully closed position" to "fully open position so that the break is distinct and clearly visible from ground level.

The Isolators offered by the Bidder shall be designed for Normal rating current for Isolator

220 kV	132 kV	33kV
2000	1250	1600 amp

It should suitable for continuous service at the system voltages specified herein. The Isolators shall be suitable to carry the rated current continuously and full short circuit current of 40/31.5/25 KA for 220/132/33 KV respectively for 3 second at site condition without any appreciable rise in temperature. These shall also be suitable for operation at 110% rated (normal) voltage. The Isolators shall be suitable for Isolating low capacitive / inductive currents of 0.7amp at 0.15 power factor. The isolators shall be so constructed that they don't open under the influence of short circuit conditions.

The Isolators and earthing switches are required to be used on electrically exposed installation and this should be taken into account while fixing the clearance between phases and between phase and earth.

3. MAIN CONTACTS

All Isolators shall have heavy duty, self-aligning and high pressure line type contacts made of high conductivity, corrosion resistant, hard-drawn electrolytic copper strips of proper thickness and contact area. Fixed contact should consist of loops of above copper strips suitable for 2000 Amps, 1250 Amps, and

1600Amps ratings for 220 KV, 132 KV and 33 KV Isolators respectively. The hard drawn electrolytic copper strips should be silver plated 25 micron thickness and fixed contacts should be backed by powerful phosphor bronze/stainless steel springs of suitable numbers. However, the thickness and contact area of the contact should conform to the drawing approved during type test. Moving contact with moving arm should be of hard-drawn electrolytic copper of proper thickness and contact area.

These fixed and moving contacts shall be able to carry the rated current continuously and the maximum fault current of 40/31.5/25 KA for 200/132/33KV respectively for 3 seconds without any appreciable rise in temperature. The Isolator blades shall retain their form and straightness under all conditions of operation including all mechanical stress arising out of operation as well as under rated short circuit condition.

Fixed guides shall be provided so that even when the blades are out of alignment by one inch (maximum), closing of the switches, proper seating of the blades in between contacts and adequate pressure to give enough contact surface is ensured. Wherever possible, the blades shall be counter balanced by weights and springs. The contact shall be self-cleaning by the wiping action created by the movements of the blades. The surface of the contacts shall be tendered smooth and silver plated (25 micron).

The Isolator shall be self-cleaning type so that when isolators remain closed for long periods in a heavily polluted atmosphere, binding does not occur. No undue wear or scuffing shall be evident during the mechanical endurance tests, contacts and springs shall be designed so that adjustment of contact pressure shall not be necessary throughout the life of the isolator. Each contact or part of contacts shall be independently sprung so that full pressure is maintained on all contact at all times.

4. ARCING HORN AND GRADING HORN

Suitable arcing horn made of tinned electrolytic copper which are required for guiding contacts shall be provided on the fixed and moving contacts of all Isolators. The contacts shall be of 'make before and break after" type.

5. ELECTRICAL INTERLOCK / MECHANICAL INTERLOCK

The disconnecting switches whenever required shall be with an approved type electrical interlock for interlocking with the associated circuit breakers and earth switch. Electrical interlock assembly should be more right in construction and properly mounted to ensure reliable operation. The design should be such that the electrical circuit for the interlocking mechanism will only remain energised during operation of the switches.

6. AUXILIARY SWITCHES

All isolators and earthing switches shall be provided with 220VDC auxiliary switches for their remote position indication on the control board and for electrical locking with other equipment. The auxiliary switch shall be provided with a minimum of six auxiliary contacts-10 normally open and 10 normally closed and 10 normally open and 10 normally closed for earth switch. Separate auxiliary switches shall be provided for isolating and earth switches. 6 additional NO and NC contact to be provided as spare in each case.

The auxiliary switches and auxiliary circuits shall have a continuous current carrying capacity of at least 10 Amps. Auxiliary switches shall not be used as limit switches. Details of make, rating and type of limit switch shall be furnished in the offer.

7. EARTH SWITCH

Line earth switch shall consist of three earthing blades for Isolator which normally rest against the frame when the connected Isolator is in closed position. The earthing blades for three phase shall be mechanically linked to a coupling shaft which shall be capable of being fitted on either side of the Isolator. The earthing blades shall match and be similar to the main switch blades and shall be provided at the hinge; with suitable flexible conductors with terminal lugs for connecting to the station ground bus. The earthing blades shall be operated by a separate mechanism but shall be mechanically interlocked with the main switch so that the earthing blades can be closed only when the main switches are in open position and vice-versa. The earthing blades shall be gang operated and all the three blades will operate simultaneously.

8. OPERATING MACHANISM

The operating mechanism shall be simple and shall ensure quick and effective 1000 operation. The design shall be such as to enable one man to operate it with nominal effort. The operating mechanism box shall be made out of aluminum extruded (Aluminum alloy) sections of minimum 3.0 mm thickness. The operating mechanism shall be strong rigid and not subject to rebound.

The Isolator blades shall be in positive continuous control throughout the entire cycles of operation. The operating rods and pipes shall be rigid enough to maintain positive control under most adverse conditions and to withstand all torsional and bending stresses arising from operation. Operation of the switches at any speed should not result in improper functioning, in displacement of parts / machines after final adjustment has been made. All holes in cranks, linkages etc. having moving pins shall be drilled and fitted accurately so as to prevent slackness and lost motion.

Provision shall be made for padlocking the operating mechanism of disconnecting and earth switches in both open and closed positions.

Bearings shall be ball and roller type shall be protected from weather and dust by means of cover and grease retainers. Bearings pressures shall be kept low to ensure long life and care of operation.

Each power operated isolator shall be motor driven as well as manually operated and shall be complete with local / remote selector switch and open / close push buttons. The function of all control facilitate operating isolators.

Provision shall be made in the control cabinet to disconnect power supply to prevent local / remote power operation. Limit switches for open and close positions of re-isolations and earth switches.

All the terminal blocks to be used in the operating mechanism should of stud type of Poly-amide/Mealmine material of make like Elmex (OAT-6 for non disconnecting type & OAT -6T for disconnecting type) / connectwell (Equivalent).

9. DESIGN, MATERIALS AND WORKMANSHIP

The live parts shall be designed to eliminate sharp points, edges and similar corona producing surfaces. Where this is impracticable, adequate shields to be provided. All ferrous metal parts shall be hot dip galvanized, as per IS 2629. All metal parts shall be of such materials or treated in such a way so as to avoid rust, corrosion and

deterioration due to continued exposure to atmosphere and rain. All current carrying parts shall be made from high conductivity electrolytic copper / aluminium.

Bolts, screws and pins shall be provided with standard locking device viz. Locknuts, spring washers, keys etc. and when used with current carrying parts, they shall be made of copper silicon or other high conductivity and wear resistant alloys.

The switches should not need lubrication of any parts except at very long interval of five year minimum.

10. PROTECTIVE COATINGS

All ferrous parts including bolts, nuts and washers of the switches assembly shall be galvanized to withstand at least six one minute dips in copper sulphate solution of requisite strength (Prece tests) except the threaded portions which should withstand four dips.

11. Insulators – Support insulators for all type of isolators shall be of solid core type. The insulator shall be made of homogeneous and vitreous porcelain of high mechanical and dielectric strength. It shall have sufficient mechanical strength to sustain electrical and mechanical loading on account of wind load, short circuit forces etc. Glazing of the porcelains shall be of uniform dark brown color with a smooth surface arranged to shed away rain water. The porcelain shall be free from laminations and other flaws or imperfections that might affect the mechanical or dielectric quality. It shall be thoroughly vitrified, tough and impervious to moisture. The porcelain and metal parts shall be assembled in such a manner and with such material that any thermal differential expansion between the metal and porcelain parts throughout the range of temperature specified in this specification shall not loosen the parts or create under internal stresses which may affect the mechanical or electrical strength or rigidity. The assembly shall not have excessive concentration of electrical stresses in any section or across leakage surfaces. The cement used shall not give rise to chemical reaction with metal fittings. The insulator shall be suitable for water washing by rain or artificial means in service condition. Profile of the insulator shall also conform to IEC-815. Insulator shall have a minimum cantilever strength of 800 Kgs (for 220 KV & 132 KV) & 600 Kgs for (33 KV). Caps to be provided on top of the insulator shall be of high grade cast iron or malleable steel casting. It shall be machine faced and hot dip galvanized. The cap shall have four numbers of tapped holes spaced on a pitch circle diameter of 127mm. The holes shall be suitable for bolts with threads having anti corrosive protection. The effective depth of threads shall not be less than the nominal diameter of the bolt. The cap shall be so designed that it shall be free from visible corona and shall have radio interference level within 500 micro volts. Casing shall be free from blow holes cracks and such other defects.

12. Control Cabinet : The control cabinet of the operating mechanism shall be made out of minimum 3mm thick aluminium alloy sheet. Hinged door shall be provided with pad locking arrangement. Sloping rain hood shall be provided to cover all sides. 15 mm thick neoprene or better type of gaskets shall be provided to ensure degree of protection of at least IP 55 as per IS 2147/IS-3947. The cabinet shall be suitable for mounting on support structure with adjustment for vertical, horizontal and longitudinal alignment. Details of these arrangements shall be furnished alongwith the offer.

13. Motor : Motors rated 1 Kw and above shall be suitable for operation on 3 phase, 415 V, 50 HZ supply. Motors of lower rating shall be single phase type suitable for 240V, 50HZ system. It shall be totally enclosed

type if mounted outside the control cabinet. The motor shall withstand without damage stalled torque for at least 3 times the time lag of the tripping device. The motor shall, in all other respects, conform to the requirement of I.S. 325.

14. Gear : The dis-connector / isolator may be required to operate occasionally, with considerably long idle intervals. Special care shall be taken for selection of material for gear and lubrication of gears to meet this requirement. The gear shall be made out of aluminium bronze or any other better material lubricated for life with graphite or better quality non-drawing and non-hardening type grease. Wherever necessary automatic relieving mechanism shall be provided suitable relay, Device shall be provided to prevent over loading of the motor. Single phase preventer (for 3 phase meter) shall be provided to operate on open circuiting of any phase and shall trip off the motor. Complete details of the devices shall be furnished in the offer.

15. Space heaters : Space heaters suitable for 1 phase 240V AC supply shall be provided for each motor operated operating mechanism to prevent condensation and shall be operated by MCB.

16. Terminal block and Wirings – Each operating mechanism shall be provided with 1100V grade stud type terminal block. All auxiliary switches, interlocks and other terminals shall be wired upto terminal block. The terminal block shall have at least 20% extra terminals. All wiring shall be carried out with 1.1KV grade insulated 2.5 sqmm copper wires.

17. Interior Illumination : A holder suitable for a 240 V lamp shall be provided in each of the motor operated mechanism of three poles & shall be door operated type.

18. Control and auxiliary supply – A 3 phase switch with MCB for phases and link for neutral, shall be provided for power supply and a 2 pole MCB shall be provided for control supply.

19. Position indicator : A position indicator to show the isolator is in ON or OFF position to be provided.

20. Name plate : Isolator, earthing switches and their operating devices shall be provided with name plate. The name plate shall be weather proof and corrosion proof. It shall be mounted in such a position that it shall be visible in the position of normal service and installation. It shall carry the following informations duly engraved or punched on it.

A. Isolator Base

Name : OPTCL

Name of manufacturer –

Order No. –

Type Designation –

Manufacturers serial No. –

Rated voltage –

Rated normal current –

Rated short time current (rms) and duration –

Rated short time peak current (KAP)

Weight

B. Earthing Switch

Name : OPTCL

Name of manufacturer –

Order No. –

Type Designation –

Manufacturers serial No. –

Rated voltage –

Rated normal current –

Rated short time current (rms) and duration

Rated short time peak current (KAP)

Weight

C. Operating Device

Name – OPTCL

Name of manufacturer –

Order No.

Type Designation –

Reduction gear ratio –

AC motor

- i) Rated auxiliary voltage
- ii) Starting current
- iii) Designation of AC motor as per I.S 4722/325
- iv) Starting torque at 80% of supply voltage
- v) Over travel in degrees after cutting off supply
- Total operating time in seconds
- i) Close operation – Electrical
- ii) Open operation – electrical
- Open operation – manual

21. Painting Galvanizing and Climate Proofing

At interiors and exteriors of enclosures, cabinets and other metal parts (other than made up of aluminium) shall be thoroughly cleaned to remove all rust, scales, corrosion, grease and other adhering foreign matter and the surfaces treated by phosphating (e.g. seven tank phosphating sequence). After such preparation of surfaces, two coats of zinc oxide primer shall be given by suitable stoving and air drying before final painting. Colour of the final paints shall be of shade no. 697 of IS:5. The finally painted cubicle shall present aesthetically pleasing appearance free from any dent or uneven surface.

Paint inside the metallic housing shall be of anti-condensation type and the paint on outside surfaces shall be suitable for outdoor installation.

All components shall be given adequate treatment of climate proofing as per IS:3202 so as to withstand corrosive and severe service conditions.

All metal parts not suitable for painting such as structural steel, pipes, rods, levers, linkages, nuts and bolts used in other than current path etc. shall be hot dip galvanized as per IS –2629. Galvanization test will be carried out during routine test.

Complete details of painting, galvanizing and climate proofing of the equipment shall be furnished in the offer.

24. TESTS

Type Tests

Isolators offered, shall be fully type tested as per the relevant standards. The Bidder shall furnish Three sets of the following valid type test reports for their different type of offered Isolators along with the offer. The Purchaser reserves the right to demand repetition of some or all the type tests in the presence of purchaser's representative. For this purpose the Bidder may quote unit rates for carrying out each type test and this will be taken during bid price evaluation, if required.

- a) short time withstand & peak withstand current test for Isolator & Earth Switch.
- b) power frequency (Dry & Wet), Lightning Impulse dry withstand Test
- c) Mechanical endurance Test
- d) IP-55 test

During type tests the isolator shall be mounted on its own support structure or equivalent support structure and installed with its own operating mechanism to make the type tests representative. Drawing of equivalent support structure and mounting arrangements shall be furnished for Purchaser's approval before conducting the type tests.

The type tests shall be conducted on the isolator along with approved insulators and terminal connectors.

Mechanical endurance test shall be conducted on the main switch as well as earth switch of one isolator of each type.

Acceptance and Routine Test :

All acceptance and routine test as stipulated in the relevant standards shall be carried out by the supplier in presence of Purchaser's representative.

Mechanical operation test (routine test) shall be conducted on isolator (main switch and earth switch) at the supplier's works as well as purchaser's substation site.

Immediately after finalization of the programme of type / acceptance, routine testing the supplier shall give sufficient advance intimation (clear 20 days advance intimation), along with shop routine test certificates, valid calibration reports from Govt. approved test house for the equipments, instruments to be used during testing for scrutiny by the purchaser to enable him to depute his representative for witnessing the tests. If there will be any discrepancies in the shop routine test certificates and calibration reports furnished by the firm then after settlement of the discrepancies only, purchaser's representative will be deputed for witnessing the tests. Special tests proposed to be conducted (if decided to conduct) as type test on isolators, are given at Annexure- II. These special type test charges shall be quoted along with all other type tests as per relevant IEC standard and these charges shall be included in the total bid price.

Test certificates of various items including but not limited to the following shall be furnished at the time of routine tests.

