



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 & 400 KV CURRENT TRANSFORMERS WITH METERING CORES OF ACCURACY CLASS 0.2S

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 and CT console(one CT console per 3 CT's) for protection and metering services in 33KV, 132KV, & 220KVand 400 KV solidly grounded system.

Current transformers shall be supplied with common marshalling box in a batch of three CT's along with terminal connectors and other fittings for forming necessary interphase and control room interconnections. The CT console shall be of Aluminum alloy sheets having 3 mm thickness.

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 upto 50⁰C. 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.

1.5 Bidders are required to quote for 0.2S accuracy class of metering cores with the following data / information etc.

- [a] Guaranteed Technical particulars.
- [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.

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-185	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.	<i>IS:13072 –of1991</i>	<i>SF6 Gas (for 220kv SF6 gas filled CTs only)</i>
18.	<i>IEC:60376</i>	<i>SF6 Gas(for 220kv SF6 gas filled CTs only)</i>

2.2 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 1 (one) copy 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 alongwith 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 an 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 PUCHASER'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	± 10%
[b]	Frequency variation	± 5%
[c]	Combined voltage and frequency variation	± 10%
[d]	DC Voltage Variation	<u>190V to 240V</u>

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 **220 KV/132KV/33 KV** 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. *The 400 KV CTs may be of live tank design.*

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 name plate 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. In case the instrument security factor of 5 or less is not possible to be achieved on higher ratios, auxiliary CTS of ratio 1/1 and 0.2S accuracy class shall be deemed to be included in the supplier's

scope of supply. This shall also be specifically brought out by the supplier in his offer. However, all parameters, specified shall have to be met treating auxiliary CT/ reactor as an integral part of the current Transformer. The auxiliary C.TS/reactor shall be inbuilt construction of the C.TS.

5.9 Current transformers' guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

5.10 For 245 KV, 145 and 36 KV Current Transformers, characteristics shall be such as to provide satisfactory performance for burdens ranging from 25% to 100% of rated burden over a range of 5% to 120% of rated current in case of metering CTS and upto accuracy limit factor / knee point voltage in case of relaying C.TS.

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

5.12.1 Primary winding may be either ring type or hair pin type or the type, which has been type tested. For 220KV, 132KV, and 33KV class C.Ts, the rated extended primary current shall be 120% on all cores of the C.Ts, specified in tables.

5.12.2 The primary windings of current transformers shall be constructed of high purity, annealed, high conductivity electrolytic copper/Aluminium 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 copper or Aluminium alloy of 99.9% conductivity. The minimum thickness of tinning shall be 1.5 microns.

5.15 SECONDARY TERMINALS

5.15.1 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.

5.15.2 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 energising the Current Transformer.

5.15.3 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 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

5.17.1 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 galvanised as per relevant standard.

5.17.2 The metal tanks shall have bare minimum number of welded joints so as to minimise 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 :

5.18.1 Secondary Terminal Boxes shall be weather proof with a rating not less than IP 55

5.18.2 All secondary terminals shall be brought out in a compartment on one side of each current transformer for easy access.

5.18.3 The exterior of this terminal box shall be of aluminium alloy sheet of minimum 3 mm thickness.

5.18.4 A terminal board which shall have arrangement for series / parallel connection and arrangement for shorting of secondary terminals shall be provided. For 220KV and

132KV C.Ts, 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 tapplings. For 132KV C.T. of ratio-400-200A/1-1-1-1A, the specified ratios may be obtained by Series parallel connection or by secondary tapping.

5.18.5 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.

5.18.6 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.

5.18.7 All terminals shall be clearly marked with identification number to facilitate connection to external wiring.

5.18.8 The secondary box of the CT's also of high quality steel materials with galvanizing as per standard (IS).

5.18.9 The CT console to be provided (one per 3 CT's) is also of high quality steel with proper galvanization.

5.19 PORCELAIN HOUSING

5.19.1 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.

5.19.2 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.

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

5.19.4 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.

5.19.5 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 ionisation.

5.19.6 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.

5.19.7 Oil level gauge and convenient means of filling, sampling and draining of oil should be provided.

5.19.8 End shields should be provided for distribution of stresses.

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

5.20 INSULATING MEDIUM (OIL TYPE)

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.

PREVENTION OF OILLEAKAGE AND ENTRY OF MOISTURE:

5.20.1 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.

5.20.2 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.

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

5.21 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.

5.21.1 (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.

5.21.2 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.

5.21.3 (A) 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.

5.21.4 EARTHING :

Metal tank of each Current Transformer shall be provided with two separate earthing terminals for bolted connection to 50mm X 6mm and 75X10 mm flat, to be provided by the purchaser for connection to station earth-mat.

5.21.5 LIFTING ARRANGEMENT :

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.

5.21.6 NAME PLATE & MARKING :

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

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

5.21.7 TERMINAL CONNECTORS :

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

- (i) 33KV C.T. – ACSR ‘MOOSE’ conductor.
- (ii) 132KV C.T. – ACSR ‘MOOSE’ conductor.
- (iii) 220 KV C.T. – ACSR ‘MOOSE’ conductor & also suitable for AC tube of 4 inchs.
- (iv) 400 KV CT – suitable for Al tube of 4 inch or more

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

5.21.7.1 Terminal connectors shall be manufactured and tested as per IS:5561.

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

5.21.7.3 No part of a clamp shall be less than 10mm thick.

5.21.7.4 All ferrous parts shall be hot-dip galvanised conforming to relevant standard.

5.21.7.5 For bimetallic connectors, copper alloy liner of minimum thickness of 2 mm shall be cast integral with aluminium body.

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

5.21.7.7 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:-

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 four sets of type test and Special Tests reports along with the offer for 0.2S accuracy class 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) High Voltage power frequency wet withstands voltage Test.
- (c) Short time current test.
- (d) Temperature rise test.

(e) Determination of errors or other characteristics according to the requirements of the appropriate designation and accuracy class as per individual parts of IS:2705.

(f) Instrument Security Factor Test.

(g) 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)

(h) Radio Interference voltage test.

(i) Corona Extinction test.

(j) Thermal stability test.

(k) Thermal Co-efficient test.

(l) Fast transient test.

(m) Seismic withstand test.

(n) Mechanical terminal load on bushing.

(o) Magnetisation and internal burden tests..

(p) Effectiveness of sealing tests.

(q) Capacitance and dielectric loss angle test. (For 400 KV, 220KV & 132KV C.Ts.)

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 withstands Test on Primary and Secondary winding including primary intersections.

(vi) Over – Voltage Inter turn 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 400 KV,220KV and 132KV C.Ts.
- (xvi) Measurement of tan delta at 0.3, 0.7, 1.0 and $1.1U_m/\sqrt{3}$ for 400 KV,220KV & 132KV C.Ts.
- (xvii) Checking of SF6 gas Pressure.(for SF6 gas filled CTs)

- 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 X145/245/400KV 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 alongwith 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 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 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 four sets of following drawings/documents along with his offer for 0.2S accuracy class metering core CTs.

- (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) One set 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.

13.2 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.

13.3 The supplier shall ensure that the bills of materials are approved by the purchaser before despatch.

13.4 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 & 220 KV CURRENT TRANSFORMERS**

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

Sl. No.	Item.	Specification		
		36 KV	145 KV	245KV
1	Type of CT/Installation.	Single phase, dead tank, oil filled, hermetically sealed, outdoor, self-cooled.(For 220KV SF6 gasfilled CTs-Single phase, live tank, hermetically sealed, out door,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
5	Nominal system voltage (KV rms)	33	132	220
6	Highest system voltage (KV rms)	36	145	245
7	Current ratio (A/A)	a) 400-200A-100/ 1-1-1A b)800-400-200A/1-1-1A c) 800-400-200/1-1-1-1A	a) 800-400-200A/1-1-1-1A b) 600-300-150A/1-1-1-1A c) 400-200A-100/1-1-1-1A d) 200-100/1-1-1-1A	1200-600-300A/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
14.	1 minute dry power frequency withstand voltage primary (KV rms)	70	275	460
15.	Switching Impulse with stand and voltage (KVP)	--	-	-
16.	1 Minute dry power frequency withstand voltage secondary (KV rms)	3	3	3
17.	Minimum creepage distance of porcelain Housing (mm)	900	3625	6125
18.	Rated short time withstand current for 1 second at all ratios (KA rms)	25KA	31.5 KA	

		40KA
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	Enclosed in separate sheets for each rating of the Current Transformers. Torroidal type 0.15g (Vertical) 0.3g (Horizontal) 0.005 or less 0.05 or better.
22.	Type of core	
23.	Seismic acceleration	
24.	Dielectric dissipation factor at 245/1.732KV (for 220KV C.T) & 145/.1.732KV (for 132 KV C.T.) at ambient temperature	
25.	Accuracy class of standard C.T. to be used during testing towards determination of ratio errors and phase angle errors for metering cores.	

400 KV Current transformer Selection philosophy

The following shall be adopted for selecting the type of current transformers:

- Insulation : Oil impregnated paper/ porcelain.
- Type : Dead / live Tank type
- Voltage Class : 400kV
- Application : Outdoors

IMPORTANT: ALSO REFER THE SPECIFICATION OF CT,S MENTIONED IN ABOVE SECTIONS.

General

Current transformers shall comply with IEC 60044-1/ IS 2705.

Current transformers shall be supplied with common marshalling box in a batch of three CT's along with terminal connectors and other fittings for forming necessary interphase and control room interconnections.

Current transformers shall operate satisfactorily in system with high **X / R** ratio.(Tp=100ms)

Current transformer tanks along with top metallic parts shall be hot dip galvanised. Spray galvanisation as per IS-5905 with 250 micron thickness of Zinc followed by finishing coats of a suitable primer with sealer.

The impregnation details along with tests and checks to ensure successful completion of impregnation cycle shall be furnished for Project Manager's approval.

Bellows if used for expansions of insulating oil shall be tested in accordance with relevant standards. The details shall be to the approval of the Project Manager.

The instrument transformers shall be designed for use in geographic and meteorological condition as stipulated (GTR)

Constructional features

The secondary windings of current transformers shall be as stated in the schedules and shown in the attached single line diagrams; the secondary windings shall meet the requirements stated in the tables attached under this section of this Specification.

Each current transformer secondary winding circuit shall be earthed at one point only i.e. in the control room.

Terminal boxes shall be weather proof with a rating not less than IP 55. The terminal box shall be provided with a gland plate suitable for PVC insulated PVC sheathed 10 core, 2.5 mm² stranded copper conductor cables.

Where adequate earth screens are fitted between the primary and secondary windings earthing of the secondary winding shall be via a link mounted in the related protection or instrument cubicle. Where such earth screens are not fitted a separate earth system may be necessary.

Wherever possible the connection to earth shall be on the side of the S2 terminals.

Necessary markings for connections shall be provided on each CT at load termination end points and at the associated terminal blocks. Provision shall be provided for short circuiting and grounding of the CT secondary at the terminal blocks.

Different ratios specified shall be achieved by secondary taps only and primary reconnection shall not be accepted.

Core laminations shall be of cold rolled grain oriented silicon steel or other equivalent alloys. The cores used for protection shall produce undistorted secondary current under transient conditions at all ratios, with specified CT parameters.

The expansion chamber at the top of the porcelain insulators should be suitable for expansion of oil.

Facilities shall be provided at terminal blocks in the marshalling box for star delta formation, short circuiting and grounding of CT secondary terminals.

A wiring diagram plate for the interconnections of the three single phase CT's shall be provided inside the marshalling box.

The physical disposition of the secondary cores shall preferably be in the same order as that given in the tables in this section of the specification.

Current transformers shall be suitable for mounting on lattice support structure as stipulated elsewhere in this Specification.

Technical specification of current transformers

Current transformers guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

For 400 kV class CT's the rated extended primary current of the CT's shall be 200 % of rated primary on all except 2000/1 tap ratio. On 2000/1 ratio the rated extended primary current shall be 120%. However, at 2000/1 ratio the CT shall be thermally rated for 200 % for 15 minutes and 120 % continuous.

For 420kV current transformers, characteristics shall be such as to provide satisfactory performance for burdens ranging from 25 % to 100 % of rated burden over a range of 10 % to 100 % of rated current in case of metering CT's, and up to the accuracy limit factor / knee point voltage in case of relaying CT's.

Current transformers shall be suitable for horizontal transportation. It shall be ensured that the CT is able to withstand all the stresses imposed on it while transporting and there shall be no damage in transit.

For 420 kV CT's the instrument security factor at all ratios shall be less than five (5) for metering cores. If any auxiliary CT's or reactors are used in the current transformers then all parameters specified shall have to be met treating auxiliary CT's or reactors as an integral part of the current transformer. The auxiliary CT's or reactors shall preferably be inbuilt construction of the CT's. In case these are to be mounted separately they shall be mounted in the central marshalling box suitably wired up to the terminal blocks.

Current transformers shall be designed so as to achieve the minimum risks of explosion in service. The Bidder shall bring out in his offer, the measures taken to achieve this.