- a) Chemical analysis of copper along with a copy of excise certificate indicating genuine source of procurement of electrolytic grade copper.
- b) Bearings
- c) Fasteners
- d) Universal / swivel joint coupling
- e) Insulators
- f) Motor
- g) Gears
- h) Auxillary switch
- i) Limit switch
- j) Timer
- k) Overload / single phase preventer relay
- l) Interlocking devices
- m) Terminal block
- n) Any other item

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- w) Limit switch
- x) Timer
- y) Overload / single phase preventer relay
- z) Interlocking devices
- aa) Terminal block
- bb) Any other item

25. INSPECTION

- i) The Purchaser shall have access at all times to the works and all other places of manufacture, where the disconnectors, earth switches and associated equipment are being manufactured and the supplier shall provide all facilities for unrestricted inspection of the works raw materials manufacture of all the accessories and for conducting necessary tests as detailed herein.
- ii) The supplier shall keep the purchaser informed in advance of the time of starting of the progress of manufacture of equipment in its various stages so that arrangements could be made for inspection.

iii) No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

iv) The acceptance of any quantity of the 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 equipment are later found to be defective.

26 QUALITY ASSURANCE PLAN

The Bidder shall invariably furnish following information along with his offer, failing which his offer shall be liable for rejection.

(i) Names of sub suppliers for 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 Supplier's representative, copies of test certificate

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

(iii) List of manufacturing facilities available

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

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

(vi) List of testing equipments with calibration certificates from Govt. approved test house available with supplier for final testing equipment and test plant limitation if any, vis-à-vis the type, special acceptance and routine test specified in the relevant standards. These limitations shall be very clearly brought out in the specified test requirements.

The supplier shall within 30 days of placement of order, submit following information to the purchaser.

i) List of raw material as well as bought out accessories and the names of sub-suppliers selected from the lists furnished along with offer.

ii) Type test certificates of the raw material and both bought out accessories.

iii) Quality Assurance Plan (QAP) with hold points for purchaser's inspection.

The supplier shall submit the routine test certificates of bought out accessories and raw material viz. Copper, aluminum conductors, lubricating material, gear material etc. at the time of routine testing of the fully assembled isolator.

27. DOCUMENTATION

All drawings shall conform to relevant international standards organization (ISO). All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. Units.

List of Drawings and Documents

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

a) General outline and assembly drawings of the dis-connector operating mechanism, structure, insulator and terminal connector.

- b) Sectional views and descriptive details of items such as moving blades, contacts, arms contact pressure, contact support bearing housing of bearings, balancing of heights, phase coupling pipes, base plate, operating shaft, guides, swivel joint operating mechanism and its components etc.
- c) Loading diagram
- d) Drawings with structure for the purpose of type tests.
- e) Name plate.
- f) Schematic drawing.
- g) Type test reports.
- h) Test reports, literature, pamphlets of the bought out items and raw material.

The supplier shall within 2 weeks of placement of order submit four sets of final versions of all the above said drawings for Purchaser's approval. The purchaser shall communicate his comments / approval on the drawings to the supplier. The supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for Purchaser's approval within two weeks from the date of comments. After receipt of approval the supplier shall within three weeks submit 15 prints and two good quality re-producibles of the approved drawings for purchaser's use.

Six sets of the type test reports, duly approved by the Purchaser shall be submitted by the supplier for distribution, before commencement of supply Adequate copies of acceptance and routine test certificates, duly approved by the Purchaser shall accompany the dispatched consignment.

The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the supplier risk.

28. INSTRUCTION MANUALS :

Fifteen copies of the erection, operation and maintenance manuals in English to be supplied for each type of disconnector one month prior to dispatch of the equipment. The manual shall be bound volumes and shall contain all drawings and information required for erection, operation and maintenance of the disconnector including but not limited to the following particulars.

- (a) Marked erection prints identifying the component parts of the disconnector as shipped with assembly drawings.
- (b) Detailed dimensions and description of all auxiliaries.
- (c) Detailed views of the insulator stacks, metallics, operating mechanism, structure, interlocks, spare parts etc.

29. PACKING AND FORWARDING.

The equipment shall be packed in crates suitable for vertical / horizontal transport, as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols.

Wherever necessary, proper arrangement for lifting, such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.

Each consignment shall be accompanied by a detailed packing list containing the following information:

- (a) Name of the consignee.
- (b) Details of consignment.
- (c) Destination.
- (d) Total weight of consignment.
- (e) Handling and unpacking instructions.
- (f) Bill of material indicating contents of each package.

The supplier shall ensure that the bill of material is approved by the purchaser before dispatch.

30. SUPERVISION OF ERECTION TESTING AND COMMISSIONING (ET & C)

Purchaser proposes to utilize the services of the supplier for supervision of testing and commissioning of the equipment being supplied by him, if it is required. For this purpose, the supplier should make available the services of trained personnel (Engineers) who shall correct in the field, any errors or omissions in order to make the equipment and material properly perform in accordance with the intent of this specification. The Engineer shall also instruct the plant operators in the operation and maintenance of the commissioned equipment. The supplier shall be responsible for any damage to the equipment on commissioning the same, if such damage results for the faulty or improper ET&C. Purchaser shall provide adequate number of skilled / semi-skilled workers as well as ordinary tools and equipment and cranes required for equipment erection, at his own expenses. Apart from the above, the Purchaser shall not be responsible for providing any other facilities to the supplier. Special tools if required for erection and commissioning shall be arranged by the supplier at his cost and on commissioning these shall be supplied to the purchaser free of cost for future use.

APPENDIX – I

(Isolators)

LIST OF SPECIAL TESTS TO BE CARRIED OUT IF DECIDED BY THE PURCHASER

Sl. No.	Name of the Test	Standard to which it conforms.
1.	Test for visible Corona and Radio interference voltage (RIV) on disconnectors and terminal connector	NEMA Pub No. 107-1964 ISRI Pub No. 1-1972
2.	Tests on insulators	IS-2544 IEC. 168
3.	Tests on terminal connectors	IS:5561
4.	Tests on galvanized components	IS:2633
5.	Stalled torque test on motor operating mechanism	At 110% of supply voltage



ORISSA POWER TRANSMISSION CORPORATION LIMITED

TECHNICAL SPECIFICATION

**FOR
250 KVA, 500KVA & 1 MVA, 33/0.433 KV STATION
TRANSFORMER**

(Energy Efficiency Level 2)

TECHNICAL SPECIFICATION FOR 250 KVA, 500 KVA & 1MVA, 33/0.433 KV STATION TRANSFORMER

1. TYPE:

The Transformers shall be of the outdoor core type double wound oil immersed self-cooled type 'ON' and conform to ISS 1180/2014 and 2026/1977 with up-to-date amendments.

All the transformers shall be suitable for operation in humid atmosphere in the tropical place with ambient temperature ranging from 50° to 60° C.

2. STANDARD

The transformers shall comply with ISS 2026/1977, 1180/2014 & the latest version thereon & CBIP standards with Class-A materials specified therein and should be designed taking ambient temp. as 50° C.

3. RATING

The transformer shall have core type copper wound construction, oil immersed 'ON' suitable for out-door service as a step down transformer. The rating and electrical characteristics of the transformers shall be as follows:

		<u>250KVA</u>	<u>500KVA</u>	<u>1MVA</u>
i)	Frequency	-	-----50 Hz ± 5%-----	
ii)	Continuous rating	- 250 KVA	500 KVA	1MVA
iii)	Rated HT/LT voltage	-	-----33/0.433 KV-----	
iv)	Number of phase	-	-----3 phases-----	
v)	Connection HT	-	-----Delta-----	
vi)	Connection LT	-	-----Star-----	
vii)	Vector group	-	-----Dyn – 11-----	
viii)	Taps	-	-5% to +7.5% in steps 2.5% in high voltage side.	
ix)	Percentage impedance at Continuous maximum Rating at 75° C	-	----- +5% (Minimum)----- (No negative tolerance is allowed)	
x)	Type tap changer for transformer		(Rotary type, off load control tap changing gear)	
xi)	BIL	-	-----170 KVP-----	
xii)	Terminal connection	-	Bimetallic clamp suitable for ACSR conductor as per system Requirement.	
xiii)	Maximum flux density at normal Voltage & normal frequency	-	1.4 Tesla	

4. The primary-winding shall be connected Delta and secondary winding star as per vector symbol Dyn-11(IS:2026/1977). The terminal arrangement shall be out door bushing suitable for bare ACSR – Twin Zebra conductors for 33 KV side and to suit 3 ½ x300 mm² armoured PVC cable with cable end box for 433volt side.

The temperature rise should not exceed the limits stated in relevant standards. The transformer shall be capable of withstanding thermal and mechanical effects, of a short circuit on the terminals of any winding with full voltage maintained on other windings for duration of at least five seconds.

5. INSULATION

- 5.1 The electric strength of the winding insulation and of bushings shall conform to the values given in the IS: 2026/1977.
- 5.2.1 For rated system voltage of 33 Kv, the impulse test voltage is 170 kV (Peak) & power frequency voltage is 70KV.
- 5.3 All windings of the transformer shall have uniform insulations.

6. VOLTAGE RATIO

- 6.1 The transformers shall be for the rated kV specified on the HV side and on the LV side.
- 6.1.1 The insulation and magnetic circuit shall be suitable for working continuously at 10% in excess of the normal voltage and at the same time at a frequency of 3% below the normal.

7. CURRENT DENSITY

The current density in windings shall be kept within 2.4 A/sq.mm.

8. FLUX DENSITY

The maximum induction with maximum system voltage i.e. 36 kV& frequency, and the type of steel used for core laminations should be stated in the tender. Flux density at maximum system voltage i.e. 36 kV and lowest frequency 48.5 C/S shall not exceed 1.6 Tesla.

9. FRERQUENCY

The transformers shall be suitable for continuous operation with a frequency variation of plus or minus 3% from the normal frequency of 50 Hz without exceeding the temperature rise specified in clause – 17.

10. TERMINAL ARRANGEMENTS

HT side – Bimetallic clamp type, suitable for ACSR conductor as per requirement and layout.

LT side – cable connection, 3 ½ x 300 mm² armoured PVC aluminium cable. The neutral of the star end brought to a separate insulation terminal for earthing purpose.

11. TAPPINGS

Tappings range shall be 12.5% in steps of 2.5% and it shall be off load type with local control. The taps shall provide for voltage adjustment on the high voltage side from –5% to +7.5% of the rated voltage, the tapplings being located on higher voltage winding.

The transformer shall be so designed that the temperature rise is maintained within limits, specified in relevant standards when operated at full output or constant primary service voltage on any primary tapplings irrespective of the tapping corresponding to the service voltage.

An externally operated off circuit tapping switch shall be provided to enable changing of taps without removing the transformer cover or lowering of the oil level. The transformer shall give full rated KVA output of each winding at all the taps.

The switch mechanism shall be so designed as to prevent the entry of moisture into the tank. The design of the switch mechanism shall ensure that the switches are making full contact and then only it shall be possible to look the operating mechanism. The tap mechanism shall be provided with a locking device.

12. BUSHING TERMINALS

All main winding and neutral leads shall be brought out through outdoor type bushing suitable for bare copper or ACSR conductors for 33 kV side and to suit for 3 ½ x 300 mm² armoured PVC cable for 433 volt side & so located that the full flash over strength will be utilized.

Each bushing shall be so coordinated with the transformer insulation that all flashovers will occur outside the tank. The porcelain used for the bushings shall be of the wet processed type, homogenous and free from cavities or other defects. The glaze of the porcelain parts shall be uniform in colour and free of blisters, burns and other defects.

The bushings should conform to IS:2099/73 and with 3347(Part-I & II Section – 1 & 2) with its latest amendments.

13. FLASHOVER CHARACTERISTICS OF BUSHINGS

The spacing between the bushings must be adequate to prevent flash over between phases under all condition of operation. Special adjustable coordinating gaps should be provided on the high-tension terminals and the gap setting adjusted with reference to the impulse coordination of the system. The tenderer is requested to give the guaranteed withstand voltage for the impulse and flash over values of the bushings.

14. SUPPRESSION OF HARMONNICS

The transformers shall be designed with particular attention for suppression of harmonic voltages especially the 3rd and 5th so as to eliminate wave form distortion and any possibility of high frequency distortion and any possibility of high frequency disturbances, inductive factor or of circulating current between neutral point at the different transformer station reaching such a magnitude as to cause, interference with post office or other communication circuits.

15. CENTRE OF GRAVITY

The center of gravity of the assembled transformer shall be low and as near the vertical centerline as possible. The transformer shall be stable with or without oil. If the center of gravity is eccentric to the vertical line either with or without oil, its location shall be shown on the outline drawing.

16. VIBRATIONS AND NOISE

The transformers shall operate without undue vibration and noise and shall comply with NEMA publication – TR – 1.

17. TEMPERATURE RISE

Each transformer shall be capable of operating continuously at this normal rating without exceeding temperature rise limits as specified below:

- i) Winding 55°C by resistance measurement.
- ii) Top oil 50°C by thermometer measurement.

The above limits are with an ambient temperature of 50° maximum. All transformers shall comply with requirement of IS: 2026/77 & it's latest amendments as regard the rating and temperature rise.

18. EFFICIENCY

The efficiencies of the transformer corresponding to 25%, 50%, 75%, 100% and 125% load may be specified. Maximum efficiency should occur at 50% load.

19. PERCENTAGE IMPEDENCE

The transformer offered must be designed for a minimum impedance of +5% at 75° C. No negative tolerance on impedance is allowed.

20. LOSSES

The no load & load losses shall not exceed the values given in the following table.

Ratings	TOTAL LOSSES (no-load+load losses at 75 ⁰ C) AT 50% LOAD IN WATTS	TOTAL LOSSES (no-load+load losses at 75 ⁰ C) AT 100% LOAD IN WATTS	PERCENTAGE IMPEDANCE AT 75 DEGREE C AT NORMAL TAP
250 KVA(Copper wound)	1054	3150	4.5 (Minimum)
500 KVA(Copper wound)	1623	4623	4.5 (Minimum)
1MVA(Copper Wound)	2999	8278	4.5 (Minimum)

The above losses are maximum allowable losses & there shall not be any + ve tolerance on the losses for the transformers. Bid evaluation will be done taking in to consideration the quoted no

load & load loss figures. The purchaser reserves the right to reject the whole lot of supply in case the loss figures exceed the limit given in above table at the time of testing.

21. PARALLEL OPERATION

The transformers with similar connection shall be capable of operating in parallel on corresponding taps and of sharing loads in proportion to their ratings subject to the tolerances of impedance.

22. WINDING AND INSULATION

All permanent current carrying joints shall be welded or brazed.

All threaded connections shall be provided with locking facilities.

The assembled core and coils shall be properly dried before impregnation. The process of impregnation should be stated.

All leads from the winding shall be rigidly supported to prevent injure isolation due to vibration. Flexible tubes shall be used where practicable.

- The HT and LT winding of all transformers shall be of the fully insulated type.
- a. Special attention should be given to provisions of adequate insulation and clearances between HT and LT windings and live parts must be adequate for normal voltage of operation plus 10%.
- b. The end turn insulation of the transformers shall in conformity with latest practice.
- c. Windings shall be circular and concentric with the HT windings on the outside. All similar coils shall be inter changeable.
- d. The windings shall be made of paper insulated continuous & smooth electrolytic copper conductor. The insulation of coils & assembly of windings shall be insoluble, non-catalytic and chemically inactive in the hot transformer oil. The insulation shall be of class "A" category.
- e. The insulation of the transformer winding and connection shall be free from insulating compound which may so often coagulate shrink or collapse during service. None of the materials used shall shrink, disintegrate, carbonized or become brittle under the action of hot oil when the transformer is operated continuously with the conductors at any temperature which may be reached at the specified loading conditions.

The finished width of any oil ducts shall be such and the clamping arrangement shall be so designed as not to impede the free circulation of oil through the ducts.

23. BRACING OF WINDINGS

Windings connections and tappings of the transformers shall be braced to withstand the shocks, which may occur during transport and during service due to short circuit, switching or other transient condition. No mechanical movement of coils shall be possible with dead short circuit on either side of the transformer. The short circuit rating shall be as per Clause 9.1 ISS: 2026/1977.

24. MAGNETIC CIRCUITS

The transformers core shall be of high grade non-ageing, electrical silicon steel cold-rolled laminations each coated with hot oil proof, lead enamel insulation clamped together firmly to the frame to ensure even pressure over the whole of the core laminations and to prevent undue vibration

and noise. After being sheared the laminations shall be treated to remove all burns and shall be reannealed to remove all strains.

Paper or varnish insulation shall not be accepted. The joints in the core shall be inter leaved and in no account will 'Butt Joints' be accepted. Suitable axial cooling ducts suitable proportioned to prevent excessive temperature rise must be provided to ensure, free circulation of oil and efficient cooling of the core. The clamping structure shall be so constructed with MS Channels, and insulated bolts and so designed that eddy currents is minimum and hood must not be used for the purpose. The core shall be designed and build up in such a manner as to avoid accidental or slow development of short circuit plates through iron and frame.

The core and coils shall be so fixed in the tank that their shifting will not occur when the transformer is moved.

Means shall be provided for earthing the core and framework at one point only.

25. TRANSFORMER TANK

The tank and cover of each transformer shall be of welded boilerplate with suitable stiffeners so constructed that all joints are hot oil tight and bulging does not occur in service. The tank shall be so designed that with the minimum dismantling necessary, the core and winding can be lifted free of the case. External lugs or eyes for lifting the core or windings shall be provided. Ample space shall be provided with an appropriate arrangement of things, suitable for lifting transformer core with winding. The tank shall be fitted with a substantial under carriage and provided with rollers. The minimum thickness of the bottom & top plates shall be 6 mm and side plates shall be 4 mm.

26. OIL

Sufficient quantity of oil shall be supplied with each transformer for filling each tank, bushing and conservator to the proper level. The oil shall be in accordance with IS No.335/1972 & it's latest amendments. Oil test certificates shall be furnished at the time of inspection of transformers in support of the use of new unused oil conforming to IS 335 in the transformer.

27. EARTHINGS

The core and tank cover shall be earthed to the tanks by means of copper connection capable of carrying for 30 seconds without injury and over loading with earth fault current not less than full load current of the main transformer. In no case shall the cross sectional area be less than 0.1 sq. inch. Two earthing terminal shall be provided suitable for No 7 SGW bare copper wire with suitable soldering lugs.

28. TANK FITTINGS AND ACCESSORIES

The standard fittings to be provided on each transformer in line with manufacturers practice may be provided including the following:-

- a. Oil conservator of sufficient capacity to prevent inadvertent operation of Buchholz relay where used and shall be provided with drain plug/valve oil gauge, with a mark to

indicate oil level at a temperature of 50° C filling cap. Silica Gel dehydrating breather to contain minimum 0.5 kg dehydrated silica gel.

b. Explosion Vent

A safety valve of chimney type shall be provided. The bottom of the safety valve pipe shall project into the tank.

c. Glass Type Thermometer

Mercury in glass type thermometer mounted on the top of the transformer to read the temperature in the hottest part of the oil.

d. Drain Valve

1" (15mm) drain valve cum lower filter valve suitable for connection to the flange of the same diameter. The valve should be fitted with an adopter for 16 mm hose for filtering purposes. The valve shall be located so as to enable with drain out of the oil from the tank. This valve shall be equipped with a small sampling cock.

e. Earthing terminal and numbers.

f. Air relief vent.

g. Rating and diagram plate

The rating plate should bear the data specified in the proper clauses of ISS-2026/1977. The diagram plate should also show the internal connection and so the voltage vector relationship of the several windings in accordance with ISS:2026/1977 and in addition a plan view of the transformer giving accurate physical relationship with the terminals.

h. Oil filter valve

The oil filter valves should be fitted with adopter for 16 mm hose. These valves are for oil filtration and for draining of oil for sample and test purpose.

i. Joint and Gaskets

All joints in the transformer and auxiliary equipment shall be made in such a manner as to prevent ingress of moisture or leakage of oil.

j. Arcing horn with each HT bushings.

k. Pad lock for tap changing switch.

l. Accessory equipment not specifically listed above but normally regarded as standard shall be provided in accordance with relevant clauses of ISS:2026/1977 & CBIP practice.

29. PACKAGE

The packing may be in accordance with the manufacture's standard practice. The bushings shall be packed and dispatched separately. Full details of packing for approval of the purchaser should be given. The package shall be such to satisfy the conditions of transport by rail and road to existing place where the transformer is to be erected and also be suitable for rough handling.

30. PAINTING

Before dispatch all steel work not under oil shall be painted with a primary coat of anti-corrosive paint of durable nature and one coat of final finishing paint. The transformers shall be painted with heat resisting dark grey paint sand blast painting will be preferred.

31. TESTS

The transformers shall be subjected to stage inspection of core, windings, tanks and fittings before the final inspection. Test certificates from manufacturer for core, conductors, oil, mild steel used for tanks, insulations and etc. shall be furnished to the purchaser before calling for stage inspection. After the successful stage inspection, final inspection, type tests & routine tests will be carried out as mentioned below & in accordance with Indian Standard Specification No. 2026/1977 at Manufacturer's works before dispatch to site.

The purchaser reserves the right of having other reasonable tests carried out at his own expenses either before dispatch or at site to ensure that transformer complies with the requirement of the specification. The test certificates(for both stage inspection & final inspection, tests) in triplicate shall be submitted as soon as the tests are completed for approval.

31.1 Before calling for final inspection, the supplier shall furnish the factory test results (routine and additional routine test results) of the offered transformer along with list of equipment used during testing with serial number, make, class of accuracy, the valid calibration certificates of the equipments/instruments used during testing to the owner for owner's information and reference. On verification of the test results, measuring instruments & calibration certificates, the owner may direct the contractor for use of better equipments/meters during inspection/testing.

31.2 **Routine & type tests are to be conducted at the manufacturer's factory as per IS: 2026/1977 & as indicated below, in presence of purchaser's representative. Routine and type test certificates are to be submitted in support of the tests conducted successfully, after which dispatch clearance will only be issued. Type tests as indicated below will only be conducted on one transformer per lot.**

31.3 **Routine Test:-** The followings shall be regarded as routine tests and shall be conducted at the manufacturer's work on each transformer in presence of purchaser's representative. No extra cost shall be paid for these tests.

- a. **Measurement of winding resistance at normal & extreme taps.**
- b. **Ratio, polarity and phase relationship & vector group test.**
- c. **Impedance voltage / short circuit impedance at the normal tap & extreme taps.**
- d. **Measurement of load loss and neutral unbalance current**

This test shall be carried out with three wattmeter's method with low power factor wattmeter, low range Ammeters and phase sequence meters. The measurement shall be made at 100% rated current & rated frequency, but in no case not less than 80% current of the rated current (Principal tapping) or tapping current (in case of extreme taps). Load loss measurement to be done on the normal tap (rated voltage tap) and extreme taps.

- e. **Measurement of no-load loss and no load current.**

This test to be carried out with 3 wattmeter method by using low power factor watt-meters, 3 power factor meters, phase sequence meters, three low range ammeters and three each average value and RMS value voltmeters. The test voltage from 10% voltage to 121% voltage shall be applied and currents, voltages (Average value and RMS value), wattmeter, power factor and frequency meter readings in all the 3 phases to be recorded during the test. A voltage(RMS) vrs. Measured current graph shall be plotted by the supplier and handed over it to the purchaser for analysis.

During the test, supplier's own generator set shall be used for feeding the rated voltage at rated frequency. If the applied frequency is greater than the rated frequency, then proportionate voltage to the rated frequency will be fed during the test and following frequency correction formula along with the formula given in Clause 16.5 IS:2026(Part-I) shall be used.

$$K = 0.5/f + 0.5 (f/f_1)^2$$

Where f = rated frequency & f_1 = applied frequency.

For example :- If measured loss = x , correction factor due to rms & Average voltage as per ISS = k_1 , and frequency correction factor = k . Then corrected loss will be calculated as = measured loss $\times k_1 \times k$.

If applied frequency is less than the rated frequency, then no frequency correction formula will be applied. Rated voltage at that frequency will be fed during the test.

- f. **Insulation resistance Test by motorized megger:-** Insulation resistance values to be taken at 1 minute & at 10 minutes intervals. Ratio of insulation resistance taken at 10 minutes and at 1 minute should not be less than 1.5.

- g. Induced over voltage withstand.
- h. Separate sources voltage withstand.
- i. Magnetic balance test
- j. Oil BDV Test
- k. Oil Leakage Test
- l. Measurement of dimensions & etc.

31.4 **Type test:-** The followings shall be regarded as type tests and shall be conducted at the manufacturer's work on one unit out of the lot at the discretion of the purchaser, in presence of purchaser's representative. Charges if any for conducting each type test shall be quoted in the relevant price schedule.

- a. **Temperature rise test**
- b. **Oil Leakage & Pressure Test:-**The transformer tanks shall be subjected to a pressure equal to the normal pressure + 35 KN/m² measured at the base of the tank. Pressure shall be maintained for a period of 12 hours for oil during oil leakage test and 1 hour for air during Pressure test on the Tank where there shall not be any leakage.

31.5 The test certificates of the routine tests mentioned above at 31.3 and Type & special tests indicated below, conducted by the supplier the tendered equipment **or higher rating (both MVA & Voltage rating) distribution transformers** at CPRI or any Govt. approved laboratory within the last 5(five) years from the date of opening of this tender shall be submitted along with the tender offer, failing which the bid will not be accepted for evaluation. CPRI/Govt. approved laboratory test certificate along with CPRI/Govt. approved laboratory drgs. (Internal and external drgs.) must accompany the bid.

Type & Special Tests

- a. Impulse Voltage withstand test
- b. Temperature rise test
- c. Short Circuit Test.

32. TEST REPORT

After all tests have been completed three certificated copies of each test report shall be furnished. Each report shall supply the following information.

- i. Complete identification data including serial number of the transformer.

- ii. Method of application where applied, duration and interpretation of the results for each test.
- iii. Temperature data corrected to 75 °C including ambient temperature.

33. The tenderer shall give the guaranteed technical particulars required in ANNEXURE-I, failing which the tender will be rejected.

34. The tenderer shall submit the detailed dimensional drawing ,short circuit,impulse & temperature rise test reports conducted in a govt. approved laboratory for the **tendered or higher rating(both MVA & Voltage rating) distribution transformers** along with the offer, failing which the offer will not be considered.

35. REJECTION

The transformer may be rejected at the discretion of the purchaser if the test results are not satisfactory and tolerances are exceeded.

36.

36.1 The supplier should guarantee after sales services for minimum period of one and half years after the Guarantee period.

36.2 The supplier should provide after sales services within 15 days of receipt of intimation from the field engineer in charge of the equipment.

37. I) The bidder shall indicate in his offer values of resistance, stray loss, %Impedance, % regulation, no load losses, load losses at rated output, voltage & frequency. These values will be guaranteed MAXIMUM VALUES.

II) Losses will be capitalized at the following rates & taken in to account when tenders will be compared as per the guaranteed losses furnished by the bidder in their guaranteed technical particulars but within the specified losses as indicated at clause 20 of the technical specification. Losses quoted beyond losses stipulated as at clause-20 of the technical specification will not be accepted & offer will be rejected:-

Iron losses (No load losses): **Rs. 212.00** per Watt.

Copper losses (Load Losses): **Rs. 127.00** per Watt

III) The losses shall be measured during routine tests. If losses will be arrived outside the limits of the guaranteed losses as quoted by the bidder in the Guaranteed technical particulars but will remain within the losses stipulated as at clause-20 of the technical specification, then a financial adjustment shall be made as follows:-

The successful bidder will be penalized at 2 times the above rates for any loss in excess of the values stated in the bid considering iron & copper losses separately. No bonus shall be payable for the losses which are less than those stated in the bid.

IV) Also on testing if any of the test results do not match with the values given in the guaranteed technical particulars & as per technical specification, the owner reserves the right to reject the transformer or free to take any other decision.

V) The owner also reserves the right to retain the rejected transformer & take in to service until the supplier replaces it with a new transformer at no extra cost.

38. Following are the list of annexure enclosed with this technical specification.

1. Annexure-1 - Schedule of technical particulars (to be furnished by the manufacturer)
2. Annexure-II- Format for stage Inspection
3. Annexure-III- Quantity & Delivery schedule
4. Annexure-IV- Calibration status of testing Equipments (To be furnished by the manufacturer)
5. Annexure-V- Check list towards type test reports (To be furnished by the manufacturer)
6. Annexure-VI- Check list for delivery schedule (To be furnished by the manufacturer)

ANNEXURE-I.

SCHEDULE OF TECHNICAL PARTICULARS TO BE FURNISHED BY THE MANUFACTURER

STANDARD FORM OF GUARANTEED TECHNICAL PARTICULARS:-

1. Name of the manufacturer.
2. Service.
3. KVA Rating:-
 - a) H.V. Winding.(KVA)
 - b) L.V. Winding.(KVA)
4. Highest system voltage/Nominal voltage.
 - a) H.V. Winding.(KV)
 - b) L.V.Winding(KV)
5. Rated frequency.(Hz)
6. Number of phases.
7. Connections:-
 - a) H.V. Winding.
 - b) L.V. Winding.
8. Connection symbol (See IS: 2026 (Part-IV-1977)).
9. Tappings:-
 - a) Range
 - b) Number of steps for high voltages variation.
10. Reference ambient temperature:-
 - a) Maximum ambient air/temperature.(°C.)
 - b) Maximum daily average ambient air temperature.(°C.)
 - c) Maximum yearly average ambient air temperature.(°C.)
 - d) Minimum ambient air temperature.(°C.)
 - e) Maximum cooling water temperature.(°C.)
11. Type of cooling (See IS-2026 (Part-II)/1977.)
12. Temperature rise over ambient temp.(See IS -2026 (Part-II)/1977)
 - a) Temperature of oil(°C).
 - b) Winding.(°C).
13. i) Total loss at rated nominal voltage

- at normal tap & rated frequency(KW).
- ii) Stray loss at 75°C(KW).
- iii) % Regulation.

14. (A) Component losses.

- i) No-load loss at rated nominal voltage and normal frequency(In watts).
- ii) Load loss at rated current and rated frequency at normal tapping at 75°C. & at extreme taps(In Watts).

(B) Resistance at normal tap & at 75°C.

- i) H.V(Ohm).
- ii) L.V. (Ohm).

15. Impedance voltage & percentage Impedance at full rated current at 75°C. at

- a) Normal tap.
- b) Lowest tap position
- c) Highest tap position.

16. % Reactance at rated current and rated frequency.

17. No load current at rated nominal voltage and rated frequency and at 50%, 75%, 100%, 110% & 121% voltage & at rated frequency(Amp).

18. **Insulation level (See IS-2026 (Part-III/1977)).**

a) Separate source power frequency voltage withstand

- i) H.V. Winding(KV rms).
- ii) L.V. Winding(KV rms).

b) Induced over voltage withstand.

- i) H.V. Winding(KV rms).
- ii) L.V. Winding(KV rms).

1.2/50 microsecond wave shape Impulse Withstand .

- i) H.V. Winding(KV Peak).
- ii) L.V. Winding(KV Peak).

c) P.I. value.

19. **Efficiency:-**

- a) Efficiencies at 75°C at unity power factor.