420 kV and 245 kV current transformers shall be suitable for high speed auto reclosing.

Oil impregnated current transformers

Post type current transformers using oil impregnated paper as the insulant may be of the bar, single or multi-turn primary and shall be hermetically sealed and conform to the requirement of IEC 185.

In case bar primary inverted type current transformers are offered the manufacturer will meet following additional requirements :

- The secondary shall be totally encased in metallic shielding providing a uniform equipotential surface for even electric field distribution.
- The lowest part of the insulation assembly shall be properly secured to avoid any risk of damage due to transportation stresses.
- The upper part of insulation assembly resting on primary bar shall be properly secured to avoid any damage during transportation.
- Nitrogen if used for hermetic sealing should not come in direct contact with oil.

The primary windings of current transformers shall be constructed of high purity, annealed, high conductivity copper or electrolytic grade aluminium meeting to the requirements of IEC 28. secondary windings shall be constructed out of copper only.

Each current transformer shall be impregnated and filled with oil of the grade specified in IEC 296.

The following facilities shall be provided:

- Visual means of determining the level of oil within the transformers from ground level.
- Oil drain cock and sampling device where applicable.
- Earth terminal of adequate dimensions so arranged that the earth connection cannot be inadvertently removed.

The creepage and flashover distances of the support insulator shall be dimensioned to suit the outdoor service conditions specified in the schedules.

Technical parameters

In addition to meeting the system technical parameters the parameters given in the following tables shall apply.

**SPECIFIED PARAMETERS FOR KPV,
SEC. WDG. RESISTANCE, EXCITATION
CURRENT FOR PS CLASS CORES**

AND

BURDEN, ISF FOR METERING CORES

OF

ACC.CLASS 0.2S

FOR

33KV,132KV,220KV & 400KV C.TS

REQUIREMENT FOR 245 KV CURRENT TRANSFORMERS OF RATIO

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

No. of Cores	Core No.	Application	Current ratio	Output burden in VA	Accuracy 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.	Instrument security factor
1	2	3	4	5	6	7	8	9	10
5	1	Bus differential oil check	1200/1	-	PS	600	5.0	40	
			600/1	-	PS				
			300/1	-	PS				
	2	Bus differential main	1200/1	-	PS	600	5.0	40	
			600/1	-	PS				
			300/1	-	PS				
	3.	Metering	1200/1	15	0.2S	-	-	-	1200/1:-5or less 600/1:-5 or less 300/1:-5 or less
			600/1	15	0.2S	-	-	-	
4.	Transformer back up / line protection	1200/1	-	PS	1200	5.0	40		
		600/1	-	PS					
5.	Transformer back up/line protection	1200/1	-	PS	1200	5.0	40		
		600/1	-	PS					
			300/1	-	PS				

REQUIREMENT FOR 145 KV CURRENT TRANSFORMERS OF RATIO

a) 800-400A-200A/1-1-1-1A

No. of Cores	Core No.	Application	Current Ratio	Output burden in VA	Accuracy 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.	Instrument security factor at all ratios
1	2	3	4	5	6	7	8	9	10
4	1.	Protection	800/1 400/1 200/1	- - -	PS PS PS	400	4	30	-
	2.	Metering	800/1 400/1 200/1	15 15 15	0.2S 0.2S 0.2S	- - -	- - -	- - -	5 or less 5 or less 5 or less
	3.	Back up	800/1 400/1 200/1	- - -	PS PS PS	400	4	30	-
	4.	For owner's future use.	800/1 400/1 200/1	- - -	PS PS PS	400	4	30	-

REQUIREMENT FOR 145 KV CURRENT TRANSFORMERS OF RATIO

b) 600-300A-150A/1-1-1-1

No. of Cores	Core No.	Application	Current Ratio	Output burden in VA	Accuracy 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.	Instrument security factor at all ratios
1	2	3	4	5	6	7	8	9	10
4	1.	Protection	600/1 300/1 150/1	- - -	PS PS PS	500	5	60	-
	2.	Metering	600/1 300/1 150/1	15 15 15	0.2S 0.2S 0.2S	-	-	-	5 or less 5 or less 5 or less
	3.	Back up	600/1 300/1 150/1	- - -	PS PS PS	500	5	60	-
	4.	For owner's future use.	600/1 300/1 150/1	- - -	PS PS PS	500	5	60	-

REQUIREMENT FOR 145 KV CURRENT TRANSFORMERS OF RATIO

c) 400-200A-100/1-1-1-1A

No. of Cores	Core No.	Application	Current Ratio	Output burden in VA	Accuracy 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.	Instrument security factor at all ratios
1	2	3	4	5	6	7	8	9	10
4	1.	Protection	400/1 200/1 100/1	- - -	PS PS PS	800	4	30	-
	2.	Metering	400/1 200/1 100/1	15 15 15	0.2S 0.2S 0.2S	-	-	-	5 or less 5 or less
	3.	Back up	400/1 200/1 100/1	- - -	PS PS PS	800	4	30	-
	4.	For owner's future use.	400/1 200/1 100/1	- - -	PS PS PS	800	4	30	-

REQUIREMENT FOR 145 KV CURRENT TRANSFORMERS OF RATIO

d) 200A-100/1-1-1-1A

No. of Cores	Core No.	Application	Current Ratio	Output burden in VA	Accuracy 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.	Instrument security factor at all ratios
1	2	3	4	5	6	7	8	9	10
4	1.	Protection	200/1 100/1	- -	PS PS	800	4	30	-
	2.	Metering	200/1 100/1	15 15	0.2S 0.2S	-	-	-	5 or less 5 or less
	3.	Back up	200/1 100/1	- -	PS PS	800	4	30	-
	4.	For owner's future use.	200/1 100/1	- -	PS PS	800	4	30	-

REQUIREMENT FOR 36KV CURRENT TRANSFORMERS OF RATIO

(a) 400-200A-100/1-1-1A

No. of Cores	Core No.	Application	Current Ratio	Output burden in VA	Accuracy 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.	Instrument security factor
1	2	3	4	5	6	7	8	9	10
3.	1	Protection	400/1 200/1 100/1	- - -	PS PS PS	400	5.0	25	
	2.	Metering	400/1 200/1 100/1	15 15 15	0.2S 0.2S 0.2S	-	-	-	5 or less 5 or less 5 or less
	3.	Protection	400/1 200/1 100/1	- - -	PS PS PS	400	5.0	25	-

REQUIREMENT FOR 36KV CURRENT TRANSFORMERS OF RATIO

(b) 800-400-200A/1-1-1A

No. of Cores	Core No.	Application	Current Ratio	Output burden in VA	Accuracy 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.	Instrument security factor
1	2	3	4	5	6	7	8	9	10
3.	1	Protection	800/ 1 400/1 200/1	- - -	PS PS PS	450	10	40	
	2.	Metering	800/1 400/1 200/1	15 15 15	0.2S 0.2S 0.2S	-	-	-	5 or less 5 or less 5 or less
	3.	Protection	800/1 400/1 200/1	- -	PS PS PS	450	10	40	-

**REQUIREMENT FOR 36KV CURRENT TRANSFORMERS OF RATIO
(b) 800-400-200A/1-1-1-1A**

No. of Cores	Core No.	Application	Current Ratio	Output burden in VA	Accuracy 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.	Instrument security factor
1	2	3	4	5	6	7	8	9	10
3.	1	Protection	800/ 1 400/1 200/1	- - -	PS PS PS	450	10	40	
	2	Protection	800/ 1 400/1 200/1	- - -	PS PS PS	450	10	40	
	3.	Metering	800/1 400/1 200/1	15 15 15	0.2S 0.2S 0.2S	-	-	-	5 or less 5 or less 5 or less
	4.	Protection	800/1 400/1 200/1	- -	PS PS PS	450	10	40	-

Requirements for 420 kV current transformers

No. of cores	Core No.	Application	Current ratio	Output burden in VA	Accuracy class as per IEC 185	Minimum knee point voltage V_k corresponding to tap position in Volts	Maximum CT resistance R_{CT} in Ω corresponding to tap position	Maximum excitation Current at V_k in mA corresponding to tap position	Remarks
5	1	Bus differential Check	2000/1 1000/1	PS PS	2000 1000	10 5	30 on 2000/1 tap 60 on 1000/1 tap	
	2	Bus differential Main	2000/1 1000/1	PS PS	2000 1000	10 5	30 on 2000/1 tap 60 on 1000/1 tap	
	3	Metering	2000/1 1000/1 500/1	15 15 15	0.2S 0.2S 0.2S	10 5 2.5	
	4	Transformer / line Protection	2000/1 1000/1 500/1	PS PS PS	4000 2000 1000	10 5 2.5	30 on 2000/1 tap 60 on 1000/1 tap 120 on 500/1 tap	
	5	Transformer back up / line Protection	2000/1 1000/1 500/1	PS PS PS	4000 2000 1000	10 5 2.5	30 on 2000/1 tap 60 on 1000/1 tap 120 on 500/1 tap	

REMARKS: THE BIDDERS ARE ALSO TO FILL-UP THE GTP FOR 400 KV CT'S AS PER THE STANDARD FORMAT OF OPTCL MENTIONED ABOVE FOR OTHER CLASS CT,S. SAME GTP TO BE FILLED-UP.

**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	In spite of imposed limitations, whether the particular meter / equipment can still be used? Justify its use for corresponding test (s)	Re-marks
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
ANNEXURE –D



**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	800
9	Short time current for 3 sec. (kA)	63	40	31.5	25
10	Rated requency	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
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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

2. SCOPE

This specification provides for design, manufacturer, testing at manufacturer's Works and delivery ,supervision of erection, commissioning (if required) of outdoor station type 400 kV/220kV /132kV /33kV, 3 phase triple pole double break electrically / mechanically gang operated center rotating type (Single / Double) Isolator with / without earth switches, with electrical interlock, insulators and complete in all respect with connectors, arcing horns, operating mechanism, auxiliary switches, indicating devices etc. as described hereinafter.

3. STANDARDS

Isolators covered by this specification shall conform to latest edition of IEC 62271-102 and IS: 9921 and unless specifically stated otherwise in this specification.

4. TYPE

- The Isolators shall be outdoor type with three phase suitable for electrical as well as manual operation and local/remote 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 Isolators and earth switches shall be of identical construction and mechanically linked for gang operation for Isolators upto 220kV. 400kV Isolators shall be individual pole electrical gang operated
- 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.
- 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 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 earth 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.

5. MAIN CONTACTS

Isolator shall have heavy duty, self-aligning and high pressure line type contacts made of high conductivity, corrosion resistant, hard-drawn electrolytic copper. All copper contact points shall be silver plated to 25 micron thickness or more. Fixed contact should be of reverse loop type with adequate number of copper strips which shall be backed by powerful phosphor bronze/stainless steel springs.

The Isolator moving arm/blade shall be made out of high conductivity, corrosion resistant, hard-drawn electrolytic copper of proper length, thickness and contact/surface area for Isolators upto 220kV.

For 400kV Isolator, the moving arm shall be made out of High conductivity *aluminium* tube of outer diameter not less than 120 mm.

The dimensions of the contacts should conform to the drawing approved during type test. However the current density of the current carrying parts shall not be more than the values specified below.

Current Density in Amps/sq. mm

	<u> Tubes</u>	<u> Flats</u>
Copper	2.5	2.0
Aluminium	1.25	1.0

These fixed and moving contacts shall be able to carry the rated current continuously and the maximum fault current 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.

The Isolator shall be self-cleaning type so that when Isolator remains 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. Contact springs shall not carry any current and shall not lose their characteristics due to heating effects. Each contact or part of contacts shall be independently sprung so that full pressure is maintained on all contact at all times.

The live parts shall be designed to eliminate sharp joints, edges and other corona producing surfaces, where this is impracticable adequate corona rings made out of aluminium tubes shall be provided. Corona shields are not acceptable.

6. Base :

Each single pole of the isolator shall be provided with a complete galvanized steel base provided with holes and designed for mounting on a supporting structure. The base for 400/220/132 kV shall be made out of two channels of size 200x100 / 150x75 / 150x75 or more having thickness not less than 5mm. Base channel shall be rigid in construction and capable of taking all the loads like short circuit force, terminal load, wind load and vibration caused due to seismic / operation of Isolator. Leveling screws of adequate size shall be provided on either side of the base channel under the Insulator for the alignment of Isolator. For 33kV Isolator single base channel of size 100x50 can be provided.

The rotating insulator shall be mounted on a rotating post which shall have two ball bearings of suitable size and housed inside a bearing housing made out of aluminium alloy and greased for life. The distance between the bearings shall not be less than 200/150/125/70 mm for 400/220/132/33 kV respectively.

7. ARCING HORN AND GRADING HORN

Suitable arcing horn made of GI shall be provided on the fixed and moving contacts of Isolators if required. The contacts shall be of 'make before and break after' type.

8. ELECTRICAL INTERLOCK / MECHANICAL INTERLOCK

The Isolators shall be equipped with electrical interlock for interlocking with the associated circuit breakers and earth switch. The interlocking scheme shall be approved by OPTCL.