- i. At full load(%)
- ii. At $\frac{3}{4}$ full load(%)
- iii. At $\frac{1}{2}$ full load(%)
- iv. At 120% of full load(%).

b) Efficiency at 75°C and 0.8 P.F. lagging(%)

- i. At full load.
- ii. At $\frac{3}{4}$ full load
- iii. At $\frac{1}{2}$ full load

c) Load at which maximum efficiency occurs(%)

d) Maximum efficiency(%)

20. Regulation at full load at 75°C

- a. At unity power factor(%)
- b. At 0.8 power factor loading & lagging(%)

21. Equipment for ONAN cooling.

- i. No. of Radiators on main tank.
- ii. Make & type
- iii. No. of tubes/Fins in each radiator.
- iv. Tube/Fins length(Meter)
- v. Total radiating surface
- vi. Thickness of sheets of Tube/Fins(mm)
- vii. Size of tubes(dia in sq. mm)/fins(L x B x H in mm)
- viii. Loss to be dissipated by Radiators in KW.
- ix. Dissipation per fin at 50°C.

22. Number of coolers or cooler banks per transformer

23. Rating of each cooler or cooler bank.

24. **Terminal arrangement.**
- a. High voltage.
 - b. Low voltage.
 - c. Neutral.
25. **Approximate masses:-**
- a. Core(Kg)
 - b. Winding(Kg).
 - c. Core Coil assembly(Kg)
 - d. Tank, fittings & accessories(Kg)
 - e. Oil(Kg)
 - f. Radiators(Kg)
 - g. Total mass(Kg)
26. **Oil data:-**
- a. Quantity for first filling(Ltr.)
 - b. Grade of oil used.
 - c. Maker's name.
 - d. BDV at the time of filling.
 - e. Type of oil.
27. **Approximate tank dimensions for over all dimensions.**
- a. Length(mm)
 - b. Breadth(mm)
 - c. Height(mm)
 - d. Thickness of main tank sheets(mm)
 - i. Top plate
 - ii. Bottom plate

iii. Side plate.

e. Tank inside dimension

i. Length

ii. Breadth

iii. Height

f. Tank outside dimension

i. Length

ii. Breadth

iii. Height.

28. Dispatch details.

a. Approximate mass of heaviest package(Kg)

b. Approximate dimensions of largest package(mm)

i) Length.

ii) Breadth.

iii) Height.

29. Un-tanking height(mm)

30. **Clearances:-**

a. Minimum clearance between phases(mm).

i) In oil.

ii) Out of oil.

b. Maximum clearance high voltage to tank in oil(mm)

c. Minimum clearance high voltage to earth in oil(mm)

d. Minimum clearance height for lifting core & windings from tank(mm)

31. **CORE :-**

a) Grade of Core materials used.

- b) Thickness of Core laminations used(mm).
- c) Sp. Loss in watts/Kg. of core materials corresponding to desired flux densities.
(Curve to be furnished along with the bid).
- d) Maximum flux density at highest system voltage
& 48.5 c/s frequency (Tesla or W/m²)
- e) Maximum flux density at rated system voltage
& rated frequency (Tesla or W/m²)
- f) No-load loss at 110% rated nominal voltage and rated frequency(Watt).
- g) No load current at 110% of nominal voltage & rated frequency
- h) No load current at 121% of nominal voltage & rated frequency
- i) EMF per turn
- j) Core diameter (mm).
- k) Core Window Height(mm)
- l) Core Leg centre(mm)
- m) Total Height of core(mm)
- n) Max width of core
- o) No. of core bolt.
- p) Dia of each core bolt in mm.
- q) Thickness of core bolt insulation(mm)
- r) Total Weight of core(Kg.)
- s) No of Steps
- t) Dimensions of Steps

	<u>Width in mm</u>	<u>Thickness in mm</u>
i) Step – 1		
ii) Step -2		
iii) Step – 3		
iv) Step – 4		
v) Step – 5		

- vi) Step – 6
- vii) Step – 7
- viii) Step – 8
- ix) Step – 9
- x) Step – 10
- u) Gross core cross sectional area(cm^2).
- v) Stacking factor
- w) Net iron section of Limb (cm^2).
- x) Net iron section of Yoke (cm^2).

32. WINDING :-

LV

HV

HV regulating.

- a) Type of winding
- b) Current per phase (Amp.)
- c) Bare conductor size (mm)
- d) Insulated conductor size(mm).
- e) Type of insulation
- f) Thickness of insulation(mm)
- g) Total Conductor cross section (mm^2)
- h) Current density (A/mm^2)
- i) Turns per phase (T).
- j) Coils per limb.
- k) Turns per coil.
- l) Turns per layer.
- m) Layers per coil.
- n) Winding depth.
- o) Coil dia inside.
- p) Coil dia outside.

- q) Length of mean turns.
- r) Resistance at 75°C,
- s) Total $I^2 R$ loss including stray at 75°C,
- t) Weight of copper with insulations.
- u) Weight of copper without insulations.

33. Breather:-

- a. Make
- b. Type
- c. Capacity
- d. Weight of silica gel filled in(grams).

34. Inter layer insulation provided in design for:-

- a. Turn insulation high voltage.
- b. Turn insulation low voltage.
- c. Insulation core to low voltage.
- d. Insulation high voltage to low voltage.
- e. Insulation between winding to top & bottom yoke
- f. In between all layers(mm)
- g. Whether wedges are provided at 50% turns of the coil.

35. Insulation materials.

- a) For conductors(H.V. & LV)
- b) For core.

36. Particulars of bushings:-

- a. Maker's name.
- b. Type IS-3347/IS-1180.
- c. Rating as per I.S.
- d. Dry flash over voltage(KV)

e. Wet flash over voltage(KV).

37. I.R. value at 30°C.

- a. HV/E
- b. LV/E
- c. HV/LV

38. Polarisation Index :-

- a. HV/E.
- b. LV/E.
- c. HV/LV.

Bidders Name:-

Signature :-

Designation :-

Date:-

ANNEXURE-II
FORMAT FOR STAGE INSPECTION

A WINDING			
Sl. No		L.V.	HV
1.	Conductor Bare mm		
2.	Conductor Insulated (mm)		
3.	Type of Conductor Insulation		
4.	No. of Conductor in parallel.		
5.	Current density (A/mm ²)		
6.	Rated volts per phase (volts).		
7.	Turns per phase (T)		
8.	Type of winding.		
9.	No. of discs (Nos.)		
10.	No. of turns/disc.		
11.	Inside diameter (mm)		
12.	Outside diameter ((mm)		
13.	Winding depth (mm)		
14.	Winding Length (mm)		
15.	Gap between disc (mm)		
16.	No. of spacers in one circle.		
17.	Size of the spacer (mm)		
18.	Length of mean turn in meter.		
19.	Weight of winding (Kg/each) (Weight of winding includes the weight of insulated conductor, spacers, runner & other insulations as has been required to make the windings).		
B. INSULATION.			
1.	Between core & L.V. Winding (Details like thickness (mm), length(mm) type of insulation etc. to be mentioned).		
2.	Between H.V. & L.V. Winding (Details like thickness (mm), length (mm), type of insulation etc. to be mentioned).		
3.	Between windings to top yoke (Details as above to be mentioned).		
4.	Between windings to bottom yoke (Details as above to be mentioned).		
C CORE			
1.	Core Diameter in mm=		
2.	Window Height in mm=		
3.	Distance between core leg center in mm=		
4.	Widths of window in mm=		
5.0	OTHER PARAMETERS OF CORE:-		

i	No. of steps	1	2	3	4	5	6	7	8 etc.
ii	Width in mm								
iii	Stack in mm								
iv	Sectional area of stack.								
6.	Total gross cross sectional area of the core in mm								
7.	Net core iron area=gross C/S area x 0.97								
8.	Maximum flux density (Bm) in Wb/sq.mm								
9.	Total core weight in Kg by weighment								
10.	Thickness of core lamination in mm								
D.	Condition of the Tank:-								
E.	Any other items/tests which have not been covered above and required & indicated in the specification to be carried out by the OPTCL's representative.								

FOR OPTCL

FOR REPAIRER.

Name:

Name of Repairer:

Designation:

Name of Repr.
Designation.

Date:

Date:

Place:

Place:

ANNEXURE- III.

SCHEDULE OF QUANTITY AND DELIVERY

Sl. No.	Description of materials	Quantity required.	Desired delivery	Destination.	Remarks.
1.	2.	3.	4.	5.	6.
1.	250KVA, 33/0.433KV Copper wound Trasns-former with OLTC.	14 Nos.	Delivery to be completed within 3 months from the date of issue of the purchase order.	Any Stores/ Sites of OPTCL within State of Odisha.	Requireme nt for 2014-15
2.	250KVA, 33/0.433KV Copper wound Trasns-former with OLTC.	16 Nos.	3 Months from the 01/04/2015.	Any Stores/ Sites of OPTCL within State of Odisha.	Requireme nt for 2015-16
3.	500KVA, 33/0.433KV Copper wound Trasns-former with OLTC.	03 Nos.	Delivery to be completed within 3 months from the date of issue of the purchase order.	Any Stores/ Sites of OPTCL within State of Odisha.	Requireme nt for 2014-15
4.	1MVA, 33/0.433KV Copper wound Trasns-former with OLTC.	01 No.	Delivery to be completed within 3 months from the date of issue of the purchase order.	Any Stores/ Sites of OPTCL within State of Odisha.	Requireme nt for 2014-15

Signature of the Tenderer with seal & date.

N.B:- The data as per the format is to be filled up by the bidder & uploaded as PDF

ANNEXURE-IV

CALIBRATION STATUS OF TESTING EQUIPMENT AND INSTRUMENTS/ METERS AVAILABLE IN THE FACTORY.

[FOR CONDUCTING TESTS AS PER CLAUSE 31.4 & 31.5 OF SECTION IV OF TECHNICAL SPECIFICATION]

Name of the Test	Meters & Equipments required for the corresponding test with range, accuracy, make & Sl.No.	Date of Calibration .	Due date of Calibration	Name of Calibrating Agency.	Whether Calibrating Agency is Govt. approved.	Whether documents relating to Govt. approval of the Calibrating Agency furnished.	Whether the meters/ equipment fulfill the accuracy class as per calibration report.	Whether the Calibration Agency has put any limitation towards the use of the particular meter/ equipment. If yes state the limitation.	Whether Green sticker or Blue sticker or Yellow sticker has been affixed on the body of the particular equipment/ meter. State the colour of the affixed sticker.	Inspite of imposed ,limitations whether the particular meter/ equipment can still be used” Justify its use for corresponding test(s)	Remarks
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12

Signature of the Tenderer with seal & date.

N.B:- The data as per the format is to be filled up by the bidder & uploaded as PDF

ANNEXURE-V

CHECK LIST TOWARDS TYPE TEST REPORTS.

Name of the Type Test.	Date of Test.	Name of the Laboratory where the Test has been conducted.	Whether the Laboratory is Government approved.	Whether the Test report is valid	Whether the copy of Test report in complete shape along with drawings etc furnished or not?	Whether the type tested Transformers full fill the technical requirements as per TS.	Remaks.
1.	2.	3.	4.	5.	6.	7.	8.

Signature of the Tenderer with seal & date

N.B:- The data as per the format is to be filled up by the bidder & uploaded as PDF

ANNEXURE- VI

CHECK LIST FOR DELIVERY SCHEDULE.

Sl.No.	Description of the Equipment	Quantity.	Delivery Schedule.

**Signature of the Tenderer
with seal and date.**

N.B:- The data as per the format is to be filled up by the bidder & uploaded as PDF



ODISHA POWER TRANSMISSION CORPORATION LIMITED

TECHNICAL SPECIFICATION

FOR

**390KV, 216KV, 120KV & 30KV SURGE
ARRESTER**

I- 390 KV

II- 216KV

III- 120KV

IV- 30KV

TECHNICAL SPECIFICATION FOR SURGE ARRESTERS FOR 400 KV,220 KV, 132KV & 33KV SYSTEMS. CONTENTS

CLAUSE NO	T I T L E
1.0	SCOPE
2.0	STANDARDS
3.0	GENERAL TECHNICAL REQUIREMENTS
4.0	CONSTRUCTION
5.0	TESTS
6.0	INSPECTION
7.0	QUALITY ASSURANCE PLAN
8.0	DOCUMENTATION
9.00	PACKING & FORWARDING
10.0	QUANTITY & DELIVERY REQUIREMENT

APPENDIX – I	TECHNICAL REQUIREMENTS
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ANNEXURES	
A	GUARANTEED TECHNICAL PARTICULARS
B	CHECK – LIST
C	CALIBRATION STATUS OF TESTING EQUIPMENTS/METERS
D	CHECK-LIST TOWARDS TYPE TEST REPOR

TECHNICAL SPECIFICATION FOR SURGE ARRESTERS FOR 400KV, 220KV, 132KV & 33KV SYSTEMS

1.0 **SCOPE** :

1.1 This Specification provides for the design, manufacture, inspection and testing before despatch, packing and delivery F.O.R. (destination) of metal oxide (gapless) Surge Arresters with discharge counters, insulating base, terminal connectors and other accessories as specified here in.

Following is the list of documents constituting this Specification. :

(i)	Technical Specification (TS)	
(ii)	Technical Requirements.	Appendix-I
(iii)	Quantity and delivery schedule.	Appendix-II
(iv)	Guaranteed Technical Particulars .	Annexure-A
(v)	Check-List.	Annexure-B
(vi)	Calibration Status of testing equipments and meters/Instruments.	Annexure-C
(vii)	Check-list towards Type Test Reports.	Annexure-D
Note : Annexure-A,B,C,& D are to be filled up by the Bidder.		

1.1 All the above along with 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 volume will prevail.

1.2 The Surge Arrester shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of offer and purchaser shall have the power to reject any work or materials, which in his judgement is not in full accordance therewith.

2.0 **STANDARDS:-**

2.1 Except to the extent modified in the Specification, the Surge Arrester shall conform to the latest editions and amendments of the standards listed hereunder.

Sl. No.	Standard Ref. No.	Title.
1	IEC-99-4	Specification for Surge Arresters without gap for AC System.
2	IS:2147	Degree of protection, provided by enclosures for low voltage switchgear and control.
3	IS:2629	Recommended practice for hot dip galvanization of iron and steel.
4	IS:2633	Method for testing uniformity of coating on zinc coated articles.
5	IS:3070	Specification for surge arresters for alternating current system.
6	IS:5621 & IEC-621155	Specification for large hollow porcelain for use in electrical installation.
7	IEC-60-1	High-Voltage Test technique.
8	IEC-270	Partial discharge measurements.
9	IEC-99-1	Non-linear resistor type gapped arresters for a.c. systems.
10		Indian Electricity Rules, 1956.
11.	IEC-60815	Shed profile of hollow porcelain Insulator.

- 2.2 Surge Arresters with the requirement of other authoritative standards, which ensure equal or better quality than the standards, mentioned above shall also be acceptable. Where the equipment offered by the supplier conforms to other standards, salient points of difference between the standards adopted and the specified standards shall be clearly brought out in the offer. 4 (Four) copies of the reference standards in English language shall be furnished along with the offer.

3.0 **GENERAL TECHNICAL REQUIREMENTS** :

- 3.1 The Surge Arrester shall confirm the technical requirements as per Appendix-I and this TS.
- 3.2 The energy handling capability of each rating of Arrester offered, supported by calculations, shall be furnished with the offer.
- 3.3 The Surge Arresters shall be fitted with pressure relief devices and arc diverting paths and shall be tested as per the requirements of IEC for minimum prospective symmetrical fault current as specified in Appendix-I.

3.4 A grading ring shall be provided if required, (for attaining all the relevant technical parameters) on each complete Surge Arrester.

3.5 **PROTECTIVE LEVELS :**

Surge Arresters shall be capable of providing protection to sub-station equipments, designed for the withstand levels, given in the following table.

Sl. No.	Equipment to be protected	Insulation level of 420KV Systems	Insulation level of 245KV Systems.	Insulation Level of 145KV Systems	Insulation Level of 36KV System
		L.I. Level (KVP)	L.I. Level (KVP)	L.I. Level (KVP)	L.I. Level (KVP)
1	Auto Transformers/Power Transformers.	± 1300	± 950	± 650	± 170
2	Instrument Transformers.	± 1425	± 1050	± 650	± 170
3	Reactors	± 1300	± 950	± 650	± 170
4	Circuit Breakers/Isolators.				
(i)	Phase to ground.	± 1425	± 1050	± 650	± 170
(ii)	Across open contacts.	$\pm 1425(+240)= 1650$	± 1200		

Surge arrester shall be suitable for the following duty cycles of circuit breaker at the following system voltages:

1.	420 KV Circuit Breaker.	0-0.3 sec-co-3 min-co
2.	245 KV Circuit Breaker.	0-0.3 sec-co-3 min-co
3.	145 KV Circuit Breaker	0-0.3 sec-co-3 min-co
4.	36 KV Circuit Breaker	0-0.3 sec-co-3 min-co

3.6 DUTY REQUIREMENT :

3.6.1 Surge Arresters shall be of heavy-duty station class and gapless type without any series or shunt gaps.

3.6.2 Surge Arresters shall be capable of discharging over voltages occurring during switching of un-loaded transformers, lines, capacitors and reactors.

3.6.3 The Surge Arresters shall be capable of discharging lightning and switching surges and temporary power frequency over-voltages.

3.6.4 The Surge Arresters shall be capable of discharging the energy equivalent to class 3 of IEC-99-4.

3.7 The reference current of the arrester shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage. The supplier shall submit values and the supporting evidence along with calculations on above.

3.8 Surge Arresters shall be fully stabilized thermally to give a life expectancy of 100 years under site conditions.

3.9 Surge Arresters shall be able to withstand maximum wind load of 260 Kg./sq.m.

3.10 Surge Arresters shall be capable of withstanding effects of direct solar radiation

3.11 Surge arresters shall be capable of spark over on severe switching Surges and multiple strokes.

3.12 The Surge Arrester should be adequately designed to operate satisfactorily under temporary power frequency over-voltage as given in specific technical requirements, after discharging two shots of respective long duration surges.

3.13 Unless otherwise brought out separately by the Bidder in the schedule of deviations, the Surge Arresters, offered shall conform to the specification scrupulously. All deviations from the specification shall be brought out in the schedule of deviations. The discrepancies between the specification and the catalogues or literature, submitted as part of the offer shall not be considered as valid deviations unless specifically brought out in the schedule of deviations.

4.0 CONSTRUCTION :

4.1 Non linear blocks shall be sintered metal oxide material. These shall be provided in such a way as to obtain robust construction with excellent electrical and mechanical properties even after repeated operations.

4.1.1 All the units of arresters of same rating shall be inter-changeable without adversely affecting the performance.

4.2 The Surge Arresters shall be suitable for pedestal type mounting.

4.3 All the necessary flanges, bolts, nuts, clamps etc. required for assembly of complete arrester with accessories and mounting on support structure to be supplied by the purchaser, shall be included in supplier's scope of supply.

4.4 The drilling details for mounting the Arrester on owner's support shall be supplied by the supplier.

4.5 The minimum permissible separation between the Surge Arrester and any earthed object shall be indicated by the Bidder in his offer.

4.6 Surge Arresters shall be designed to incorporate pressure relief devices and arc diverting paths to prevent shattering of the blocks or the porcelain housing, following prolonged current flow or internal flash over and providing path for flow of rated fault currents in the event of arrester failure.

4.7 Surge Arresters shall incorporate anti-contamination feature to prevent arrester failure, caused by uneven voltage gradient across the stack, resulting from contamination of the arrester porcelain.

4.8 Seals shall be provided in such a way that these are always effectively maintained even when discharging rated lightning current.

4.9 The heat treatment cycle details alongwith necessary quality checks used for individual blocks alongwith insulation layer, formed across each block are to be furnished. Metalised coating thickness for reduced resistance between adjacent discs is to be furnished alongwith the procedure for checking the same. Details of thermal stability test for current distribution of current on individual disc is to be furnished.

4.10 Each individual unit of Surge Arresters shall be hermetically sealed and fully protected against ingress of moisture. The hermetic seal shall be effective for the entire lifetime of the arrester and under the service conditions as specified. The supplier shall furnish sectional view of the arrester showing details of sealing employed.

4.11 The Surge Arresters shall be suitable for hot line washing.

4.12 PORCELAIN HOUSING :

4.13.1 All porcelain Housings shall be free from lamination cavities or other flaws, affecting the maximum level of mechanical and electrical strengths.

4.13.2 The porcelain shall be well vitrified and non-porous.

4.13.3 The minimum creepage distance of the arrester housing shall be as per Appendix-I.

4.13.4 The porcelain petticoat shall be preferably of self-cleaning type (Aerofoil design). The details of the porcelain housing such as height, angle of inclination, shape of petticoats, gap between the petticoats, diameter (ID and OD) etc. shall be indicated by the Bidder in his offer in the form of detailed drawing.

4.13.5 Porcelain housings shall be so co-ordinated that external flash over will not occur due to application of impulse or switching Surge voltages up to the maximum design value for arrester.

4.14 GALVANISATION, NICKEL PLATING ETC. :

4.14.1 All ferrous parts exposed to atmosphere shall be hot dip galvanised as per IS: 2629, as amended from time to time. Tinned copper/brass lugs shall be used for internal wiring of discharge counter. Screws used for electrical connections shall be either made of brass or shall be nickel-plated.

4.14.2 Ground terminal pads and nameplate brackets shall be hot dip galvanised.

4.14.3 The material shall be galvinised only after completing all shop operations

4.15 ACCESSORIES AND FITTINGS :

4.15.1 Surge Counters;

4.15.1.1 A self- contained Surge counter, suitably enclosed for outdoor use and requiring no auxiliary of battery supply for operation shall be provided for each unit. The surge counter shall be operated by the discharge current, passed by the surge arrester and shall be suitable for mounting on the support structure of the Arrester.

4.15.1.2 Surge counters shall be of the Electro-mechanical type and designed for continuous service.

4.15.1.3 The cyclometer counter shall be visible through an inspection window from ground level. The counter terminals shall be robust and adequate size and shall be so located that the incoming and outgoing connections are made with minimum possible bends.

4.15.1.4 Internal parts shall be unaffected by atmospheric conditions at site. Alternatively, a weather proof housing to IP 55 shall be provided and this shall be designed to allow the recording device to be read from ground level without exposing the internal parts to the atmosphere.

4.15.1.5 The Surge Counter shall be connected in the main earth lead from the arrester in such a manner that the direction of the earth lead is not changed or its surge impedance materially altered. A bolted link shall be provided so that the surge counter may be short circuited and removed without taking the arrester out of service.

4.15.1.6 All necessary accessories and earthing connection leads between the bottom of the Arrester and discharge counter shall be in the supplier's scope of supply.

4.15.2 **LEAKAGE CURRENT METERS :**

4.15.2.1. Leakage current meters (suitable milli-ammeter) shall be connected in the earthing path of the surge arresters to measure the resistor grading leakage current. Meters shall be designed for continuous service.

4.15.2.2. The ammeter shall be suitable for mounting on the support structure of the arrester. The push buttons shall be mounted such that it can be operated from the ground level.

4.15.2.3. The internal parts shall be fully weather - proof to IP 55 or better with a transparent cover to provide an unobstructed view of the ammeter..

4.15.3. Arresters shall be complete with insulating base having provision for bolting to flat surface of the structure.

4.15.4. Grading /corona rings shall be provided on each complete Arrester unit, as required, for proper voltage stress distribution.

4.15.5. The grounding terminals shall be suitable for accommodating purchaser's grounding connection to steel earth mat.

4.15.6. The Bidder has to quote unit rates of the insulating base and the surge counter separately. The purchaser reserves its option to procure insulating base and surge counter.

4.15.7. Clamp type terminal connector, suitable for 400 KV-ACSR MOOSE/AL TUBE, 220KV-ACSR MOOSE Conductor 132KV & 33KV-ACSR MOOSE Conductor shall be provided having both horizontal and vertical take-off.

4.15.8. Two clamp type ground terminal connectors, suitable for G. I. Strip (50 x 6) or (50 x 8) should be provided.

4.15.9. All interconnecting hardware such as nuts, bolts, spring washers etc. with 5% spares shall be supplied for different units

4.15.10. Pollution Shunt (Copper braid) shall be supplied along with each surge Arrester for by-passing the surface current..

4.15.11. Other standard accessories, which are specifically not mentioned, but are usually, provided with Surge Arrester of such type and rating for efficient and trouble free operation should be supplied.

4.16 **NAME PLATE :**

Each single pole Arrester shall be provided with non-corrosive legible name plate, at the base bearing thereon, voltage rating of the complete pole and the number of demountable sections with the following data, indelibly marked

- (a) ORISSA POWER TRANSMISSION CORPORATION LIMITED.
- (b) Purchase order No. & Date.
- (c) Name of device.
- (d) Manufacturer's name and trademark and identification no. Of the arrester being supplied.
- (e) Year of manufacture
- (f) Rated voltage
- (g) Rated Frequency
- (h) Maximum continuous operating voltage.
- (i) Type
- (j) Nominal discharge current.
- (k) Long duration discharge class.
- (l) Pressure relief current in KA(rms)
- (m) Energy discharge capability (KJ/KV rating).

5.0 **TEST :**

5.1 **Type Tests:**

The surge Arrester offered should have been subjected to the following type tests in an independent Government approved test laboratory. The bidder shall furnish four sets of type test reports alongwith the offer. These tests must not have been conducted earlier than five years from the date of opening of technical bid. For any change in the design, type already type tested and the design type offered against this specification, the purchaser reserves the right to demand repetition of some or all type tests without any extra cost to OPTCL in the presence of Purchaser's representative at the cost of the supplier.

- 1 Insulation withstands tests :
 - (a) Lightning Impulse Voltage Test.
 - (b) Wet switching impulse test. (For 390KV/216KV only).
- 2 Residual voltage tests.
- 3 Long duration current impulse withstand tests.
- 4 Operating duty tests.
- 5 Pressure relief tests.
 - (a) High current test.
 - (b) Low current test.
- 6 Power frequency voltage vs. time curve.
(Temporary over voltage test)
- 7 Contamination test. (artificial pollution test).
- 8 Seismic withstand test.
- 9 IP-55 test on surge counter.
- 10 Minimum current operation tests of the surge counter.
- 11 Maximum current withstand test of the surge counter.
- 12 Mechanical terminal load test on bushing.
- 13 Partial discharge test.

N.B. :- Even if the condition i.e. ' the dry arcing distance or the sum of the partial dry arcing distances is larger than the test voltage divided by 500 KV/m', the lightning impulse voltage test must have been conducted or is to be conducted without any financial liability to OPTCL.

Even if the type test reports are found to be valid as per this specification, the purchaser reserves the right to demand the repetition of some or all the type tests in the presence of purchaser's representative. For this purpose, the bidder shall quote unit rates for carrying out each type test. These prices, if necessary, will be taken into consideration for bid evaluation.

5.2 **ROUTINE TESTS** :

The following routine tests shall be conducted at the supplier's cost on each surge arrester and shall be submitted along with or before offering for inspection for purchaser's approval.

- (a) Measurement of reference voltage.
- (b) Residual voltage tests.
- (c) Measurement for partial discharge and contact noise.
- (d) Sealing test for units with sealed housings.

5.3 **ACCEPTANCE TESTS** :

The following tests, considered as acceptance tests, shall be conducted in the presence of purchaser's representative for which no charges will be payable by OPTCL. The acceptance tests, whenever possible shall be conducted on the complete arrester unit. The number of samples to be subjected to acceptance test shall be decided by the purchaser at the time of actual testing.

- I Temperature Cycle Test on Housing.
- II Measurement of Power Frequency Voltage at the reference current.
- III Measurement of leakage current and capacitive current at M.C.O.V.
- IV Lightning Impulse Residual Voltage Test at N.D.C., 50% of N.D.C. & 200% of N.D.C.
- V Partial Discharge Tests on complete arresters/units at 1.05 times M.C.O.V.
- VI Special Thermal stability test.
- VII Porosity test on porcelain components.
- VIII Galvanisation test on metal parts.

- IX The functional (operational) test on the Surge Counter by way of checking its operation at following nominal discharge currents :
 - (i) 100 Amps with 8/20 micro second wave shape.
 - (ii) 10 KA with 8/20 micro second wave shape.

- X Check of calibration of leakage current meters.

6 **INSPECTION** :

- I The purchaser shall have access at all time to the works and all other places of manufacture, where the Surge Arresters are being manufactured and the supplier shall provide all facilities for unrestricted inspection of the supplier's works, raw materials, manufacture of all the accessories and for conducting the necessary tests.

- II The supplier shall keep the purchaser informed in advance of the time of starting and the progress of manufacture of equipment in its various stages so that arrangements could be made for inspection.

- III No material shall be despatched from its point of manufacture unless the material has been satisfactorily inspected, tested and despatch schedule attached to this specification.
- IV 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 later found to be defective.

7 **QUALITY ASSURANCE PLAN :**

7.1 The Bidder shall invariably furnish following informations alongwith his offer, failing which the offer shall be liable for rejection.

- (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 inspections.
- (vi) Special features provided in the equipment to make it maintenance free
- (vii) List of testing equipments, meters available with Bidder for final testing of equipment, specified and test plant limitation, if any, vis-à-vis the type, acceptance and routine tests, specified in the relevant standards and this specification. 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-wise as per Annexure-C of this Technical Specification.

7.2 The suppliers, within 30 days of placement of order submit the following informations 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 names of sub-suppliers, selected from those, furnished alongwith the offer.
- (ii) Type test certificates of the raw material and bought out accessories.
- (iii) Quality Assurance Plan (QAP) with hold points for the purchaser's inspection. The QAP and hold points shall be discussed between the purchaser and the supplier before the QAP is finalised.

7.3 The supplier shall submit the routine test certificates of bought out item and raw material at the time of acceptance testing of the fully assembled equipment.

8.0 **DOCUMENTATION :**

8.1 All drawings shall conform to relevant Indian Standard as per relevant IS. All drawings shall be in ink and suitable for microfilming. All dimensions and data shall be in S.I. Units.

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

- (i) General outline drawings of the complete Arrester with technical parameters.

- (ii) Drawings showing clearance from grounded and other line objects and between adjacent poles of Surge Arresters, required at various heights of Surge Arresters.
- (iii) Drawings showing details of pressure relief devices.
- (iv) Detailed drawing of discharge counters along with the wiring and schematic drawing of discharge counter and meter.
- (v) Outline drawing of insulating base.
- (vi) Details of grading rings, if used.
- (vii) Mounting details of Surge Arresters.
- (viii) Details of line terminal and ground terminals.
- (ix) Volt-time characteristics of Surge Arresters.
- (x) Details of galvanization being provided on different ferrous parts.
- (xi) 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.
- (xii) Cross-sectional view of the Surge Arrester Units showing all components.

8.3 TEST REPORTS :

- (i) Four copies of type test reports shall be furnished to the purchaser with the tender specification. 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.
- (ii) All records of routine test reports shall be maintained by the supplier at his works for periodic inspection by the purchaser.
- (iii) All test reports of tests, conducted during manufacture shall be maintained by the supplier. These shall be produced for verification as and when requested for by the purchaser.

9.0 PACKING AND FORWARDING :

9.1 The equipment shall be packed in suitable crates so as to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement of lifting such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost.