Suitable mechanical / constructional interlock shall be provided between Isolator and earth switch which should be rigid in construction and properly mounted to ensure reliable operation.

9. AUXILIARY SWITCHES

All isolators and earth switches shall be provided with 220V DC auxiliary switches for remote position indication on the control panel and for electrical interlocking with other equipment.

The auxiliary switch shall be provided with a minimum of auxiliary contacts-12 normally open and 12 normally closed and 10 normally open and 10 normally closed for earth switch.

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 auxiliary switch along with the type test report shall be furnished in the offer.

10. EARTH SWITCH

a) Where earth switches are specified these shall include the complete operating mechanism and auxiliary contacts. The earth switch shall be operated by a separate mechanism.

b) The earth switches shall form an integral part of the isolator and shall be mounted on the base frame of the isolator.

c) Earth switches shall be only locally operated.

d) The earth switches shall be constructionally interlocked with the isolator so that the earth switches can be operated only when the isolator is open and vice versa. The constructional interlocks shall be built in construction of isolator and shall be in addition to the electrical interlocks. Suitable mechanical arrangement shall be provided for delinking electrical drive for manual operation.

e) Each earth switch shall be provided with flexible copper braids or any other improved design for connection to earth terminal. These braids shall have the same short time current carrying capacity as the earth blade.

f) The plane of movement and final position of the earth blades shall be such that adequate electrical clearances are obtained from adjacent live parts in the course of its movement between ON and OFF position.

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

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

i) 400 kV earth switches shall be of double movement type (telescopic) i.e. it has to rotate 90 degree in first movement and then lift upwards to make a contact which ensures a

reliable and jerk free operation of the earth switch. Proper locking arrangement shall be provided such that the earth switch shall be locked after lifting upwards to avoid opening during short circuit.

11. OPERATING MACHANISM

a) The bidder shall offer motor operated Isolators and earth switches except for the earth switches of 33 kV Isolator which shall be manual operated with crank and reduction gear mechanism.

b) *Control cabinet/operating mechanism box shall be made of cast aluminium / aluminum sheet of adequate thickness (minimum 3 mm) for 33 KV,132KV and stainless steel (grade-316) of minimum thickness 1.6 mm for 400 KV and 220 KV.*

c) The enclosure shall be painted / powder coated to the Shade no 631 of IS:5(for aluminium enclosure)

d) The enclosures of the operating mechanism Box shall conform to the degree of protection IP- 55

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

f) For 400kV Isolators, Gang / Individual switch shall be provided.

g) Provision shall be made in the control cabinet to disconnect power supply through suitable MCBs to prevent local/remote power operation.

h) All control switches shall be of MCB/rotary switch type and Toggle/piano switches shall not be accepted.

i) Motor shall be an AC motor as per IS:325. Motors rated 373 watt and above shall be used. The motor shall withstand without damage stalled torque for atleast 3 times the time lag of tripping device.

j) Suitable reduction gearing shall be provided between the motor and the drive shaft of the isolator. The mechanism shall stop immediately when motor supply is switched off.

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

l) Gear should be of forged material suitably chosen to avoid bending/jamming on operation after a prolonged period of non operation. Also all gear and connected material should be so chosen/surface treated to avoid rusting. The Gears shall be lubricated for life with graphite or better quality non-drawing and non-hardening type grease.

m)The test report for blocked rotor test of motor shall be submitted

n) Only stranded copper conductor shall be used for wiring. Minimum size of the conductor for control circuit wiring shall be 2.5 sq.mm Copper.

o) The operating mechanism shall be located such that it can be directly mounted on the support structure.

- p) Suitable anti condensation heaters with the provision of thermostat shall be provided.
- q) Each operating mechanism shall be provided with 1100V grade stud type terminal block of Polyamide material. (OAT-6 for non-disconnecting type and OAT 6T for disconnecting type of Elmex) / Connectwell (Equivalent). At least 20% spare terminals shall be provided.
- r) A light fixture suitable for a 240 V CFL tube light shall be provided in each of the motor operated mechanism & shall be door operated type.
- s) A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps.
- t) A position indicator to show the isolator is in ON or OFF position to be provided at a suitable location.

12. OPERATION

The main Isolator and earth switches shall be individual pole electrically ganged motor operated for 400 kV and mechanically gang operated in case of 220/132/33 kV. The operating mechanism of the three poles shall be well synchronized and interlocked.

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.

The isolator and earth switches shall be provided with "dead center mechanism" to prevent accidental opening by wind, vibration, short circuit forces or movement of the support structures.

13. 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 rings made out of aluminium tubes shall be provided. Corona shields are not acceptable.
- 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.
- 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.

14. PROTECTIVE COATINGS

All ferrous parts including bolts, nuts and washers of the switches assembly shall be galvanised to withstand at least six one minute dips in copper sulphate solution of

requisite strength (Preece dip tests) except the threaded portions which should withstand four dips.

15. 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 colour 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.
- 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 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.
- Casting shall be free from blow holes cracks and such other defects.

16. Name plate :

Isolator, earth 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 information's duly engraved or punched on it. Name plate shall be bilingual i.e. in English & Oriya

A. Isolator Base

Name : OPTCL
Name of manufacturer –
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 –
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 –
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

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

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

17. TESTS

Type Tests

Isolators offered, shall be fully type tested as per the relevant standards. The Bidder shall furnish one set 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.

The following type test reports shall be submitted for evaluation purpose. In the absence of any one of the following, the bid is liable to reject.

- a) Short time withstand & peak withstand current test for Isolator & Earth Switch.
- b) Power frequency (Dry & Wet), Lightning Impulse dry withstand Test
- c) Radio interference voltage (RIV) test

- d) Mechanical endurance Test & Terminal load test
- e) Degree of Protection test (IP-55)
- f) Corona Test (For 400kV Only)
- g) Temperature rise test
- h) Blocked rotor 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 voltage class for M0 class (1000 operations) for Isolators upto 220kV. 400kV Isolators shall be tested for extended mechanical endurance test, M2 class (10000 operations) as per IEC 62271-102 which shall be tested at any NABL accredited independent laboratory like CPRI/ERDA.

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 completion of the routine test, the supplier shall give 20 days' advance intimation along with routine test certificates, valid calibration reports from Govt. approved test laboratories 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 routine test certificates and calibration reports furnished by the manufacturer, 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. 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 raw materials and bought out items including but not limited to the following shall be furnished at the time of routine tests.

- a) Chemical analysis of copper alongwith a copy of excise certificate indicating genuine source of procurement of electrolytic grade copper.
- b) Aluminium extrusions
- c) Aluminium ingots & castings
- d) Fasteners
- e) Insulators
- f) Motor
- g) Gears
- h) Auxiliary switch

- i) Limit switch
- j) Overload / single phase preventer
- k) Interlocking devices
- l) Terminal block

18. INSPECTION

- i) The Purchaser shall have access at all times to the works and all other places of manufacture, where the Isolators, earth switches and associated equipment are being manufactured and the supplier shall provide all facilities for unrestricted inspection of the works of 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.

19. 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 list 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.

20. DOCUMENTATION

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

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 5 prints and soft copies in two CD 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 despatched 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.

21. INSTRUCTION MANUALS :

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

- (a) Marked erection prints identifying the component parts of the Isolator 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.

22. 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.

23. SUPERVISION OF ERECTION TESTING & 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 general 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.

24. QUANTITY AND DELIVERY REQUIREMENTS :

The scope of supply shall include a supply of 2.5% extra quantity of galvanised bolts, nuts, washers, split pins, cotter pins and such other small loose items free of cost.

ANNEXURE
(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 Isolators 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 galvanised components	IS:2633
5.	Stalled torque test on motor operating mechanism	At 110% of supply voltage

LIST OF MANDATORY SPARES

Sl. No	Item	Quantity
1.	Copper contact fingers for male and female contact per Isolator	2sets each for each Type of Isolators (400/220/132/33KV)
2.	Relay, power contactors, MCBs, Rotary switches for electrical control circuit per Isolator (Indicate the nos of relay, power contactors, MCBs, Rotary switches used in the electrical circuit of each type of isolators)	2sets for each Type of Isolators
3.	Support insulator stack for one pole of the isolator	2 stacks for each type of Isolators
4.	Terminal pad	2 Nos. for each type of isolators
5.	Limit switch and Auxiliary switch per Isolator (Indicate the nos of each switch used in each type of isolators)	2sets for each type of Isolators
6.	Terminal connectors per Isolator	2 sets for each type of isolators.

ODISHA TRANSMISSION CORPORATION LIMITED



TECHNICAL SPECIFICATION FOR 250 KVA, 33/0.433 KV STATION TRANSFORMER

TECHNICAL SPECIFICATION FOR 250 KVA, 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 1183/1964 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, 1183/1964 & 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:

SI No	Description	Specification
I	Frequency	50 Hz ± 5%
II	Continuous rating	250 KVA
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	Terminal connection	Bimetallic clamp suitable for ACSR conductor as per system requirement.
XI	1.1 Maximum flux density at normal BIL Voltage & normal frequency 1.4 Tesla	170 KVP
XII	Type tap changer for transformer	Rotary type, off load control tap changing gear.

4. The primary-winding shall be connected Delta and secondary winding star as per vector symbol Dyn-II (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 For rated system voltage of 33 kV the impulse test voltage is 170 kV (Peak).

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.
- 6.2 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. FREQUENCY

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 tappings 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 tappings 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 it's 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 & its 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	NO LOAD LOSS WATTS	LOAD LOSS IN WATTS	LOAD LOSS IN WATTS AT 75 DEGREE C AT NORMAL TAP	PERCENTAGE IMPEDANCE AT 75 DEGREE C AT NORMAL TAP
250 KVA (Copper wound)	620		3700	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 L T 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 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 tapings 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 re-annealed 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.

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 silicagel.
- b) Explosion Vent
- c) A safety valve of chimney type shall be provided. The bottom of the safety valve pipe shall project into the tank.
- d) 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.
- e) 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.
 - i) Earthing terminal and numbers.
 - ii) Air relief vent.
 - iii) Rating and diagram plate
- f) 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.
- g) 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.
- h) 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.

- (i) Arcing horn with each HT bushings.
- (ii) Pad lock for tap changing switch.

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.

15 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 will be carried out as per the attached Appendix 'A' & 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.

15.1 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.

16 TEST REPORT

After all tests have been completed seven 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.

Type test.

16.1.1 Temperature rise test

16.1.2 **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.

In addition to the routine tests, the type and special test certificates for the tests as indicated below, conducted by the supplier on proto type of transformers of identical design at CPRI or any Govt. approved laboratory within the last 5(five) years from the date of opening of this. CPRI/Govt. approved laboratory test certificate along with CPRI/Govt. approved laboratory drgs (Internal and external drgs.) must accompany along with the drawings for approval.

Type & Special Tests

1. Impulse Voltage withstand test
2. Temperature rise test
3. Short Circuit Test.

The test results of CPRI tested transformer should confirm with the technical particulars as stipulated in this specification .The bidder shall indicate the values of resistance , stray loss, %Impedance, % regulation, no load losses, load losses at rated output , voltage & frequency along with the drawing submitted for approval. These values will be guaranteed **MAXIMUM VALUES.**

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 as stipulated.

The successful bidder will be penalized at 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.

The tenderer shall give the guaranteed technical particulars required as indicated in Vol-II-A along with the drawing for approval.

The tenderer shall submit the detailed dimensional drawing, short circuit , impulse & temperature rise test reports conducted in a govt. approved laboratory for the

transformer offered along with the offer ,failing which the offer will not be considered.

17. REJECTION

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

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

The supplier also should guarantee after sales services beyond the free service period as stipulated in.

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

APPENDIX – A

TESTS

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 of each rating.

1. Routine Test

All transformers shall be subjected to routine tests at the manufacturer's works. The tests shall comprise as per the followings:-

- 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 a 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 & f₁ = applied frequency.

For example: - If measured loss = x, correction factor due to rms & Average voltage as per ISS = k₁, and frequency correction factor = k. Then corrected loss will be calculated as = measured loss x * k₁ * 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 withstands.
- i) Magnetic balance test
- j) Oil BDV Test
- k) Oil Leakage Test
- l) Measurement of dimensions & etc.

18.0 Following are the list of annexures 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--- Quality & Delivery schedule
4. Annexure-IV--- Calibration status of testing Equipment (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.

APPENDIX-I.

SCHEDULE OF TECHNICAL PARTICULARS TO BE FURNISHED BY THE MANUFACTURER CONFIRMING TO THE TRANSFORMERS PASSED C.P.R.I TYPE TEST, IN RESPECT OF IMPULSE HIGH VOLTAGE SHORT CIRCUIT CURRENT, TEMPERATURE RISE TEST AND OTHER DESIGN DATA.