9.2 Each consignment shall be accompanied by a detailed packing list containing the following informations :

- (a) Name of the consignee :
- (b) Details of consignment :
- (c) Destination :
- (d) Total weight of consignment :
- (e) Sign showing upper/lower side of the crate :
- (f) Handling and unpacking instructions :
- (g) Bill of materials indicating contents of each package :

9.3 The supplier shall ensure that the bill of materials is approved by the purchaser before despatch.

10.0 QUANTITY AND DELIVERY REQUIREMENT :

- (i) The scope of supply shall include a supply of 2.5% extra quantity of bolts, nuts, washers, split pins, cotter pins and such other small loose items free of cost.

APPENDIX – I.

(TECHNICAL REQUIREMENTS)

TECHNICAL REQUIREMENTS FOR METAL OXIDE (GAPLESS) SURGE ARRESTERS

The Surge Arrester under this Specification shall conform to the parameters given below :-

		390KV	216KV	120KV	30KV
Sl. No.	Particulars.	Technical Parameters	Technical Parameters.	Technical Parameters	Technical Parameters
1	Nominal system voltage (phase to phase) (KV rms).	400	220	132	33
2	Highest system voltage (phase to phase) (KV rms).	420	245	145	36
3	System Frequency (HZ).	50 ± 5 %	50 ± 5 %	50 ±5%	50 ±5%
4	System Neutral earthing.	Effectively earthed.	Effectively earthed.	Effectively earthed	Effectively earthed
5	Installation.	Outdoor.	Outdoor.	Outdoor	Outdoor
6	Class.	Station class, 10 KA, heavy duty type.	Station class, 10 KA, heavy duty type.	Station class, 10 KA, heavy duty type.	Station class, 10 KA, heavy duty type.
7	Type of construction for 10 KA rated arrester.	Single column, single phase.	Single column, single phase.	Single column, single phase.	Single column, single phase
8	No. of phases.	Three	Three	Three	Three
9	Maximum duration of earth fault (Sec.)	3	3	3	3
10	Maximum prospective symmetrical fault current at arrester location (KA rms.)	40	40	40	40
11	Rated arrester voltage (KV rms)	390	216	120	30
12	Nominal discharge current (KAP) Disscharge current at which insulation co ordination will be done	10 KA of 8/20 micro-second Wave. And 20 KA of 8/20 microsec wave	10 KA of 8/20 micro-second Wave.	10 KA of 8/20 micro-second Wave.	10 KA of 8/20 micro-second Wave.
13	Minimum energy discharge capability (KJ/KV)	As per relevant ISS/IEC	As per relevant ISS/IEC	As per relevant ISS/IEC	As per relevant ISS/IEC

14	Maximum continuous operating voltage at 50° C(KV rms)	303	175	102	25
15	Maximum switching surge residual voltage (KVP)	780 at 1KA	496 at 1KA	272 at 1KA	72 at 500A
16	Maximum residual voltage at 8/20 micro second(KVP)				
	(i) 5 KA.		567	320	85
	(ii) 10 KA Nominal discharge current.	900 KVP	600	340	90
	(iii) 20 KA.	975 KVP	668	380	100
17	Long duration discharge class	3	3	3	2
18	High current short duration test value (KAP)(4/10 Micro-second wave).	100	100	100	100
19	Current for pressure relief test (KA-rms)	40	40	40	40
20	Minimum total creepage distance (mm).	10500	6125	3625	900
21	One minute dry and wet power frequency withstand voltage of Arrester housing (KV-rms).	630	460	275	70
22(a)	Impulse withstand voltage of arrester housing with 1.2/50 micro-second wave (KVP).	+1425	+ 1050	+650	+170
22(b)	Switching Impulse Voltage (Wet) (KVP)	+1050	700	-	-
23	Pressure relief class.	A	A	A	A
24	Corona extinction voltage (KV-rms).	320 min	216	-	-
25	RIV at 92 KV rms.	Less than 500 micro volts	Less than 500 micro volts.	Less than 500 micro volts.	Less than 500 micro volts
26	Partial discharge at 1.05 times continuous over-voltage.	Nor more than 50 PC.	Nor more than 50 PC.	Nor more than 50 PC	Nor more than 50 PC
27	Seismic acceleration.	0.3g horizontal 0.15g vertical	0.3g horizontal 0.15g vertical.	0.3g horizontal 0.15g vertical.	0.3g horizontal 0.15g vertical
28	Reference ambient temperature.	50°C	50°C	50°C	50°C
29	(a) IR at MCOV.	Less than 500 micro amperes.	Less than 500 micro amperes.	Less than 500 micro amperes.	Less than 400 micro amperes

	(b) IC at MCOV.	Less than 1500 micro amperes.	Less than 1500 micro amperes.	Less than 1500 micro amperes.	Less than 1200 micro amperes
30	a) Reference Current (mA)	1 to 5 mA	1 to 5 mA	1 to 5 mA	1 to 5 mA
	b) Reference voltage at reference current.	Greater than rated voltage.	Greater than rated voltage.	Greater than rated voltage.	Greater than rated voltage.
31	Maximum steep current Impulse RDV (KVP). at 10 KAP	1050	654	372	100
32	Maximum cantilever strength of the arresters (KGM).	1000	1000	1000	325
33	TOV(KVP).				
	(i) 0.1 sec.	580	382	170	53
	(ii) 1.0 sec.	565	366	163	51
	(iii) 10.0 sec.	550	351	156	49
	(iv) 100.0 sec.		336	149	47

ANNEXURE – B

CHECK – LIST

- 1 Whether calculation towards energy handling capability of the Surge Arrester furnished as per Clause No.3.2 of TS ?
- 2 Whether there is provision of Corona Grading Ring in the SA as per Clause No.3.4 and 4.15.4 of TS ? If not, whether justification for non-provision of the same furnished ?
- 3 Whether calculations and supporting evidence furnished to satisfy Clause No.3.7 of TS ?
- 4 Whether the heat treatment cycle details alongwith necessary quality checks used for individual blocks furnished as per Clause 4.10 of TS ?
- 5 Whether sectional view of arrester showing details of sealing provided as per Clause No.4.11 of TS furnished ?
- 6 Whether S.A. is suitable for hot line washing as per Clause No.4.12 of TS ?
- 7 Whether porcelain petticoat is of Aero foil design ? Whether drawing of porcelain Housing as per Clause No.4.13.4 of TS furnished ?
- 8 Whether information as per Clause No.7.1 (i) to (viii) of TS

furnished ?

9 Whether drawings and documents as per Clause No.8.2 (i) to (xii) of TS furnished ?

10 Whether special measures in the manufacture of Surge Arrester for operating at ambient temperature of 50°C (against 40°C as per IEC-99-4, Clause No.4.4.1) are to be taken ?
..... State the special measures in details

Signature of the Tenderer With Seal & Date

ANNEXURE-D
CHECK LIST TOWARDS TYPE TEST REPORTS.

Name of the Type Test.	Date of Test.	Name of the Laboratory where the Test has been conducted.	Whether the Laboratory is Government Approved.	Whether the Test reports are valid as per Clause No.5.1 of T.S.	Whether the copy of Test Report in complete shape alongwith drawings etc. furnished or not ?	Whether the Type Tested Surge Arrester fulfills the technical requirements as per TS.	If the type tested Surge Arrester does not fulfill the technical requirements as per this specification, whether the bidder agrees to conduct the particular type test again at their own cost without any financial liability to OPTCL in the presence of OPTCL's representative within the specified delivery period.	Remarks.
1	2	3	4	5	6	7	8	9

Signature of the Tenderer with seal and date.

CALIBRATION STATUS OF TESTING EQUIPMENTS AND INSTRUMENTS/METERS.

Name of the test.	Meters and equipments required for the corresponding test with range accuracy make and Sl. No.	Date of Calibration.	Due date of Calibration.	Name of the Calibrating Agency	Whether Calibrating Agency is Govt. Approved.	Whether documents relating to Govt. Approval of the calibrating Agency furnished ?	Whether the meters/equipment fulfill the accuracy class as per calibration report	Whether the calibrating agency has put any limitation towards the use of the particular meter/equipment. If yes, state the limitations.	Whether green sticker or blue sticker or yellow sticker has been affixed on the body of the particular equipment/meter. State the colour of the affixed sticker.	Inspite of imposed limitations, whether the particular meter/equipment can still be used? Justify its use for corresponding test(s).	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

Signature of the tenderer with seal and date.



ODISHA POWER TRANSMISSION CORPORATION LIMITED

TECHNICAL SPECIFICATION

FOR

**33 KV, 132KV, 220KV INDUCTIVE &
132KV, 220KV, & 400 KV
CVT & IVT**

TECHNICAL SPECIFICATION FOR 33 KV,132KV ,220KV INDUCTIVE & 132KV, 220KV,& 400 KV CAPACITIVE VOLTAGE TRANSFORMER

1.0 SCOPE :

- 1.1. This specification provides for the design, manufacture, assembly inspection and testing at the manufacturer's works, packing and delivery FOR [Destinations] of outdoor mounted type, single phase, oil filled, self-cooled, single unit type Inductive voltage transformers for 33 KV, 132KV,220 KV systems, & Capacitive Voltage Transformers for,132KV, 220kv & 400 KV system to be used for voltage indication, supply of potential to tariff meters, relays for feeder protection in Grid Sub-stations of OPTCL, ODISHA.. In addition to the above functions the 400 KV 220kv, 132KV CVT shall be suitable for carrier coupling..
- 1.2 The IVTs shall be complete in all respects with insulators, bimetallic connectors, fixing details etc. as described herein.
- 1.3 Bidders are required to quote for 0.2 accuracy class [metering winding] for 33 KV, 132KV, 220 Kv IVTs &132KV, 220kv,400 Kv CVTs in the following manner.
- (a) Guaranteed Technical Particulars.
 - (b) Technical literatures, brochures and drawings as per this specification.
 - (c) Type Test reports.
 - (d) List of orders, executed and Users' certificates with offer, failing submission of the above particulars with the offer, the tender may not be considered for evaluation.

2.0 Following is the list of documents constituting this Specification.

- (i) Technical Specification (TS).
- (ii) Technical requirements. - [Appendix-I]
- (iii) Quantity and delivery schedule. - [Appendix-II]
- (iv) Guaranteed Technical Particulars. - [Annexure-A]
- (v) Calibration status of testing equipment and meters/Instruments. - [Annexure-B]
- (vi) Check list towards Type Test Reports.- [Annexure-C]
- (vii) Check list for Delivery Schedule. - [Annexure-D].

N.B.:- Annexure-A,B,C & D are to be filled up by the Bidder.

3.0 STANDARDS:-

- 3.1 The IVTs & CVTs 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.
- 3.2 Except to the extent modified in the specifications, the IVTS & CVTs 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 switch gears.
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 switch-gear 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.

- 3.3 All the above alongwith 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.
- 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 conforms 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 alongwith the offer.
- 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.

4.0 CLIMATIC AND SERVICE CONDITIONS :

- 4.1 The VTS are required to operate satisfactorily under the following conditions.

- (a) Maximum ambient temperature - 50°C.
- (b) Maximum daily average ambient air temperature - 45°C.
- (c) Maximum relative humidity – 100%.
- (d) Average number of rainy days in a year – 120 days.
- (e) Average annual rainfall – 150 cms.
- (f) Altitude not exceeding – 1000 M.
- (g) Maximum wind pressure – 260kg/sq.m.

4.2 EARTHQUAKE INCIDENCE:-

The VTS are to be designed to withstand earthquake of an intensity, equivalent to 0.3g in the horizontal and 0.15g in the vertical direction

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

5.0 PURCHASER'S AUXILIARY POWER SUPPLY:-

- 5.1 Following power supplies shall be made available at site:

- (a) AC-3 phase, 415V, 50HZ earthed.
- (b) AC single phase, 240V, 50HZ earthed.
- (c) 220V DC, Ungrounded.

- 5.2 All equipments and devices shall be capable of continuous satisfactory operation on AC and DC supplies of nominal voltage, mentioned above with variations as given below.

- (a) AC voltage variation. $\pm 10\%$
- (b) Frequency variation. $\pm 5\%$.
- (c) Combined voltage & frequency variation. $\pm 10\%$
- (d) DC voltage variation. 190V to 240V DC.

- 5.3 The supplier shall make his own arrangements for the power supplies other than those specified under Clause-5.1 above.

6.0 INSTALLATION:-

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

A.7.0. GENERAL TECHNICAL REQUIREMENTS FOR IVT :-

- 7.1 Each IVT shall be supplied, filled with insulating oil and shall be hermetically sealed to prevent atmosphere coming in contact with oil, avoiding filtration and change of oil. In case the tenderer intends to use Nitrogen or any other inert gas above the oil level, the gas must not leak out and the same shall be stated in the tender.
- 7.2 However, the IVT shall have a provision for draining and filling insulating oil after drying or preferably must have arrangement for drying the oil by continuous process with oil filters.
- 7.3 The IVT shall be suitable for transport in horizontal position if the transport limitations so demand.
- 7.4 **SECONDARY TERMINAL BOX:-**
 - 7.4.1 The secondary terminals shall be brought out in a weather proof terminal box with a rating not less than IP-55.
 - 7.4.2 All secondary terminals shall be brought out in a compartment on one side of each IVT for easy access.
 - 7.4.3 The exterior of this terminal box shall be hot-dip galvanized.
 - 7.4.4 The terminal box shall be provided with removable gland plate and glands suitable for 1100 volts grade. PVC insulated, PVC sheathed multi core 4 sq.mm to 6 sq.mm stranded copper conductor cable.
 - 7.4.5 The terminal box shall be provided with a door in front so as to have easy access of secondary terminals. The door shall have a sealing/locking arrangement and shall be suitable to prevent penetration of moisture and rain water.
 - 7.4.6 The dimensions of the terminal box and its openings shall be adequate to enable easy access and sufficient working space for use of normal tools.
 - 7.4.7 The terminal blocks shall be standard type and provided with ferrules indelibly marked or numbered and their identifications shall correspond to the designation on the relevant wiring diagram.
 - 7.4.8 Secondary wiring terminal studs shall be provided with at least three nuts, plain and spring washers. The studs, nuts and washers shall be of brass, duly nickel plated. The minimum diameter of the studs shall be 6 mm. The length of at least 15 mm shall be available on the studs for inserting the leads.
 - 7.4.9 Primary earthing link should be provided for measurement of capacitance & dielectric dissipation factor.
 - 7.4.10 Separate point should be provided
- 7.5 Polarity shall be indelibly marked on each primary and secondary terminal.
- 7.6 The IVT shall be vacuum filled with oil after processing and thereafter hermetically sealed to eliminate breathing and to prevent air and moisture from entering the tanks. Oil filling and/or oil sampling cocks, if provided to facilitate factory processing should be properly sealed before dispatching the IVT. The method, adopted for hermetic sealing shall be described in the offer.
- 7.7 The castings of base, collar etc. shall be die cast and tested before assembly to detect cracks and voids, if any.
- 7.8 The characteristics of the IVTS shall be such as to provide satisfactory performance such as voltage error and phase displacement at rated frequency shall not exceed the values as per relevant standards at any voltage between 80% and 120% of rated voltage and with burdens of between 25% and 100% of rated burden at a power factor of 0.8 lagging. The error shall be determined at the terminals of the IVT and shall include the effects of any fuses or resistors as an integral part of the IVT.
- 7.9 Inductive voltage transformers shall be designed so as to achieve the minimum risk of explosion in service. The bidder shall bring out in his offer, measures taken to achieve this.
- 7.10 **PRIMARY WINDING:-**

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

7.11 SECONDARY WINDING.

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

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

7.13 TANK.

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

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

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

7.14 PORCELAIN HOUSING.

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

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

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

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

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

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

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

7.14.8 End shields should be provided for distribution of stresses.

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

7.15 INSULATING OIL.

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

7.16. PREVENTION OF OIL LEAKAGE AND ENTRY OF MOISTURE:-

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

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

7.16.1 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.

7.16.2 For gasketed joints, wherever used, nitrile butyl rubber gaskets shall be used. The gasket shall be fitted in properly machined groove with adequate space for accommodating the gasket under compression.

7.17 FITTINGS AND ACCESSORIES:- Fittings and accessories, listed below shall be supplied with each IVT. Any fitting, required essential other than those listed below shall also be supplied along with each IVT.

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

7.18.1 **OIL LEVEL GAUGE:-** An oil level gauge shall be provided to indicate the oil level in the IVT. This gauge shall be mounted in such a way that the oil level can be seen from the ground level.

7.18.2 **PRESSURE RELIEVING DEVICE:-** Each IVT shall be provided with a pressure relieving device so as to protect bushing of the IVT even under unfavorable conditions.

7.18.3 **OIL DRAIN COCK:-** An oil drain cock alongwith a stop cock shall be provided in the bottom flange so as to permit taking of oil samples for testing, if required.

7.18.4 **EARTHING:-** Metal tank of each IVT shall be provided with two separate earthing terminals for bolted connection to 50mm x 6mm flat to be provided by the Purchaser for connection to station earth-mat.

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

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

7.18.7 **GASKET JOINT:-** The manufacturer shall furnish the type of gasket used or setting methods.

TERMINAL CONNECTORS:-

All the IVTS shall be provided with bimetallic solderless clamp type, rigid type terminal connectors, suitable for ACSR Moose Conductor for 400 Kv, 220KV IVT & CVT. ACSR.ZEBRA Conductor for 33 KV, 132KV IVT & 132KV CVT..Each terminal connector shall be of universal type, suitable for both horizontal and vertical connections to the transmission line conductors/station bus bar.

7.18.8.1 **TERMINAL CONNECTORS** shall be manufactured and tested as per IS:5561.

7.18.8.2 All castings shall be free from blow holes, surface blisters, cracks and cavities.

All sharp edges and corners shall be blurred and rounded off.

7.18.8.3 No part of a clamp shall be less than 10mm thick.

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

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

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

7.18.9 **SECONDARY WIRING:-**

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

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

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

B.7.0 **GENERAL TECHNICAL REQUIREMENTS FOR 400 KV, 220KV & 132KV CAPACITIVE VOLTAGE TRANSFORMER:-**

7.1 The design of capacitor voltage transformers shall such that its accuracy shall not be affected by the presence of pollution on the external surface of its insulators.

7.2 The CVT shall operate satisfactorily in system with high X/R ratio. ($T_p=100$ ms).

7.3 The CVT transformer tanks along with top metallic shall be galvanized and painted to required shade.

7.4 Impregnation details along with tests and checks to ensure successful completion of impregnation cycle shall be furnished for purchaser's approval.

7.5 Bellows, if used to cater for expansion of insulating oil, shall be tested in accordance with relevant standards. The details shall be subject to the approval of the purchaser.

7.6 The CVT shall be capacitor voltage type with electromagnetic units and shall be suitable for carrier coupling..

7.7 All windings of voltage transformer secondaries shall be protected by HRC cartridge type fuses. In addition, fuses shall be provided for the protection and metering windings for fuse monitoring scheme. The secondary terminals of the CVTs shall be terminated to stud type non-disconnecting terminal blocks in the individual phase secondary boxes via. the fuse

7.8 CVTs shall be suitable for high frequency (HF).coupling, required for power line carrier communication. The carrier signal must be prevented from flowing into potential transformer (EMU) circuit by meant of a RF choke/reactor, suitable for effectively blocking the carrier signal over the entire carrier frequency range i.e. 40 to 500 KHZ. Details of the arrangement shall be furnished along with the bid. HF terminal of the CVT shall be brought out through a suitable bushing and shall be easily accessible for connection to the coupling devices of the carrier communication equipment, when utilized. The bushing shall be fully protected against rain and vermin so as to avoid the possibility of short circuits to earth. An earthing link with fastener shall be provided for HF terminal.

7.9 The electromagnetic unit, comprising compensating reactor, intermediate transformer and protective and damping devices should have a separate terminal box with all secondary terminals, brought out.

7.10 Voltage transformers should be thermally and dielectrically safe when the secondary terminals are loaded with the guaranteed thermal burdens.

- 7.11 The accuracy of the windings (3P/3P/0.2) shall be maintained through out the entire burden range preferably in the frequency range of 48 HZ to 51.5 HZ on all the three windings without any adjustment during operation. Preference will be given to such bidders who can offer for maintaining the above accuracy class in the frequency range i.e. 48 HZ to 51.5 HZ up to the above specified burden values.
- 7.12 **CONSTRUCTIONAL FEATURES:-**
- 7.12.1 The 400 KV, 220KV & 132KV CVT shall be suitable for mounting on support structure of tubular GI pipe of nominal bore of 300/200 mm. or lattice type structures.
- 7.12.2 Access to secondary terminals shall be possible without any danger of access to high voltage circuit.
- 7.12.3 CVTs shall be hermetically sealed units.
- 7.12.4 A protective surge Arrester/spark gap shall be provided to prevent break down of insulation by incoming surges and to limit abnormal rise of terminal voltage of shunt capacitor/primary winding, tuning reactor/RF choke etc. due to short circuit in transformer secondaries. In case of an alternative arrangement, the Bidder shall bring out the details in the Bid.
- 7.12.5 The CVT secondary terminals shall be brought out in to a weather proof terminal box for ease of access. The terminal box shall have an IP rating of not less than IP 55. The terminal box shall be provided with a removable gland plate at the bottom and shall be suitable for accepting the required number of PVC insulated PVC sheathed, 10 core 2.5 mm² standard copper conductor cable.
- 7.12.6 All terminals shall be clearly marked to facilitate connection of secondary wiring.
- 7.12.7 Secondary fuses or MCBs shall be provided on or adjacent to each CVT, located such that they are accessible while the primary is live and shall be provided with labels indicating their function and their phase colours CVT secondary circuits shall be complete in themselves and shall be earthed at one point only. A separate earth link shall be provided for each secondary winding and shall be situated at the CVT. Primary earthing links should be provided.
- 7.12.8 Where CVTs are supplied which are, or may be connected to different sections of the bus bar, it shall not be possible for the CVT secondary circuits, to be connected in parallel.
- 7.12.9 An auxiliary switch or relay shall be provided in each phase of the secondary circuit of the synchronizing and metering voltage supply connections to break the circuits automatically as soon as the circuit breaker is opened.
- 7.12.10 To prevent ferro resonance, suitable damping devices shall be provided for connection to the transformer secondaries.
- 7.12.11 CVTs shall meet the requirements, given in this section of the specification.
- 7.12.12 The creepage and flashover distances of the high voltage insulator shall be suitable for the outdoor service conditions, specified in the schedules.
- 7.12.13 The bidder in the offer is to state the suitable precautions/methods, adopted during design stage of the CVT to avoid the undesirable effects due to ferro resonance phenomena. The precautions/methods include lower level of working flux density in EMU, greater utilization of the linear portion of the magnetization curve, providing an air gap in the magnetic circuit, connecting a suitable damping resistance permanently across the secondary etc.
- 7.12.14 It should be stated in the bid offer regarding the steps taken in the design stage for elimination/minimization of the influence of the transient response on the behavior of high speed relays.
- 7.12.15 It shall be ensured by the bidder in the offer that the connection of carrier, frequency coupling device across the CVT will not affect the designated accuracy class of the CVT windings.
- 7.12.16 The capacitor divider unit shall comply to IS: 9348/1979.
- 7.12.17 It shall also be complied in the offer through a calculation sheet, proving that the designated accuracy class of the CVT (both metering and protection) are not affected by extreme temperatures, to be encountered in service conditions (Max. ambient temperature 50° C and minimum -0° C).

7.12.18 The terminal connectors should be suitable for ACSR ' ZEBRA' Conductor, complying to Cl.No.A.7.18.8 of this specification.

7.12.19 Separate point should be provided for measurement of capacitance & dielectric dissipation factor.

8.. **TESTS:-**

8.1 **Type Tests:-** The offered 33 KV, 132KV & 220 KV Inductive voltage transformer & 220kv, 132KV capacitive 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 OPTCL in the presence of purchaser's representative at the cost of the supplier.

For 220 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.

N.B.:- [I] The dielectric type tests should have been carried out on the
Same transformer.

- (ii) After the IVT was subjected to the dielectric tests, it should have been subjected to all routine tests as per relevant standards.
- (i) For Temperature Rise Test, the test must have been made with the appropriate rated burden, connected to each secondary winding.

For 400 KV, 220KV & 132KV CVT.

TYPE TESTS/SPECIAL TESTS FOR 400 KV, 220KV, 132KV CVT:-

- a) Lightning Impulse voltage test on complete CVT unit.
- b) Power frequency over-voltage test on complete CVT unit.
- c) Partial discharge test.
- d) Radio interference voltage test.
- e) Corona extinction voltage test.
- f) Temperature rise test on complete CVT unit.
- g) Ferro resonance test on the complete C.V.T. unit.
- h) Transient response tests.
- i) Determination of Temperature Co-efficient test.
- j) High frequency capacitance and equivalent resistance measurement test (as per IEC-358)
- k) Stray capacitance and stray conductance test (as per IEC-358).
- l) Accuracy tests.
- m) Thermal stability test.
- n) Thermal Co-efficient test (as per IEC-358)
- o) Fast transient test.
- p) Seismic withstand test.
- q) IP-55 test on secondary Terminal Box.
- r) Magnetization and internal burden tests.
- s) Effectiveness of sealing tests.
- t) Mechanical Terminal load test on Bushing.
- u) Dielectric loss angle test (Tan Delta Test).

N.B:- 1.The dielectric type tests should have been carried out on the same CVT.

2. After the CVT was subjected to the dielectric tests, it should have been subjected to all routine tests as per relevant standards.

3. The ratio errors, phase displacements before, during and after the temperature rise test on complete CVT unit should have been determined with stipulated burdens and the same should comply with the designated accuracy class for each winding of the CVT.

8.2 **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 OPTCL. No sampling is allowed.

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

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

9. **INSPECTION:**

- 9.1 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.
- 9.2 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.
- 9.3 No material shall be despatched from its manufacture unless the material has been satisfactorily inspected, tested and despatch clearance issued. However, the Purchaser reserves the right to alter the despatch schedule attached to this Specification.
- 9.4 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.
- 9.5 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 OPTCL 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.

10. **QUALITY ASSURANCE PLAN:-**

- 10.1 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-wise as per ANNEXURE-B of the Technical Specification.

10.2 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 is finalised.

10.3 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.

11 **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.

12. **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.
- 13. The necessary galvanized flanges, bolts etc. for the base of the Inductive/Capcitive Voltage Transformers shall be supplied without any extra cost to the purchaser.
- 14. **PACKING AND FORWARDING:-**
- 14.1 The equipment shall be packed in suitable crates so as to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.
- 14.2 Each consignment shall be accompanied by a detailed packing list containing the following informations:
 - [a] Name of the consignee.
 - [b] Details of consignment.
 - [c] Destination.
 - [d] Total weight of consignment.
 - [e] Sign showing upper, lower side of the crate.
 - [f] Handling and unpacking instructions.
 - [g] Bill of materials indicating contents of each package.
 - [h] Set of approved drawings.
- 14.3 The supplier shall ensure that the bill of materials is approved by the Purchaser before despatch.
- 15. Any bid without complete information as asked for in the above Specification is likely to be rejected.

APPENDIX – I.

**TECHNICAL REQUIREMENTS FOR 33 KV, 132KV & 220 KV INDUCTIVE VOLTAGE TRANSFORMERS
&, 132KV, 220KV, 400 KV CAPACITIVE VOLTAGE TRANSFORMER.**

SL. NO	PARTICULARS	33 KV IVT	132KV IVT	220 KV IVT	132KV CVT	400 KV/220KV CVT
1	Type	Single phase, 50Hz, oil filled, self cooled, Hermetically sealed, outdoor porcelain type.	Single phase, 50Hz, oil filled, self cooled, Hermetically sealed, outdoor porcelain type.	Single phase, 50Hz, oil filled, self cooled, Hermetically sealed, outdoor porcelain type.	Single phase, 50Hz, oil Filled, self cooled, Hermetically sealed, Outdoor or porcelain type.	Single phase, 50Hz, oil Filled, self cooled, Hermetically sealed, Outdoor porcelain type.
2	Nominal system voltage.	33 KV	132KV.	220 KV.	132KV	400 KV/ 220KV
3	Highest system voltage.	36 KV	145KV.	245KV.	145KV	420 KV/245KV
4	Frequency.	50Hz± 5%	50Hz± 5%	50Hz± 5%	50Hz ± 5%	50Hz± 5%
5	System earthing.	Effectively solidly earthed	Effectively solidly earthed	Effectively solidly earthed	Effectively solidly earthed.	Effectively solidly earthed.
6	Number of phases.	3 [single phase]	3 [single phase]	3 [single phase]	3 [single phase]	3 [single phase]

7	(i)Number of secondary windings. (ii)Purpose of windings.	2 [two] Protection & metering.	2 [two] Protection & metering.	3 [three] Protection & metering.	3 [three] Protection & metering.	3 [three] Protection & metering.
8	Rated primary voltage.	33/1.732 KV	132/1.732KV	220/1.732KV	132/1.732 KV	400/1.732 KV 220/1.732 KV
9	Rated secondary voltage.	Winding-I-110/1.732V (Protection) Winding-II-110/1.732V(Metering)	Winding-I-110/1.732V (Protection) Winding-II-110/1.732V(Metering)	Winding-I & II-110/1.732V (Protection) Winding-III-110/1.732V(Metering)	Winding-I-110/1.732V Winding-II-110/1.732V Winding-III-110/1.732V	Winding-I-110/1.732V Winding-II-110/1.732V Winding-III-110/1.732V
10	Ratio	33 KV/1.732: 110V/1.732	132KV/1.732: 110V/1.732	220KV/1.732: 110V/1.732	132KV/1.732: 110V/1.732	400/1.732KV/110/1.732 KV,220KV/1.732: 110V/1.732
11	Rated burden.	Winding-I(P)-75 VA Winding-II(M)-75 VA Simultaneous Burden- 150 VA with accu. cl-0.2	Winding-I(P)-200 VA Winding-II(M)-200 VA Simultaneous Burden- 400 VA with accu. cl-0.2	Winding-I(P)-100 VA Winding-I(P)-100 VA Winding-II(M)-100 VA Simultaneous Burden- 300 VA with accu. cl-0.2	Winding-I (P)-75 VA Winding-II (P)-75 VA Winding-III (M)-75 VA/0.2 class simultaneous burden-75 VA with accu. cl-0.2	Winding-I (P)-75 VA Winding-II (P)-75 VA Winding-III(M)-75 VA/0.2 class simultaneous burden-75 VA with accu. cl-0.2
12	Accuracy class	3P/ 0.2	3P/ 0.2	3P/3P/ 0.2	3P/3P/0.2	3P/3P/0.2
13	Rated voltage factor at rated frequency.	1.2 continuous. 1.5 for30 seconds.	1.2 continuous. 1.5 for30 seconds.	1.2 continuous. 1.5 for30 seconds.	1.2 continuous. 1.5 for 30 second.	1.2 continuous. 1.5 for 30 second.
14	Temperature rise at 1.2 times the rated primary voltage, rated frequency & rated burdens.	As per IEC-186.	As per IEC-186.	As per IEC-186.	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.	As per IEC-186.	As per IEC-186.	As per IEC-186.
16	One-minute power frequency dry withstands test voltage for primary winding.	70 KV [rms]	275KV [rms]	460 KV [rms]	275KV [rms]	630 KV [rms]/460 KV rms
17	1-minute power frequency wet withstands test voltage for primary winding.	70 KV [rms]	275KV [rms]	460KV [rms]	275KV [rms]	630 KV [rms]/460 KV rms
18	1.2/50 micro second impulse withstand test voltage for primary winding	170 KV [peak]	650KV [peak]	1050KV [peak]	650KV [peak]	1425 KV peak/1050KV [peak]
19 (i) (ii)	One-minute power frequency withstands test voltage for Secondary winding Between LV(HF) terminal & earth terminal	3KV [rms] -	3KV [rms] -	3KV [rms] -	3KV [rms] 10KV [rms] for exposed terminals & 4KV [rms] for terminals, enclosed in a weatherproof box.	3KV [rms] 10KV [rms] for exposed terminals & 4KV [rms] for terminals, enclosed in a weatherproof box.
20	Class of insulation.	'A'	'A'	'A'	'A' or better for EMU.	'A' or better for EMU.
21	Material of the conductor of primary and secondary windings.	Copper.	Copper.	Copper.	Copper for EMU	Copper for EMU
22	Fault level of the bus to which PTs will be connected.	25KA [rms].for 1second.	31.5KA [rms].for 1second.	40 KA [rms].for 1second.	31.5KA [rms] 1 second.	40KA [rms].for 1 second.
23	Minimum creepage distance.	900mm	3625mm	6125mm	3625 mm	10500/6125mm