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 (See 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.
iii) % Regulation.
14. (A) Component losses.
a) No-load loss at rated nominal voltage and normal frequency. KW
b) Load loss at rated current and rated frequency at normal tapping at 75°C. & at extreme taps.
- (B) Resistance at normal tap & at 75°C.
i) H.V.
ii) L.V.
15. Impedance voltage & percentage Impedance at full rated current at 75°C. for the
a) Normal tap.
b) Lowest tap position
c) Highest tap position.
16. Reactance at rated current and rated frequency. Percentage.
- i) No load current at rated nominal voltage and rated frequency and at 50%, 75%, 100%, 110% & 121% voltage & at rated frequency.
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.
c) Full wave lightning impulse withstand voltage with time vrs. peak voltage characteristic curves.
i) H.V. Winding. KV Peak.
ii) L.V. Winding. KV Peak.
d) P.I. value.
19. Efficiencies at 75°C at unity power factor.
a) At full load. Percent
b) At $\frac{3}{4}$ full load -do-
c) At $\frac{1}{2}$ full load -do-
d) At 120% of full load.

20. Regulation at full load at 75°C
- a) At unity power factor. -do-
- b) At 0.8 power factor loading & lagging. -do-
21. Equipment for ONAN cooling.
- a) State.
- i) No. of Radiators on main tank.
- ii) Make & type
- iii) Total radiating surface
- iv) Thickness of radiator fins
- v) Clear distance between fins
- vi) Width of radiator fins
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) Tank, fittings & accessories. (Name of accessories to be mentioned). Kg.
- d) Oil. Kg.
- e) Core coil assembly Kg.
- f) radiators Kg.
- g) Total mass Kg.
26. a) Approximate quantity of oil required for first filling. Ltrs.
- b) Name of the manufacturer of oil used
27. Approximate tank dimensions for over all dimensions.
- a) Length mm
- b) Breadth. mm
- c) Height. mm
- d) Thickness of main tank cover plate, side & bottom plate. mm
- e) Tank inside & outside dimension. mm
- Length/breadth/height. No. of tubes in each radiator. Tube length in copper, thickness & dia. Each side tubes (Nos.).

28. Despatch details.
- a) Approximate mass of heaviest package. Kg.
- b) Approximate dimensions of largest package.
- i) Length. mm
- ii) Breadth. mm
- iii) Height. mm
29. Un-tanking height. mm
30. Additional technical particulars.
- i) (a) i. Maximum flux density at highest system voltage & 48.5 c/s frequency. Tesla or Wo/m².
- ii) Maximum flux density at rated system voltage & rated frequency.
- (b) Maximum current density in windings. Amps/Sq.Cm
- (c) Size of conductor used. HV/LV
- High voltage. }
- Low voltage. }
- ii) Efficiency at 75°C and 0.8 P.F. lagging
- At full load. Percent.
- At $\frac{3}{4}$ full load -do-
- At $\frac{1}{2}$ full load -do-
- Over loading capacity & efficiency.
- iii) Load at which maximum efficiency occurs. -do-
- iv) Maximum efficiency. Percent.
- v) Impulse level with 1/50 Micro.S. Wave.
- High voltage KV
- Low voltage KV
- vi) No-load loss at 110% rated nominal voltage and rated frequency. KV
- vii) No load current at 110% & 121% of nominal voltage & rated frequency. Percentage.
- viii) Type of winding.
- High voltage.
- Low voltage.
- No. of turns of H.V.
- No. of turns of L.V.
- ix) Insulation materials.
- Turn insulation high voltage.
- Turn insulation low voltage.
- Insulation core to low voltage.
- Insulation high voltage to low voltage.
- x) Clearance:-
- Minimum clearance between phases.
- a) In oil. mm
- b) Out of oil. mm
- Maximum clearance high voltage to tank in oil. mm
- Minimum clearance high voltage to

earth in oil. mm
 xi) Minimum clearance height for lifting core & windings from tank. mm.

31. CORE :-

- (i) Core materials used. (grade & thickness).
- (ii) Loss in watts/Kg. of core materials corresponding to desired flux densities. (Watts/Kg. curve to be furnished along with the bid).
- (iii) EMF per turn
- (iv) Core circumcircle dia (d).
- (v) No. of core bolt holes per phase.
- (vi) Dia of each core bolt holes in mm.
- (vii) Net iron section (cm²). Limb/Yoke.
- (viii) Weight (Kg.)
- (ix) Total GI (Kg.)
- (x) Total (KW).

No. of steps.	1	2	3	4
---------------	---	---	---	---

Stack in mm.

Width of core in mm.

Stacking factor of core.

32.(a) WINDING :-

- | | | | |
|--|----|----|----------------|
| | LV | HV | HV regulating. |
|--|----|----|----------------|
- Current per phase (Amp.)
 - conductor bare (mm) No. of conductor insulation (mm).
 - Conductor section (mm²)
 - Current density (A/mm²)
 - Turns per phase (T).
 - Coils per limb.
 - Arranged.
 - Turns per coil.
 - Turns per layer.
 - Layers per coil.
 - Winding depth.
 - Coil dia inside.
 - Coil dia outside.
 - Length of mean turns.
 - Resistance at 75°C,
 - Total I² R including stray at 75°C,
 - Weight of copper with/without insulations.

- (b) Radiators provided (Nos.).
- No. of fins provided.

Radiator size in mm (Length x wide x fin Nos.)
Loss to be dissipated by Radiators in KW.
Dissipation per fin at 50°C.
Thermal head in mm.
Radiator area.

33. **Oil data:-**
1. Quantity for first filling. Ltr.
 2. Grade of oil used.
 3. Maker's name.
 4. BOV at the time of filling.
 5. Type of oil.
34. Make of breather and type with capacity of silica gal filled in grams.
35. Inter layer insulation provided in design for:-
1. Top and bottom layer. mm
 2. In between all layers. mm
 3. Details of insulation. mm
 4. Whether wedges are provided at 50% turns of the coil.
36. Insulation materials.
- a) For conductors. H.V.
 - b) For core. L.V.
37. Particulars of bushings:-
1. Maker's name.
 2. Type IS-3347/IS-1180.
 3. Rating as per I.S.
 4. Dry flash over voltage KV
 5. We flash over voltage KV.
38. I.R. value at 30°C.
HV/E
LV/E
HV/LV
39. Polarisation Index :-
Measurement of Insulation resistance at 10 minutes/1 minute.

HV/E.
LV/E.
HV/LV.

Bidders Name:-

Signature :-

Designation :-

Date:-

Authorised common rubber seal.

**(Certificate against authorization for signature of the bidding document)
to be furnished.**

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ANNEXURE-II

FORMAT FOR STAGE INSPECTION

Sl. No		L.V.	HV
A	WINDING		
1.	Conductor Bare mm		
2.	Conductor Insulated (mm)		
3.	Type of Conductor Insulation		
4.	No. of Conductor in parallel.		
5.	Base Conductor in parallel.		
6.	Current density (A/mm ²)		
7.	Rated volts per phase (volts).		
8.	Turns per phase (T)		
9.	Type of winding.		
10.	No. of discs (Nos.)		
11.	No. of turns/disc.		
12.	Inside diameter (mm)		
13.	Outside diameter ((mm)		
14.	Winding depth (mm)		
15.	Winding Length (mm)		
16.	Gap between disc (mm)		
17.	No. of spacers in one circle.		
18.	Size of the spacer (mm)		
19.	Length of mean turn in meter.		
20.	Weight of winding (Kg/each) (Weight of winding includes the weight of insulated conductor, spacers, runner & other insulations as has been complete 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 H.V. & L.V. & Stabilising (Tertiary) Winding (Details like thickness (mm), length (mm), type of insulation etc to be mentioned).		
4.	Between windings to top yoke (Details as		

	above to be mentioned) .		
5.	Between windings to top 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:-

No. of steps	1	2	3	4	5	6	7	8 etc.
Width in mm								
Stack in mm								
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 weight=
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.

ANNEXURE-IV

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

[FOR CONDUCTING TESTS AS PER CLAUSE 18.1 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.	In spite of imposed limitations whether the particular meter/ equipment can still be used” Justify its use for corresponding during test(s)	Remarks
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.

Signature of the Tenderer with seal & date.

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



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.	± 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 hard wares 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 martial 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).	$50 \pm 5 \%$	$50 \pm 5 \%$	$50 \pm 5\%$	$50 \pm 5\%$
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 coordination 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.

ANNEXURE –C.

CALIBRATION STATUS OF TESTING EQUIPMENTS AND INSTRUMENTS/METERS.

Na	Meters	Date	Due	Name	Whether	Whether	Whether	Whether the	Whether	Inspite of	Rema
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me of the test.	and equipment s required for the corresponding test with range accuracy make and Sl. No.	of Calibr ation.	date of Calibr ation.	of the Calibra ting Agency	Calibrat- ing Agency is Govt. Approv- ed.	documents relating to Govt. Approval of the cali- brating Agency furnished ?	the meters/eq- uipment fulfill the accuracy class as per calibration report	calibrat- ing agency has put any limitation towards the use of the particular meter/equipm ent. If yes, state the limitations.	green sticker or blue sticker or yellow sticker has been affixed on the body of the particular equipmet/meter. State the colour of the affixed sticker.	imposed limitations , whether the particular meter/equi pment can still be used? Justify its use for correspond ing test(s).	rks
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

220,132 & 33 KV IVT

&

400,220 & 132 KV CVT

TECHNICAL SPECIFICATION
FOR
**220 KV, 132KV, 33KV INDUCTIVE VOLTAGE
& 400 KV,220KV,132KV CAPACITIVE VOLTAGE
TRANSFORMERS WITH METERING WINDING OF
ACCURACY CLASS (0.2)**

I- 220KV IVT

II-132KV IVT

III-33KV IVT

IV-400 KV CVT

V-220KV CVT

VI-132KV CVT

TECHNICAL SPECIFICATION FOR 220 KV, 132KV, 33KV INDUCTIVE & 400 KV,220KV, 132KV CAPACITIVE VOLTAGE TRANSFORMER

1.0 SCOPE :

Voltage transformers shall be supplied with common marshalling box in a batch of 3 CVT's/ IVT's along with terminal connectors and other fittings for providing necessary inter phase and control room interconnections.

The design of capacitor/Inductive voltage transformers shall be such that its accuracy shall not be affected by the presence of pollution on the external surface of its insulators.

The voltage transformer shall operate satisfactorily in system with high **X/R** ratio.(Tp=100ms)

Voltage transformer tanks along with top metallics shall be galvanised and painted to required shade stipulated under relevant sections of the specification.

1.1 This specification provides for the design, manufacture, assembly inspection and testing at the manufacturer's works, packing and delivery FOR [Destination] of outdoor mounted type, single phase, single unit type Inductive voltage transformers for 220 KV, 132KV & 33KV systems, & Capacitive Voltage Transformers for 400 kv,220kv, 132KV system to be used for voltage indication, supply of potential to tariff meters, relays for feeder protection in Grid Sub-stations of OPTCL, Orissa.. 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 33KV, 132KV, 220KV IVTs &220kv, 132KV 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) Guaranteed Technical Particulars. - [Vol-III]
- (iv) Calibration status of testing equipment and meters/Instruments. - [Annexure-B]
- (vi) Check list towards Type Test Reports.- [Annexure-C]

N.B.:- Annexure-A,B & ,C 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.

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.

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.

SECONDARY TERMINAL BOX:-

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

1.2.2 All secondary terminals shall be brought out in a compartment on one side of each IVT for easy access. The exterior of this terminal box shall be Aluminum extruded sheets.

1.2.3 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.

1.2.4 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.

1.2.5 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.

1.2.6 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.

1.2.7 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.

Polarity shall be indelibly marked on each primary and secondary terminals.

1.3 The IVT shall be filled with oil under vacuum 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 despatching the IVT. The method, adopted for hermetic sealing shall be described in the offer.

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

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

1.6 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.

1.7 **PRIMARY WINDING:-**

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

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. Each 220KV IVT & 132KV IVT will have two secondary windings, protection-150VA; –Metering-150VA –burden at 0.8 lagging power factor and rated voltage of 110V/1.732V for protection and 110/1.732V for metering winding. 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. 33KV IVT will have two secondary winding of 75 VA burden at 0.8 lagging power factor and rated voltage 110/1.732 volts(one metering and one protection winding).

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 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) MCB & 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 unfavourable 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.
- 7.18.8 TERMINAL CONNECTORS:- All the IVTS shall be provided with bimetallic solderless clamp type, rigid type terminal connectors, suitable for ACSR Moose Conductor for 220KV IVT & CVT ACSR .MOOSE /MOOSE Conductor for 132KV, 33KV 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 liner 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 MCB and 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 400kv, 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, turning 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 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.
- 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 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 out door 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 un-desirable 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 contractors should be suitable for ACSR MOOSE,/' ZEBRA'(as per requirement) Conductor, complying to Cl.No.A.7.18.8 of this specification.

8.. TESTS:-

- 8.1 Type Tests:- The offered 220KV, 132KV & 33KV Inductive voltage transformer &400KV,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, 132KV & 33KV IVT:

- (a) Temperature rise test.
- (b) Short circuit withstand capability test.
- (c) Lightning Impulse Test.
- (d) High Voltage power frequency wet withstand voltage tests.

- (e) Determination of errors.
- (f) IP-55 Test on secondary Terminal Box.

N.B.:- [I] The dielectric type tests should have been carried out on the same transformer.

- (ii) After the IVT was subjected to the dielectric tests, it should have been subjected to all routine tests as per relevant standards.
- (iii) For Temperature Rise Test, the test must have been made with the appropriate rated burden, connected to each secondary winding.

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 400 KV, 220KV, 132KV IVT & 220KV & 132KV CVT.
- (d) Power frequency withstand tests on secondary windings/Low voltage terminal of the capacitor divider for 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 400 KV,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] Designation.
- [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 tender without complete information as asked for in the above Specification is likely to be rejected.

CVT's 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 means of a RF choke/reactor suitable for effectively blocking the carrier signals 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 utilised. 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. 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. Voltage transformers should be thermally and dielectrically safe when the secondary terminals are loaded with the guaranteed thermal burdens. The accuracy of the metering winding (0.2) shall be maintained throughout the entire burden range up to 100 VA/100 VA/1100 VA for 420kV CVT's on all the three windings without any adjustments during operation.

Constructional features

420 KV CVT's shall be suitable for mounting on support structure of made out of preferably lattice or tubular GI pipe of nominal bore of 300/200 mm.

Access to secondary terminals shall be possible without any danger of access to high voltage circuit. Voltage transformers shall be hermetically sealed units.

A protective surge arrester/spark gap shall be provided to prevent breakdown 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 alternate arrangement, Bidder shall bring out the details in the Bid.

The wiring diagram for the interconnection of the three single phase CVT's shall be provided inside the marshalling box in such a manner that it does not deteriorate with time. The wiring diagrams shall be fixed

The primary and secondary windings of voltage transformers shall be constructed from high purity, annealed, high conductivity copper meeting the requirements of IEC 28.

The VT secondary terminals shall be brought out into 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 stranded copper conductor cable.

All terminals shall be clearly marked to facilitate connection of secondary wiring.

Secondary fuses or MCB's shall be provided on or adjacent to each voltage transformer, located such that they are accessible while the primary is live and shall be provided with labels indicating their function and their phase colours. Voltage transformer 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 voltage transformer.

Where voltage transformers are supplied which are, or may be, connected to different sections of the busbar, it shall not be possible for the voltage transformer secondary circuits to be connected in parallel.

An auxiliary switch or relay shall be provided in each phase of the secondary circuit of the synchronising and metering voltage supply connections to break the circuits automatically as soon as the circuit breaker is opened.

To prevent ferro resonance, suitable damping devices shall be provided for connection to the transformer secondaries.

Voltage transformers shall meet the requirements given in this section of the Specification.

The creep age and flash over distances of the high voltage insulator shall be suitable for the outdoor service conditions specified in the Schedules.

Oil Filled voltage transformers

The following facilities shall be provided for oil filled voltage transformers:

- Visual oil level indicator of prismatic or other or means of determining the position of the diaphragm or bellows seal visible from ground level.
- Oil drain cock and sampling valve where applicable.

Requirement Of 420kv Capacitor Voltage Transformer

Particulars	Parameters		
Rated primary	420kV		
Type	Single phase capacitor voltage transformer		
No. of secondaries	3		
Rated voltage factor	1.2 continuous 1.5 for 30 seconds		
Phase angle errors	±20 minutes		
Capacitance(pF)	4400/8800+10% ,-5%(as per applicable)		
Voltage Ratio $\frac{kV}{V}$	Secondary core Nos.		
	Core-1 $\frac{400/\sqrt{3}}{110/\sqrt{3}}$	Core-2 $\frac{400/\sqrt{3}}{110/\sqrt{3}}$	core-3 $\frac{400/\sqrt{3}}{110/\sqrt{3}}$
Application	Protection	Protection	Metering and instrumentation
Accuracy	3P	3P	0.2
Output burden(VA) minimum*	50	50	50

*The bidder shall also estimate the requirement of burden and offer the same as an alternative for the Employers consideration.

REMARKS :

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.

APPENDIX – I.

TECHNICAL REQUIREMENTS FOR 400 KV,220KV, 132KV & 33KV INDUCTIVE VOLTAGE TRANSFORMERS &400 KV,220KV, 132KV CAPACITIVE VOLTAGE TRANSFORMER.

Sl. No	Particulars.	Description.				
		400 KV/220KV CVT	220KV IVT	132KV CVT	132KV IVT	33KV IVT
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 porcelain type.	Single phase,50Hz, oil filled, self cooled, Hermetically sealed, outdoor porcelain type.
2	Nominal system voltage.	400 KV/220KV	220KV	132KV	132KV.	33KV.
3	Highest system voltage.	420 KV/245KV	245KV	145KV	145KV.	36KV
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.	3 [three] Protection & metering.	2 (two) Protection & metering	3 [three] Protection & metering.	2 [two] Protection & metering.	2 (two) one protection and one Metering)
8	Rated primary voltage.	400/1.732 KV / 220/1.732 KV	220/1.732 KV	132/1.732 KV	132/1.732KV	33/1.732KV
9	Rated secondary voltage.	Winding-I-110/1.732V Winding-II-110/1.732V Winding-III-110/1.732V	Winding-I-110V /1.732V (Protection) Winding-II-110/1.732V (Metering)	Winding-I-110/1.732V Winding-II-110/1.732V Winding-III-110/1.732V	Winding-I-110V/ 1.732V (Protection) Winding-II-110/ 1.732V(Metering)	110/1.732V (Metering) 110/1.732V Protection
10	Ratio	400 KV/1.732/110V/1.732 & 220KV/1.732/ 110V/1.732	220KV/1.732/ 110V /1.732V	132KV/1.732/ 110V/1.732	132KV/1.732/ 110V/1.732V	33KV/1.732/ 110/1.732
11	Rated burden.	Winding-I (P)-50VA Winding-II (P)-50VA Winding-III(M)-50VA/0.2 class & simultaneous burden-100 VA with accu. cl-0.2	Winding-I(P)- 75VA /3P; Winding-II(M)- 75VA/0.2 class & simultaneous burden-75 VA with accu. cl-0.2	Winding-I (P)-50VA /3P; Winding-II (P)- 50VA/3P; Winding-III (M)- 50VA/0.2 class & simultaneous burden-100	Winding-I(P)- 75VA /3P; Winding-II(M)- 75 VA /0.2 & Simultaneous Burden- 75 VA with accu. cl-0.2	Winding-I(P)- 75VA /3P; Winding-II(M)- 75 VA /0.2 & Simultaneous Burden- 75 VA

				VA with accu. cl-0.2		
12	Accuracy class .	3P/3P/0.2	3P/ 0.2	3P/3P/0.2	3P/ 0.2	3P/0.2
13	Rated voltage factor at rated frequency.	1.2 continuous. 1.5 for 30 second.	1.2 continuous. 1.5 for30 seconds.	1.2 continuous. 1.5 for 30 second.	1.2 continuous. 1.5 for30 seconds.	1.2 continuous. 1.5 for 30 seconds
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.	630KV (rms)/ 460KV [rms]	460KV [rms]	275KV [rms]	275KV [rms]	70KV (rms)
17	1-minute power frequency wet withstands test voltage for primary winding.	630KV(rms)/460KV [rms]	460KV [rms]	275KV [rms]	275KV [rms]	70KV (rms)
18	1.2/50 micro second impulse withstand test voltage for primary winding	1425 KV(peak) /1050KV [peak]	1050KV [peak]	650KV [peak]	650KV [peak]	170KV (peak)
19	One-minute power frequency withstands test voltage for Secondary winding	3KV [rms]	3KV [rms]	3KV [rms]	3KV [rms]	3 KV (rms)
(ii)	Between LV(HF) terminal & earth terminal	10KV [rms] for exposed terminals & 4KV [rms] for terminals, enclosed in a weatherproof box.		10KV [rms] for exposed terminals & 4KV [rms] for terminals, enclosed in a weatherproof box.	-	
20	Class of insulation.	‘A’ or better for EMU.	‘A’	‘A’ or better for EMU.	‘A’	‘A’
21	Material of the conductor of primary and secondary windings.	Copper for EMU	Copper	Copper for EMU	Copper.	Copper
22	Fault level of the bus to which PTs will be connected.	40KA [rms].for 1 second.	40KA [rms].for 1 second.	31.5KA [rms]	31.5KA [rms].for 1second.	25KA for 1 second.
23	Minimum creepage distance.	10500mm /	6125mm	3625 mm	3625mm	900mm
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	500 micro volts.	500 micro volts.	500 micro volts.	500 micro volts.	-

	times maximum rated voltage at 1.0 MHZ.					
26	Partial discharge level.	Less than 10 piccocoulombs.	Less than 10 piccocoulombs.	Less than 10 Piccocoulombs.	Less than 10 piccocoulombs.	
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)	4400/8800 (as applicable) + 10%,-5%	-	4400/6600 + 10%,-5%(or as applicable)	-	-

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.

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 requirements 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.	Re mark
1	2	3	4	5	6	7	8	9

Signature of the Tenderer with seal and date.



ODISHA POWER TRANSMISSION CORPORATION

TECHNICAL SPECIFICATION

FOR

**220 & 48 V VOLTS LEAD ACID PLANTE & 48 V
VRLA TYPE STORAGE BATTERY ALONGWITH**

BATTERY CHARGER

I- a) 350AH/ 220 & 48 V BATTERY (FOR 132 and 220KV S/S)
b) 645 AH for 220 & 48 V BATTERY(FOR 220 KV & 400 KV S/S).
c) 48 V, 300 AH,Maintenance Free VRLA Type Battery.

II- BATTERY CHARGER SUITABLE FOR 350 AH & 645 AH for
220V & 48 V
LEAD PLANTE ACID & 48 V, 300AH VRLA Type STORAGE BATTERY

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Part – B [CHARGER]

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PART – A
TECHNICAL SPECIFICATION FOR 220 VOLTS LEAD ACID PLANTE STORAGE BATTERY

A.1. SCOPE :

A.1.1. These specifications cover the design, manufacturer, assembly, shop testing at manufacturer's works before despatch, supply and delivery at SITE and erection testing and commissioning of 220 volt lead Acid Plante Storage battery.

A.1.2. The scope of supply shall include all parts and accessories etc. which are usual and necessary for erection, operation and maintenance of the battery banks and the chargers, as specified, above though not individually and specifically stated or enumerated.

A.2.0. STANDARDS :

2.1. The equipments shall comply in all respects with the latest edition of relevant Indian Standard Specifications except for the modifications specified herein. The equipments manufactured according to any other authoritative national / international standard which ensure an equal or better quality than the provisions of these specifications shall also be acceptable. Where the equipment offered conform to any other standard, salient points of differences between the proposed standard and the provisions of these specifications shall be clearly brought out in the tender. A Xerox copy of such standards [in English shall be enclosed with the offer].

2.2. A LIST OF RELEVANT STANDARDS IS GIVEN BELOW :

- | | | |
|--------|---------------------|---|
| [i] | IS-1652-1991 - | Specification for stationery cells and batteries, lead Acid type with Plante Positive Plates |
| [ii] | IS : 266-1993 - | Specification for Suphuric Acid. |
| [iii] | IS-6071-1986 - | Specification for synthetic separators for lead acid batteries. |
| [iv] | IS:1069-1993 - | Specification for quality tolerances water for storage batteries. |
| [v] | IS:1146-1981 - | Specification for rubber and plastic containers for lead acid storage batteries. |
| [vi] | IS:8320-2000 - | General requirements and methods of tests for lead-acid storage batteries. |
| [vii] | IS:1885-Part-8/1996 | Electro technical vocabulary-stationary cells & batteries. |
| [viii] | IEEE-485/1983 - | IEEE recommended practice for sizing large lead storage batteries for generating stations and sub-stations. |

A3.0 INSTALLATIONS :

A3.1. Equipments covered under these specifications shall be suitable for indoor installation.

A4.0 PARTICULARS OF THE SYSTEM:

A4.1. One set of 220 Volts, 350AH and 645 AH capacity battery alongwith equipments such as boost charger, trickle charger shall be sufficient to cater to the DC power requirements in the Sub-stations as proposed. The system offered should be suitable to OPTCL system.

A.5.0 GENERAL REQUIREMENTS OF THE EQUIPMENTS :

General requirement of the different components of the Battery system are given below.

A5.1 One set of 220V,350 & 645 AH lead acid type plante storage battery set is required for meeting the D.C. load requirements of indicating lamps, emergency lighting, relays, alarms, circuits breakers etc. The battery shall be kept in healthy conditions with the help of the existing float charging unit. The existing boost charger unit shall supply quick charging current to bring back the battery to fully charged conditions after it has discharged to a considerable extent while meeting the emergency load. The battery shall meet practically all the heavy current demands, as required for operation [closing and / or operating of circuit breakers, emergency lighting load and field flashing load etc). It should be noted that, the 220V batteries are to be accommodated in the Battery Room and should operate satisfactorily over the entire range of ambient temperature of 0⁰ C to 50⁰ C and relative humidity of 95%.