24	Quality of oil.	EHV Grade As per IS-335.	EHV Grade As per IS-335.	EHV Grade As per IS-335.	EHV Grade As per IS-335.	EHV Grade As per IS-335.
25	Radio interference voltage at 1.1 times maximum rated voltage at 1.0 MHZ.		500 micro volts.	500 micro volts.	500 micro volts.	500 micro volts.
26	Partial discharge level.		Less than 10 piccoulombs.	Less than 10 piccoulombs	Less than 10 Piccoulombs.	Less than 10 piccoulombs.
27	Seismic acceleration- Horizontal – Vertical.	0.3g. 0.15g.	0.3g. 0.15g.	0.3g. 0.15g.	0.3g. 0.15g.	0.3g. 0.15g.
28	Accuracy class of standard V.T. to be used during testing towards determination of ratio errors and phase angle errors for metering windings.	0.05 or better.	0.05 or better.	0.05 or better.	0.05 or better.	0.05 or better.
29.	Capacitance (Pf)		-	-	4400 + 10%,-5%	4400/8800 + 10%,-5%

ANNEXURE – A
GUARANTEED TECHNICAL PARTICULARS.

Sl. No	Description.	33 KV IVT	400 KV CVT	220 KV IVT	132KV IVT	132KV CVT	220KV CVT
		3P/0.2 Accuracy Class	3P/3P/0.2 Accuracy Class.	3P/0.2 Accuracy Class	3P/0.2 Accuracy Class	3P/3P/0.2 Accuracy Class.	3P/3P/0.2 Accuracy Class.
1	Bidder's name and address.						
2	Name and address of the Manufacturer.						
3	Manufacturer's type and designation.						
4	Standards applicable.						
5	Type of IVT/CVT						
6	Rated primary voltage (kv).						
7	Rated secondary voltage (volts).						
7.1	Winding-I.						
7.2	Winding-II.						
7.3	Winding-III.						
8	Rated frequency [HZ].						
9	Rated burden:- Protection Winding Protection Winding Metering Winding						
10	Number of secondary windings.						
11	Accuracy class.						
[I]	[protection] Winding						
[II]	[metering] Winding						
12	Rated voltage factor for continuous operation at						

	rated frequency.						
13	Rated voltage factor for 30 seconds at rated frequency.						
14	One minute dry and wet power frequency withstand voltage for primary side [kv] rms.						
15	One minute power frequency withstand voltage for secondary winding [kv] rms.						
16	1.2/50 micro-second impulse withstand test voltage for primary side						
17	Temperature rise over an ambient temperature of 50°C						
[a]	With 1.2 times rated primary voltage at rated frequency and at rated burdens. [I] Winding [°C] [II] Oil [°C] [III] Other parts [°C]						
[b]	With 1.5 times rated primary voltage for 30 seconds at rated frequency and at rated burdens. [I] Winding [°C] [II] Oil [°C]						

	[III] Other parts [°C]						
18	Class of insulation.						
19	Total creepage distance in (mm)						
20	Maximum radio interference voltage at 1.1 times maximum line to ground voltage (micro volts)						
21	Corona inception and extinction voltage (kv) rms						
22	Partial discharge level (piccoulombs)						
23	Primary.[For 220KV, 132KV & 33KV IVT] (a) No. of primary turns (b) Material of primary (c) Size of the primary conductor bare/insulated. (d) Cross sectional area of primary conductor (sq.mm) (e) Current density adopted for primary winding(A/sq.mm) (f) Type of primary winding. (g) Name of the insulating materials						

	used for primary conductor. (h) Weight of primary winding.						
24	<p>Secondary. [For 220KV, 132KV & 33KV IVT]</p> <p>(a)No. of secondary turns</p> <p>(b) Material of secondary</p> <p>© Size of the secondary conductor bare /insulated.</p> <p>(d)Cross sectional area of secondary conductor (mm²)</p> <p>(e)Current density adopted for secondary winding(A/mm²)</p> <p>(f)Type of secondary winding</p> <p>(g)Name of the insulating materials used for secondary conductor.</p> <p>(h)Weight of secondary winding.</p>						
25.	<p>Core. [For 220KV, 132KV & 33KV IVT]</p> <p>(a)Shape of the core</p> <p>(b)Material and</p>						

	<p>grade of the core laminations</p> <p>(c) Thickness of the core lamination (mm)</p> <p>(d) Maximum flux density adopted (Tesla)</p> <p>(e) Net iron area of the core</p> <p>(f) Watt loss/kg. for the core materials at the operating flux density (W/kg)</p> <p>(g) Total weight of the core (kg)</p> <p>(h) Whether B-H curve for core material enclosed?</p> <p>(i) Whether specific loss vrs. Flux density curve enclosed ?</p>						
26	<p>INSULATION. .[For 220KV, 132KV & 33KV IVT]</p> <p>(a) Insulation between core and secondaries.</p> <p>(b) Insulation between secondaries.</p> <p>© Insulation between secondary and primary.</p> <p>(d) Insulation between primary .and core.</p>						
27	<p>DIMENSIONS OF CORE AND WINDINGS. .[For 220KV, 132KV & 33KV IVT]</p>						

	(a)Diameter of the core (mm) (b)Inner diameter of the secondary windings(mm) (c) Outer diameter of the secondary windings (mm) (d) Inner diameter of the primary winding(mm) (e) Outer diameter of the primary winding(mm) (f) Minimum clearance from primary winding to tank(mm) (g) Minimum clearance from secondary winding to tank(mm)						
28.	Percentage voltage ratio (error)/phase displacement (min.)at 100% rated burden at 0.8PF lagging for measuring winding. (a) 80% of rated voltage at frequency:- (b) 120% of rated voltage at frequency:- (c) Accuracy of standard PT to be used. during determination of errors (0.05 or better.						
29.	Percentage Voltage ratio /phase						

	displacement (min.)at 25% rated burden at 0.8PF lagging for measuring winding. (a) 80% of rated voltage at rated frequency:- (b) 120% of rated voltage at rated frequency:-						
30.	Percentage voltage (ratio)error /phase displacement (min.) at 100% rated burden at 0.8PF lagging for protection winding (a)5% of rated voltage. (b)1.2 times rated voltage (c)1.5 times rated voltage (d) 2% of rated voltage..						
31.	Percentage voltage (ratio) error /phase displacement (min) at 25% of rated burden at 0.8PF lagging for protection winding (a)5% of rated voltage (b)1.2 times rated voltage. ©1.5 times rated voltage. (d) 2% of rated voltage.						
32.	Whether IVT/CVT is						

	suitable for horizontal transportation.						
33.	Quantity of oil per IVT/ CVT (Ltrs/kg)						
34.	Standard to which oil conforms.						
35.	Characteristic of oil(Prior to filling)						
35. 1.	Breakdown voltage (kv-rms)						
35. 2.	Dielectric dissipation constant tan delta)						
35. 3	Water content(PPM)						
35. 4	Gas content(PPM)						
35. 5	Interfacial tension at 27 degree C(N/m)						
35. 6	Specific resistance.						
35. 6.1	At 90 deg.C(ohm-cm)						
35. 6.2	At 27 deg.C(ohm-cm)						
36.	Whether IVTS are hermetically sealed ? If so how ?						
37.	Total Weight (kg)						
38.	Transport weight (kg)						
39.	Dimensional details.						
40	Whether IVT characteristic curves enclosed?						
41.	TANK AND SECONDARY TERMINAL BOX.						

41.1	Material of the IVT/ CVT tank						
41.2	Material of the secondary terminal box.						
41.3	Thickness of the IVT/ CVT tank material.						
41.4	Thickness of the secondary terminal box material.						
41.5	Zinc coating of IVT/ CVT tank(g/sq.m)						
41.6	Zinc coating of the secondary terminal box (g/sq.m)						
41.7	Weather proof rating of secondary terminal box.						
41.8	Weight of tank fitting and other accessories.						
	TERMINAL CONNECTORS						
01.	Manufacturer's name						
02.	Applicable standards.,						
03.	Type.						
04.	Material of connector. (a)Clamp body. (b)Bolts and Nuts. (c) Spring Washers						
05.	Rated current.						
06.	(a) Rated terminal load(kg) (b) Factor of safety.						
07.	Minimum thickness of any part(mm)						

08.	Weight of connector complete with hardware.						
09.	Type test reports as per IS enclosed.						
10.	OGA drawing enclosed.						
	BUSHING/SUPPORT INSULATOR						
01	Manufacturer's name						
02.	Type.						
03.	Applicable standards.						
04	Dimensions: (i)Height(mm) (ii)Diameter(top)(mm) (iii)Diameter(bottom)(mm)						
05	Total creepage distance (mm).						
06.	Rated voltage(KV)(rms)						
07.	Power frequency withstand voltage for (1 minute dry and wet(KV/rms)						
08.	1.2/50 micro-second Impulse withstand voltage (KVP)						
09.	Corona Extinction voltage(kv)						
10.	Weight(kg)						
11.	Maximum allowable span (mm)						
12.	Cantilever strength(kg)						

13.	OGA drawing enclosed.						
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ADDITIONAL TECHNICAL REQUIREMENT FOR 132KV, 220KV,& 400 KV CVT.

1. Rated capacitance of the CVT
2. High frequency capacitance for entire carrier frequency range.
3. Equivalent series resistance over the entire frequency.
4. Stray capacitance and stray conductance of the LV terminal over entire carrier frequency range.
5. Capacitance (PF) /Tan delta between:-
 - a) HV-HF point
 - b) HF point-Ground point of International Transformer.
 - c) HV-Ground point of Intermediate Transformer winding.
6. Capacitive reactance of the two parts of the divider i.e. High voltage capacitor, and Intermediate voltage capacitor, connected in parallel.
7. Total Inductive reactance, offered by CVT.
8. Voltage ratio of the capacitor divider.
9. Open circuit Intermediate voltage.
10. Rated open circuit Intermediate voltage.
11. Reference range of temperatures within which the CVT complies with the relevant accuracy requirements.
12. Protective device, in-corporate in the CVT for limiting over voltages and/or to prevent sustained Ferro resonance.
13. Rated voltage of Surge Arrester, connected at the secondary of CVT.
14. Natural frequency of coupling (KHZ).
15. Self tuning frequency of CVT (KHZ).

16. Bandwidth (KHZ).
17. Temperature rise over ambient.
18. One minute power frequency test voltage of secondary winding (KV).
19. One minute power frequency test voltage of H.F. terminal (KV).
20. One minute power frequency test voltage of capacitor (dry & wet) (KV).
21. 1.2/50/micro second Impulse withstand test voltage of capacitor (KVP).
22. 250/2500 micro second switching surge withstand voltage of capacitor (dry & wet).
23. Literature
Whether the followings are enclosed?
 - 23.1 Type Test reports as per IEC 186.
 - 23.2 OGA drawing of CVT and terminal connector.
 - 23.3 Characteristic curves.
 - 23.4 Drawing showing clearance from earthed object.
 - 23.5 Details of Surge Arrester, connected at secondary winding of CVT.
24. **ELECTROMAGNETIC UNIT:-**
 - 24.1 **CORE:-**
 - a) Core diameter (mm)
 - b) Window Weight (mm)
 - c) Leg centre (mm)
 - d) Net cross sectional area of iron In the core (mm²)
 - e) Core lamination thickness (mm)
 - f) Type & grade of core.
 - g) Design flux density at rated voltage. And rated frequency (Tesla)
 - h) Design flux density at highest system voltage & lowest system frequency (Tesla).
 - i) Minimum knee point voltage (volts).
 - 24.2 **PRIMARY WINDING:-**
 - a) No. of turns.
 - b) Bare size of conductor
 - c) Insulated size of conductor.
 - d) Area of cross section.
 - e) Current density (A/ mm²).
 - f) Conductor material.
 - g) Class of insulation.
 - h) Power frequency withstand level. (KV-rms).

24.3	i) Impulse withstand level (KVP).			
	<u>Secondary Winding</u>	<u>Protection Winding</u>	<u>Protection Winding</u>	<u>Metering Winding.</u>
	a) No.of turns			
	b) Bare conductor size (mm)			
	c) Insulated conductor size (mm)			
	d) Cross-sectional area (sq.mm)			
	e) Current density (A/ mm ²)			
	f) Conductor material.			
	g) Class of Insulation.'			
	h) Power frequency withstand Level (KV-rms).			

ANNEXURE –B.

CALIBRATION STATUS OF TESTING EQUIPMENTS AND INSTRUMENTS/METERS.

Name of the test	Meters and equipments required for the corresponding test with range, accuracy, make and Sl. No.	Date of Calibration.	Due date of Calibration	Name of the Calibrating Agency.	Whether Calibrating Agency is Govt. Approved.
1	2	3	4	5	6

Whether documents relating to Govt. Approval of the calibrating Agency furnished ?	Whether the meters/ equipment fulfill the accuracy class as per calibration report	Whether the calibrating agency has put any limitation towards the use of the particular meter/equipment. If yes, state the limitations.	Whether green sticker or blue sticker or yellow sticker has been affixed on the body of the particular equipment/meter. State the colour of the affixed sticker.	In spite of imposed limitations, whether the particular meter/equipment can still be used ? Justify its use for corresponding test(s).	Remarks
7	8	9	10	11	12

Signature of the tenderer with seal and date.

ANNEXURE-C

CHECK LIST TOWARDS TYPE TEST REPORTS.

Name of the Type Test.	Date of Test.	Name of the Laboratory where the Test has been conducted.	Whether the Laboratory is Government Approved.	Whether the Test reports are valid as per Clause No.8.1 of T.S.	Whether the copy of Test Report in complete shape alongwith drawings etc. furnished or not ?	Whether the Tested I.V.T/ CVT fulfills the technical require-ments as per TS.	If the type tested I.V.T/ CVT does not fulfill the technical requirements as per this specification, whether the bidder agrees to conduct the particular test(s) again at their own cost without any financial liability to OPTCL in the presence of OPTCL's representative within the specified delivery period.	Remark
1	2	3	4	5	6	7	8	

Signature of the Tenderer with seal and date.