A.6.0. DETAILS OF SPECIFICATIONS OF PLANTE BATTERIES Type Battery:

6.1. The batteries shall be made of closed type lead acid cells with 'plante' type plates manufactured to conform to IS: 1652-1991.

6.2. CAPACITY :

6.3. The capacity of the batteries shall be as follows :

- [i] Voltage. - 220V/48 V
- [ii] Output at 27⁰ C - 350AH/550AH at 10 hrs. discharge rate.

The batteries shall normally remain under 'floating' condition with the 'trickle' charger supplying the continuous load. However, the batteries shall be capable of supplying the following loads under emergency conditions without any assistance from the chargers and without their terminal voltage falling below 200 V [90% of rated voltage]

350AH/645AH

[I] I stage [continuous]- 35A for 10 hours. ,65 A for 10 hours

[ii] Stage emergency - 15A for 3 hours for lighting.

6.4. The number of cells for the 220 V/48V batteries shall be so chosen that for the nominal floating voltage of the cells, the battery voltage shall be 237.5V/51.85V and for the minimum [discharged condition] voltage of the cells, the voltage of the battery shall not be less than 198V/43.2V, while the assigned rating of the battery bank can not lowered below its rated voltage of 220/48V volts.

A7.0 DESIGN AND CONSTRUCTION DETAILS : (For Plante Type)

7.1 **Containers** : The containers for the cells shall be of impervious, moulded transparent, plastic/glass material having heat-resisting, high strength, non-reacting and low inflammable properties conforming to IS-1146-1981. The containers shall be mounted on insulators blocks. The containers shall be of robust construction and free from flaws, bubbles or foreign matter. The surface of the containers shall have a finish substantially free from blisters, rough spots, scales, blow holes and other imperfections or deformations. The handle bars, if provided, shall be of such that sufficient sediment space shall be available and the batteries will not have to be cleared out during their normal life. Battery containers shall be subjected to type, Routine and Acceptance Tests as per the requirements of IS-1146-1981. The containers of the label attached firmly to the containers shall be marked with the information as per requirements of cl No. 2.2 of the above standard. The supplier's manufacturer's test certificates shall be submitted by the tenderer for the scrutiny of the purchaser.

7.2 **Plates** : The positive plates shall be of pure lead lamelle type with plante formation. The negative plates shall be pasted antimonial-lead Grid type so designed as to hold the active material securely in place and in firm contact with the grid during service. The plates shall be designed for maximum durability and shall not buckle during all service conditions including high rate of discharge and the fluctuation of load.

7.3 **Separators** : The separators shall be of synthetic material conforming to the latest edition of IS-6071-1986. These shall permit free flow of electrolyte and would not be affected by the chemical reaction inside the cell and shall last for indefinite time. The internal resistance factor of the separators shall assure high discharge characteristics under all operating conditions. Proper arrangement to keep end plates in position shall be furnished by the bidder alongwith his offer.

7.4 **Electrolyte** : The electrolyte shall be prepared from the battery grade sulphuric acid conforming to IS-266-1993 and shall have a specific gravity of 1.2 at 27^oC. The sulphuric acid of battery grade shall be colourless liquid. The concentrated sulphuric acid on dilution with an equal volume of distilled water shall be free from suspended matter and other visible impurities. The sulphuric acid shall meet the requirements of columns – 4 and 5 Table –1 of IS-266-1993. The requisite quantity shall be despatched in non-returnable containers suitably packed and marked as per the requirements of the above Indian Standards. The container materials and packing shall be subject to approval of the purchaser.

Sufficient quantity of distilled water conforming to IS-1069-1993 shall be supplied in non-returnable containers to correct the level of electrolyte during initial testing and commissioning. The material of containers and packing shall be subject to the approval of the purchaser.

7.5. **Plate group bar with terminals** : The plate group bar with terminals shall conform to IS-1652-1991. The positive and negative terminals shall be clearly marked for easy identification. The legs of the plates of like polarity shall be connected to the load, turned to a horizontal group

bar having an upstanding terminal post adopted for connection to the external circuit. The group bars shall be sufficiently strong to hold the plates in position.

7.6. **Buffers/spring:** Suitable buffers / springs shall be provided in the cells to keep the end plates in position. These shall have adequate length and strength.

7.7. **Cell lids :** Lids used with sealed or closed type cells shall be of glass, plastic or ebonite and shall be provided with vent plugs. Terminal post shall be suitably sealed at the lid to prevent escape of acid spray, by means of rubber grommets, sealing compound or other suitable device. The positive and negative terminal posts shall be clearly and indelibly marked for easy identification.

7.8. **Water :-** Water used for preparation of electrolyte and also to bring the level of electrolyte to approximately correct height during operation / testing shall conform to relevant standards.

7.9. **Venting device :** The venting device shall be anti splash type and shall allow gases to escape freely but shall effectively prevent acid particles or spray from coming out. There shall be two vent holes, one serving as a guide for acid level indicator for checking the electrolyte level and other to permit drawing of electrolyte samples, servicing, checking of specific gravity etc.

7.10. **Marking :** Acid level line shall be permanently and indelibly marked around on all the containers.

The following information shall be indelibly marked on the outside surface of each cell :

- [i] Manufacturer's name, type and trade mark.
- [ii] Nominal voltage.
- [iii] AH capacity at 10 hours rate with specified end cell voltage.
- [iv] Cell number.
- [v] Upper and lower electrolyte level in case of transparent containers.
- [vi] Type of positive plate.
- [vii] Type of container.
- [viii] Date of manufacture [month and year] or [week and year].

A8.0. INSTALLATION OF BATTERY :

8.1. The battery set shall be installed on wooden racks in a separate battery room non air – conditioned but ventilated. The tenderer shall offer racks and mounting insulators etc.

8.2. The cell shall be arranged on the racks in a two-tier arrangement with two rows of cells on each tier or with some other suitable arrangement depending upon the availability of space inside the battery room. The lay out shall be subject to the approval of the purchaser. The racks shall be constructed of best quality seasoned **teak wood** / with metallic stand with at least three [3] coats of anti-acid paint of approved shade and also flame proof coating. These racks shall be such that cells are located at convenient height to facilitate maintenance and they may be so constructed so as to promote free access to the floor directly beneath the rack to facilitate easy cleaning of the floor. These shall be designed and arranged in such a way that easy handling of the cells is possible while in operation. Numbering tags for each cell shall be attached on to the racks.

8.3. The tenderer shall indicate and include the proposed arrangement of the batteries and include arrangement for fixing and mounting of inter-bank, inter-row, inter-cell and tap-off connectors etc.

A9.0. CONNECTORS:

Bars tinned copper lead connectors shall be employed for Inter-cell and inter-row, inter-tier connections. However, the tee-off connection from the battery unit shall be made with acid resisting cables of suitable size. A suitable terminal box alongwith acid-resisting cable shall be provided by the tenderer for this purpose. The connectors shall preferably be of bolted type and the bolts and nuts shall be of similar material as that of connectors and shall be provided with corrosion resisting lead coating.

The connectors shall be of sufficient cross-section to withstand all the working conditions including one minute discharge rate as well as short circuit conditions.

A.10. ACCESSORIES :-

The equipments and accessories, listed below shall be furnished as part of each battery set and the price of the battery quoted shall be inclusive of these items.

- [a] Teak wood racks with three coats of anti-acid paint and flame-proof coating.
- [b] Stand insulators +5% extra.
- [c] Cell insulators +5% extra.
- [d] All Cell interconnectors and end take-offs.
- [e] Lead coated connection hardware such as bolts, nuts etc.5% extra. Or any other connector suitable for VRLA type Battery.
- [f] Cell numbering tags with fixing arrangement.
- [g] Teakwood, cable clamps with hardware.
- [h] Diluted sulphuric acid of sufficient quantity and of specific gravity according to the relevant ISS and 10% extra shall be supplied in non-returnable acid proof containers, suitable packed.
- [i] Two numbers cell testing centre-zero voltmeters 3-0-3 volts range, Accuracy class shall be 0.5 or better and resistance not less than 1000 ohms.
- [j] One number syringe type hydrometer complete with accessories and suitable for measuring SP gravity between 1.1 to 1.320 with graduation of 0.005 Sp. Gravity together with temperature correction charts.
- [k] One number floating hydrometer.
- [l] Two numbers thermo-meters having range 0-100 deg. C whose one division of the graduated scale shall represent at the most 1 degree centigrade with separate gravity correction chart.
[Accuracy of calibration shall not be less than 0.5^oC]
- [m] One number wall mounting teak-wood for hydrometers and thermo-meters.
- [n] Two numbers acid-resisting plastic jugs [2 litre capacity]

- [o] Two numbers plastic funnels.
- [p] Two numbers rubber syphone.
- [q] Two numbers rubber aprons.
- [r] Two pairs of rubber gloves.
- [s] Two pairs of rubber boots-knee height.
- [t] Two sets special tools or tools required for connecting the terminals of the batteries.
- [u] The battery terminals shall be brought out in a junction box to be mounted on the battery stands.
- [v] Ampere-hour meter[10 hour discharge rate] of 600 –1250 AH range-1 no.
- [w] Any other accessories, not specified but required for installation, satisfactory operation and maintenance of batteries for a period of 5 [five] years.

A.11.0 MAXIMUM SHORT CIRCUIT CURRENT :

The Bidder shall state the maximum short circuit current of each battery alongwith the safe duration in seconds which it can withstand. Methods, proposed to be adopted for protecting batteries from the short circuit conditions should also be stated to avoid damage to the battery and loss to the associated equipment.

A.12. VENTILATION :

The bidder shall indicate in his bid the requirements of ventilation in the battery room. The battery shall operate satisfactorily over the entire range of the temperature and humidity indicted in this specification without affecting its normal life. Bidder shall indicate the percentage reduction in battery capacity at the lowest temperature of 27 deg C. If any special ventilation requirements are necessary, the same shall be indicated.

A.13. CAPACITY :

The standard Ampere-hour capacity at ten hour rate shall be 350/550 AH with an end cell voltage of 1.85 volts/cell.

A.14. CHARGING :

The bidders shall state whether an equalising charge is recommended for the battery. If so, the equalising charge voltage, current, duration and the interval between the equalising charging shall be specified in the Data sheet. Bidder shall also indicate the requirements for boost charging.

A.15. LIFE :

The bidder shall quote in his offer the Guaranteed life of the battery when operating under the conditions specified.

A.16. INSTRUCTION MANUALS :

Eight sets of instruction manuals for installation, commissioning, charging and maintenance instruction shall have to be furnished.

A.17. TRANSPORT :

The batteries, accessories and racks etc. shall be suitably packed and transported to site.

A.18. TESTS:

A.18.1 TYPE TESTS : The bidder shall submit the test reports alongwith his offer for the following type tests, conducted on the offered samples as per relevant National Standard[s] within five years from the date of opening of the bid and test witnessed by any Government Department / Government undertaking, failing which the offer is liable for rejection.

- [a] Verification of constructional requirements.
- [b] Verification of dimensions.
- [c] Test for capacity.
- [d] Test for retention of charge.
- [e] Endurance Test.
- [f] Ampere-hour and watt-hour efficiency test.
- [g] Test for voltage during discharge.

If the type test report [s] does/do not meet the requirements as per this specification, OPTCL at its discretion may ask the supplier to conduct the above type tests [s] at the supplier's cost in the presence of OPTCL's representative without any financial liability to OPTCL

A.18.2 ACCEPTANCE TESTS : Following shall constitute the acceptance tests which shall be test witnessed by the purchaser's representative at the works of the manufacturer at the cost of supplier.

- [i] Verification of marking.
- [ii] Verification of dimensions.
- [iii] Test for capacity for 10 hours discharge rate along with the Test for voltage during discharge.
- [iv] Ampere-hour and watt-hour efficiency test.

A18.3.1 The Purchaser may at his discretion undertake test for capacity and voltage during discharge after installation of the battery at site without any extra cost.

A.18.3.2. The supplier shall arrange for all necessary equipments including the variable resistor, tools, tackles and instruments. If a battery fails to meet the guaranteed requirement, OPTCL shall have the option of asking the supplier to replace the same within 15 [fifteen] days from the date of declaring the same to be insufficient/failed / not as per the specification [s].

A.19. DRAWINGS / DOCUMENTS :

The tenderer shall submit the following drawings / documents along with his offer failing which the offer is liable for rejection.

- [a] General battery arrangement, proposed size of individual and over all dimensions along with sectional views showing all connections etc.
- [b] Pamphlets and technical literature giving detailed information of

the batteries offered.

The manufacturer shall submit the following drawings / documents in 7 [seven] copies within 15[fifteen] days from the date of issue of the purchase order for purchaser's approval. :-

- [a] Lay out details of the batteries.
- [b] OGA and cross-sectional details for battery cells.
- [c] Instruction manuals for initial charging and subsequent charging.
- [d] Technical data, curves etc.

A.20. GUARANTEED TECHNICAL PARTICULARS :

The Guaranteed technical particulars, as called for in the 'Annexure – I & II shall be furnished alongwith the tender. Any tender lacking complete information in this respect is likely to be rejected.

A.21. All deviations from the specification shall be separately listed, in the absence of which it will be presumed that the provisions of these specifications are complied with by the tenderer

**TECHNICAL SPECIFICATION
FOR
220VOLT,350Ah MF-VRLA STORAGE BATTERY**

A.1.0. SCOPE:-

A.1.1. This specification covers the design, manufacture, assembly, shop testing at manufacturer's works before despatch, supply and delivery at site and erection, testing and commissioning of 220 volt 350Ah MF- VRLA storage batteries.

A.1.2. It is the intention of the purchaser to install the most up to date type of equipment conforming to modern practices.

A.1.3. The scope of supply shall include all parts and accessories etc, which are usual and necessary for erection, operation and maintenance of VRLA batteries as specified above, though not individually and specifically stated or enumerated.

A.2.0. STANDARDS:-

A.2.1. All equipment and their accessories, covered by this specification shall be designed, manufactured and tested in compliance with the latest relevant standards, published by the Bureau of Indian Standards including those, listed at Clause 2.6 in order that specific aspects under Indian climatic conditions are taken care of .

A.2.2. The equipment and accessories for which Indian Standards are not available shall be designed, manufactured and tested in accordance with the latest standards, published by any other recognized National Standards Institution and latest publication of International Electro Technical commission [IEC].

A2.3. The equipment manufactured according to any other authoritative national / international standard, which ensures an equal or better quality than the provisions of these specifications shall also be acceptable. Where the equipment, offered conform to any other standard, salient points of differences between the proposed standard and the provisions of these specification shall be clearly brought out in the tender. A copy of such standards [in English] shall be enclosed with the offer.

A.2.4. The equipment shall conform to the Indian Electricity Rules, 1956 with latest amendments as regards safety earthing and other essential provisions specified therein for installation and operation of electrical plants.

A.2.5. All equipment shall also comply with the statutory requirements of the Government of Odisha where the equipment will be installed. Nothing shall be construed to relieve the supplier of his responsibility.

A.2.6. GOVERNING SPECIFICATION:-

The VRLA batteries and the associated chargers shall unless otherwise specified, conform to the following standards. The firms are requested to furnish the following specifications for our further reference.

i	IS-1651/1991	Specification for stationary cells batteries, leads acid type.
ii	IS-1885 [Part-8] / 1986	Electro technical vocabulary: Part- 8-Secondary cells & batteries.
iii	IS-266/1977	Sulphuric acid
iv	BS-46290 (Part-4) / 1997	British standard specification for lead acid type valve regulated sealed type batteries.
v	ANSI, IEEE STD 450/1987	IEEE recommended practice for maintenance, testing and replacement of large lead storage batteries for generating stations and sub-stations.
vi	IEC 896-2/1995	Stationary lead-acid batteries, general requirements and methods of test (part-2, valve regulated types)
vii	IS-(1146 / UI-94) / ASTM - d -29863	Plastic container for lead acid storage batteries.
viii	IS-3136-1965	Specification for polycrystalline semiconductor rectifier equipment
ix	IS-1248-1968	Specification for direct acting indicating analogue electrical measuring instruments and tier accessories. (Part - I)-1983-General Requirements. (Part - II)- 1983 - Ammeters & voltmeters. (Part-III)-1984-Accessories.
x	IS-2208-1962	Specification of HRC Cartridge fuse link up to 650V

xi	IS-2959-1966	Specification of contractors for voltages not exceeding 1000V AC or 1200V DC
xii	IS-3395-1966	Specification for monocrystalline semiconductor rectified cells and stacks.
xiii	IS-4540-1968	Monocrystalline semiconductor rectifier assemblies & equipment
xiv	IS-2147/1962	Degree of protection provided by enclosure for low voltage switchgear and control gear
xv	IS-5578/1984	Guide for marking of insulated conductors.
xvi	IS-8623/1993 [Part 1 to 3]	Low voltage switchgear and control gear assemblies.
xvii	IS-11171/1985	Dry type power transformers.
xviii	IS-11353-1985	Guide for uniform system of marking and identification of conductors and apparatus
xix	IS-13947-1993 (Part 1 to 5)	Low voltage switchgear and control gear

A.3.0. **OTHER REQUIREMENTS:-**

A.3.1. **ACCESSIBILITY AND INTER CHANGEABILITY:-**

All working parts, in so far as possible, shall be arranged for convenience of operation, inspection, lubrication and ease of replacement with minimum down time. All like parts of the equipment, furnished shall be inter changeable.

A.3.2. **QUALITY AND WORKMANSHIP:-**

Workmanship and materials shall be of good commercial quality, suitable for the purpose, intended and in accordance with the highest standards and practices for equipment of the class, covered by this specification.

A.3.3. **SAFETY**

A3.3.1. All equipment shall be complete with approved safety devices wherever a potential hazard to personnel exists and with provision for safe access of personnel to and around the equipment for operational and maintenance functions. The design shall include all necessary precautions and provisions for the safety of operating and maintenance personnel.

A3.3.2. Special care shall be taken to make enclosed equipment proof against entry of rat, lizards and other creeping reptiles, which may create electrical short circuits inside, live equipment.

A.3.3.3. Continuity of power supply is the first consideration and the design shall be such as to provide facilities to simplify inspection, testing maintenance, clearing and repair at site.

A.3.4. **SPECIAL SITE CONDITIONS:-**

A.3.4.4. The equipment with their accessories shall be designed for smooth, efficient and trouble free operation tropical humid climate for maximum temperature of 50 degree C and maximum humidity of 98 percent. Maximum temperature and maximum humidity are however not likely to occur simultaneously. De-rating of equipment shall be done for an ambient temperature of 50 degree C.

A.3.5. **PAINTING:-**

All items of equipment and materials shall be thoroughly cleaned and painted in accordance with IS Specification. The clean surface shall be given two coats of epoxy polyamide resin based red-oxide zinc-phosphate primer, deposited either by immersion or powder spray. They phosphate coated surface shall have one coat of high build epoxy resin based intermediate paint coating and two coats of air drying epoxy polyamide

enamel suitably pigmented finish paint. The colour shade for exterior parts of equipment located inside the sub-station control room building shall be as per shade No. 631. Clean and touch-up paint shall be applied at site as required.

A.4.0. **CONSTRUCTIONAL DETAILS OF VRLA BATTERY.**

A.4.1. **PLATES:**

Positive plates shall be made of flat pasted type using lead-Cadmium-antimony alloys for durability, high corrosion resistant, maintenance free, low discharge rates and long life both in cyclic as well as in the float applications.

Negative plates shall be heavy duty, durable flat plate using lead calcium ally pasted box grid. Negative plates shall be designed to match the life of positive plates and combination of positive and negative plates shall ensure long life, durability and trouble free operation of the battery. PLC Operated equipment should be deployed for preparation of paste to ensure consistency in paste quality. Conventional / manual type of plate preparation is not allowed.

A.4.2. **SEPARATORS:-**

The separator shall be absorptive glass mat type or spun glass micro porous matrix type and shall be resistant to sulphuric acid. It shall be capable of keeping all the electrolyte and shall be electrically insulated. Sufficient separator overlap and PVC shield protection to top and bottom edges of the plates is to be provided to prevent short circuit formation between the edges of adjacent plates. The uncompressed water absorption of the separator shall be at least 5 gm. of water / gm of separator material.

A.4.2.1. **REQUIREMENT OF WICKING TEST ON SEPARATORS:-**

The total wicking height shall not be less than 635 mm in 24 hours. The minimum water content at 125 mm. Height shall be at least 5 gm. of water per gm. of separator. The weight of water per gm. shall be at least 90% of the value at 125 mm when checked at a height of 450 mm.

A.4.3. **VALVE:-**

Safety valve vent plugs shall be provided in each cell. They shall be explosion resistant, self-resealing and pressure regulating type. They shall not allow gas (air) to enter into the cell but shall allow gas to escape from the cell above a certain internal pressure, which does not lead to deformation or other damage to the cell.

A.4.3.1. The vent plug used shall be explosion resistant and self re-sealing pressure regulating type. Vent plug shall be such that it cannot be opened without proper tool.

A.4.3.2. The valve shall be so designed that it operates at a pressure between 0.14 Kg / Sq. mm to 0.63 Kg / Sq. mm to release the excess gas and reseal automatically as soon as the gas pressure within the cell drops to atmospheric value.

A.4.3.3. All the cells shall be subjected to pressure test upto 0.7 Kg / Sq. mm.

A.4.3.4. The self-discharge rate at room temperature shall not be more than 5 % of the capacity of each battery per month.

A.4.3.5. Each valve opening shall be covered with flame barrier capable in preventing the ingress of flame into the cell interior when the valve opens and hydrogen / oxygen gas mixture is released.

A.4.4. **CONTAINERS AND LID:-**

A.4.4.1. The container shall be made up of a special grade polypropylene copolymer plastic material, which should be of flame-retardant.

A.4.4.2. The container shall be sufficiently robust and not liable to deformation under internal operating pressures and within the temperature range, naturally encountered, leak proof, non-absorbent and resistant to the acid with low water vapor permeability.

A.4.4.3. The container shall be enclosed in epoxy coated steel trays. The steel trays shall be so designed as to make both vertical and horizontal stacking of cells / batteries possible.

A.4.5. **LIDS / COVERS:-**

Sealed maintenance free batteries shall have polypropylene copolymer covers. The complete container along-with lid / cover shall be able to withstand without fracture for 5 hours at 25 degree Celsius at an internal pressure of 5 times the normal operating pressure as declared by the manufacturer. The complete design includes the pillar to lid

seal, which shall be designed to remain gas-tight and electrolyte-tight during the designated life of the battery.

A.4.6. **PILLAR SEAL ASSEMBLY:-**

A.4.6.1. The pillar to lid seal shall be designed to remain gas-tight and electrolyte-tight during the designated life of the unit. The terminal shall conform to Class 3.2 of BS: 6290, Part - 4 - 1987.

A.4.7. **ELECTROLYTE:-**

The electrolyte shall be prepared from the battery grade H₂ SO₄ conforming to ISS:266. The batteries shall be supplied in factory filled charged condition. All the acid will be in immobilized condition the AGM separator.

A.4.8. **WATER:-**

Water required for preparation of electrolyte shall conform to IS:1069.

A.4.9. **CONNECTORS AND FASTENERS:-**

Lead or lead coated copper connectors shall be used for connecting up adjacent cells and rows. The thickness of lead coating of connectors should be not less than 0.025 mm. The lead coating thickness shall be measured in accordance with APPENDIX-F of IS : 6848 : 1979. All the terminals and cells inter connectors shall be fully insulated or have insulation shrouds. End take off connections from positive and negative poles of batteries shall be made by single core cable having stranded aluminum / copper conductors and PVC / XPE insulation. Necessary supports and lugs for termination of these cables on batteries shall also be supplied by the supplier. All connectors and lugs shall be capable of continuously carrying the 30 minute discharge current of the respective batteries and through fault short circuit current which the battery can produce and withstand for the period declared. Bidder shall furnish necessary sizing calculations to prove compliance to the same.

A.4.10. **PLATE CONNECTIONS:-**

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

A.4.11. **NUT & BOLTS:-**

Nuts and bolts for connecting the cells shall be made of copper, brass or superior grade passivated stainless steel which should be resistant to sulphuric acid. Copper & brass shall be coated / plated with suitable materials such as Nickel / Chromium to prevent sulphation or corrosion.

A.4.12. **TERMINALS:-**

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

A.4.13. **SEAL:-**

- (i) TIG welding shall be done for post sealing.
- (ii) Additional Epoxy resin sealing shall be provided for double assurance against leakage.

A.4.14. **SUPPORTING RACKS:-**

Batteries shall be installed on MS racks to be supplied by the supplier to fit in the battery /battery charger room. Racks / trays shall be powder coated with anticorrosive paint and supplied in unassembled state. Rack / tray shall be subjected to 7 tank process before painting for protection against fungus growth and other harmful effect due to tropical environment.

The steel trays / containers shall be stackable one over the other horizontally in multi-tier arrangement. The bottom most tray shall be mounted on I-channels with 150 mm height. The positive and negative terminals shall be terminated onto the terminal plate assembly, which is fitted to one of the steel tray depending on the convenience at site.

A.4.15. **MARKING:-**

The following informations shall be legibly laid durably marked on each cell battery:-

6. Nominal Voltage.
7. Name of the manufacturer and type reference.

8. Rated or nominal capacity expressed in ampere hour (AH) with an indication of the rating expressed either as a current or as time together with the relevant final voltage of each cell.
 9. Voltage for float operation 27° C with tolerance of 1%.
 10. Cell number.
 11. Type of positive plate.
 12. Type of container.
 13. Date of manufacture (month and year) or (week and year).
- A.5.0. **MAXIMUM SHORT CIRCUIT CURRENT:-**
The bidder shall state the maximum short circuit current of each battery along-with the safe duration in seconds, which it can withstand. Complying with clause 5.5 of IEC – 896 – 2/1995. Method proposed to be adopted for protecting batteries from the short circuit conditions should also be stated to avoid damage to the battery and loss to the associated equipment.
- A.6.0. **VENTILATION:-**
The Bidder shall indicate in his bid the requirements of ventilation in the battery room. The battery shall operate satisfactory over the entire range of temperature indicated in this specification without affecting its normal life. Bidder shall indicate the percentage reduction in battery capacity at the lowest temperature of 27 Degree C. If any special ventilation requirements are necessary, the same shall be indicated.
- A.7.0. **CAPACITY:-**
The standard Ampere-hour capacity at ten hour rate shall be 200, 300 and 500 AH and end cell voltage of 1.80 volts /cells.
- A.7.1. **SELF DISCHARGE RATE OF BATTERY:-**
Self discharge rate shall be less than 0.5% of C 10 Capacity per week at 27degree C.
- A.8.0. **CHARGING:-**
The bidder shall state whether an equalizing charge is recommended for the battery. If so, the equalizing charge voltage, current, duration and the interval between the equalizing charging shall be specified in the Data Sheet. Bidder shall also indicate the requirements for boost charging.
- A.9.0. **LIFE:-**
The bidder shall quote in his offer the guaranteed life of the battery, when operating under the conditions, specified. The bidder shall also quote the change in life of the battery due to change in temperature form 27 degree centigrade in the event the batteries are required to be operated under higher temperature environment.
- A.10.0. **DESIGN VALIDATION:-**
Over the range of manufacturer's capacity, at least one capacity should have been tested and should meet the requirement of Service Life as per ANSI TI : 330 Specification. Necessary evidences maybe enclosed along-with the offer.
- A.11.0. **MAINTENANCE TOOLS & INSTRUCTION:-**
- A.11.1. One cell – testing –center-zero volt meter 3-0-3 volt range of accuracy class not less than 0.5 shall have to be supplied alongwith each of the battery sets. The resistance of the voltmeter shall not less than be 100 ohms.
 - A.11.2. Eight sets of instruction manuals for installation, commissioning and initial charging, the calculations of charging / discharge under float and boost charging and maintenance instructions shall have to be furnished.
 - A.11.3. It is mandatory for the bidder to provide with the spare relating to the batteries including cells for replacement for a minimum period of 8 years and above.
- A.12.0. **ELECTRICAL CHARACTERISTICS:-**
DESIGN SHOULD ENSURE THAT:-
- (a) Battery shall be suitable for constant current constant voltage charging.
 - (b) Nominal float voltage shall not exceed 2.25 V per cell @ 27 degree C.
 - (c) Recharging shall be done at normal float voltage.
 - (d) Charging current shall not exceed 0.15 C. Where C is the capacity in AH @ 10 hours of discharge to end cell voltage 1.80 V @ 27 deg C.

(e) Except during commissioning. Battery shall not demand boost charging at any point of time during its operation.

(f) Battery shall not demand equalizing charge at any point of time during its operation.

A.13.0. PROCESS REQUIREMENT:-

- (a) 100% cells shall be tested by Helium. I on leak tester for leak free performance. Vendor shall attach a copy of the Helium. I on tester report along with the dispatch documents.
- (b) Vendor is expected to monitor the voltage and current data of the cells during initial charge and test discharge by means of automatic data logging for traceability. Vendor shall maintain the database of the same and provide the document to the company as and when called for.

A.14.0. TESTS

A.14.1. TYPE TESTS:-

The bidder shall submit the test reports along with his offer for the following type tests, conducted on the offered samples as per relevant National Standard (s) within five years from the date of opening of the bid and test witnessed by any Government Department / Government undertaking failing which the offer is liable for rejection.

- (a) Verification of constructional requirements.
- (b) Verification of dimensions /weight.
- (c) Test for capacity.
- (d) Test for charge retention.
- (e) Endurance test.
- (f) Ampere-hour and watt-hour efficiency test.
- (g) Test for voltage during discharge.
- (h) Test for endurance under short circuit conditions.
- (i) Test for gas recombination efficiency.
- (j) Wicking test Separators.
- (k) Service Life test as per ANSITI : 330 Specification.

If the type test report (s) does / do not meet the requirements as per this specification. GRIDCO at its discretion may ask the supplier to conduct the above type test (s) at the supplier's cost in the presence of GRIDCO's representative without any financial liability to GRIDCO.

A.14.2. ROUTINE TESTS:-

All the routine tests, listed below shall be carried out on all the cells, containers. Hardware being supplied as per latest issue of BS : 6290, Part – 4. IE C89-I or IEEE – 1188 (whichever is applicable) at the cost of the supplier.

(a) Container

- (i) Verification of constructional requirements.
- (ii) Verification of marking and packing.
- (iii) High voltage tests (CI : 7.6 of IS : 1146).

(b) Cells and batteries:-

- (i) Verification of constructional requirements.
- (ii) Verification of markings.
- (iii) Verification of dimensions.

A.14.3.0. ACCEPTANCE TESTS:-

Followings shall constitute the acceptance tests which shall be test-witnessed by Purchaser's representative at the works of the manufacturer at the cost of the supplier.

1. Verification of dimensions.
Verification of marking.
3. Tests for capacities for 10 hours discharge rate alongwith the test for voltage during discharge.
Ampere-hour and watt-hour efficiency test.
5. Short circuit current test of batteries (arrangement for this shall be provided
during testing).
6. Resistance of cell / batteries.

8. Pressure of vent plug connected with battery (measuring shall be provided during testing).

9. Measurement of weight / material type and dimension of cell / racks / batteries and all other accessories as per approval of drawings / technical data submitted during tender process. All these shall be submitted in detail with the submission of tender paper.

A.14.3.1. The purchaser may at his discretion undertake test for capacity and voltage during discharge after installation of the battery at site without any extra cost.

A.14.3.2. The supplier shall arrange for all necessary equipments, including the variable resistor, tools, tackles and instruments. If a battery / battery charger fails to meet the guaranteed requirements, GRIDCO shall have the option of asking the supplier to replace the same.

A.15.0. DRAWINGS / DOCUMENTS:-

The tenderer shall submit the following drawings documents along with his offer failing which the offer is liable for rejection.

(a) General battery arrangement including proposed size of individual and over all dimensions along with sectional views showing all connections etc.

(b) Pamphlets and technical literature giving detailed information of the batteries offered.

The manufacturer shall submit the following drawings / documents in 7 (seven) copies within (fifteen) days from the date of issue of the purchase order for purchaser's approval.

(a) Layout details of the batteries with all accessories.

(b) OGA Cross-sectional details for battery cells.

(c) Instruction manuals for initial charging and subsequent charging.

(d) Technical data, curves etc.

A.17.0. TRAINING:-

The bidder shall arrange for training of at least five Telecom. engineering personnel of OPTCL on operation and maintenance of the VRLA type of batteries at free of cost. Every detail regarding the intricacies of these special type batteries need be imparted to the trainee engineers at works of the manufacturer. The bidder in their offer need intimate the duration of training. However the training must be imparted prior to the delivery of the battery sets.

A.18.0. TRANSPORT:-

The charged batteries, accessories and racks shall be suitably packed and transported to site in ready to use condition.

ANNEXURE -1A

SPECIFICATION FOR 350AH 220 VOLT MF-VRLA BATTERY SYSTEM

[To be filled in by the bidder]

SL. NO.	SPECIFICATION	CONFIRM / NOT CONFIRM
1	Maintenance free valve regulated sealed type acid battery 200,300 and 500 AH. 2V per cell [Total 24 Nos. battery cells]	
2	The cells should be assembled in stack over insulated steel rack to make 48 Volt / 200,300,400, 510 & 800AH battery system for Power Line Carrier Communication application.	
3	The steel rack will be placed over porcelain. Hard rubber insulator of 100 mm Height [approx.] to minimize leakage current to ground	
4	All the battery cells are to be assigned with number	
5	The final positive and negative terminals are to be brought to the terminal plate assembly (TPA). Suitable arrangement should be made for terminating the cables at the TPA	
6	Test for capacity of batteries should conform to IS: 1652 (Clause 11.6)	
7	The battery should be supplied with all accessories like connectors, links, S.S. nuts. Bolts and insulator etc.	
8	All the portion of connectors and adjacent steel plates are to be sleeved and insulated.	
9	Discharge test of batteries at 10 hr. rate of discharge to end cell voltage of 1.85 volt per cell to conform to the requirement of IS : 1652. Clause - 11.7 (Test for capacity) should be carried out by the supplier at the works of manufacturer and at the site. The ambient temperature at the place of installations will be considered for the calculation period of discharge.	
10	The battery should have a life expectancy of minimum 8 years at battery room ambient temperature that varies from a minimum of 20 degree centigrade during winter season and a maximum of 50 degree centigrade during peak summer. The tenderer should submit the relevant technical literature preferably in pdf form with details design calculation graph documents etc. in support of indicated life of the battery taking care of the above seasonal ambient temperature variation.	
11	The supplier should submit the documentary evidence (P.O. copy) for supply, installation and commissioning of battery capacity of 200,300,400,510 & 800 AH or higher capacity to the PLCC. Systems under any GRID Sub-stations and the same is in successful operation for a minimum period of 5.	
12	The watt-hour and ampere-hour efficiency and internal resistance value of the battery should be furnished.	
13	The supplier should show the values of internal resistance of all the cells at the time of commissioning at site and the same should confirm to the value indicated by them in their technical bid.	
14	The procedure of charging the battery before the capacity test should be furnished. The battery set will be inspected tested at works before despatch to store site.	

ANNEXURE IIA

**SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR 220 VOLT 350 AH MF-VRLA LEAD ACID STORAGE BATTERY
(TO BE FILLED IN BY THE BIDDER)**

1	Manufacturer's name and address :																																										
2	Conforming to standards.																																										
3	Type and designation as per IS.																																										
4	Manufacturer's type and designation																																										
5	Capacity of battery bank at the following discharge rates at 27°C																																										
	<table border="1"> <thead> <tr> <th>Cap. AH</th> <th>Rate of Disch. Current</th> <th>End Cell voltage</th> </tr> </thead> <tbody> <tr> <td>a. 15 minutes.</td> <td></td> <td></td> </tr> <tr> <td>b. 30 minutes.</td> <td></td> <td></td> </tr> <tr> <td>c. 45 minutes.</td> <td></td> <td></td> </tr> <tr> <td>d. 1 hour</td> <td></td> <td></td> </tr> <tr> <td>e. 2 hours</td> <td></td> <td></td> </tr> <tr> <td>f. 3 hours.</td> <td></td> <td></td> </tr> <tr> <td>g. 4 hours.</td> <td></td> <td></td> </tr> <tr> <td>h. 5 hours.</td> <td></td> <td></td> </tr> <tr> <td>i. 6 hours.</td> <td></td> <td></td> </tr> <tr> <td>j. 7 hours.</td> <td></td> <td></td> </tr> <tr> <td>k. 8 hours.</td> <td></td> <td></td> </tr> <tr> <td>l. 9 hours.</td> <td></td> <td></td> </tr> <tr> <td>m. 10 hours.</td> <td></td> <td></td> </tr> </tbody> </table>	Cap. AH	Rate of Disch. Current	End Cell voltage	a. 15 minutes.			b. 30 minutes.			c. 45 minutes.			d. 1 hour			e. 2 hours			f. 3 hours.			g. 4 hours.			h. 5 hours.			i. 6 hours.			j. 7 hours.			k. 8 hours.			l. 9 hours.			m. 10 hours.		
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l. 9 hours.																																											
m. 10 hours.																																											
6	Number of cells in the battery.																																										
7	Method of interconnection between cells.																																										
8	Maximum short circuit current of battery when short circuit is at the end of terminals																																										
9	Recommended float-charging voltage across the battery terminals (volts).																																										
10	Recommended boost charging voltage across battery terminals (volts).																																										
11	Time required for boost charging from discharged conditions (in hours).																																										
12	Recommended trickle / float charging rate																																										
13	Recommended boost charging rate.																																										
14	Trickle charging current range / cell.																																										
15	Shelf life of charged battery bank.																																										
16	Open circuit voltage of battery bank when fully charged.																																										
17	AH capacity at 10 hours rate at room temperatures of:-																																										
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20	Type of material / thickness / dimension of positive plates.																																										
21	Type of material / thickness / dimension of negative plates.																																										
22	Separators:-																																										

	<ul style="list-style-type: none"> a. Type. b. Materials. c. Thickness of separator.
23	Type of valve provided.
24	Internal resistance of each cell at
25.	Clearance in mm between.
	<ul style="list-style-type: none"> a. Top of plates and top of container. b. Bottom of plates and bottom of container. c. Edges of plates and inner surface of container.
26	Maximum ambient temperature that the cells can withstand. Without injurious effect.
	<ul style="list-style-type: none"> a. Continuously. b. Short periods (duration to be stated along with temperature).
27	Maximum number of charge / discharge cycles that the cell can withstand.
28	Ampere-hour efficiency at ten-hour discharge rate.
29	Watt-hour efficiency at ten hour discharge rate
30	Estimated life of cell under normal operating conditions (in years) % change in life of battery for change in ambient temperature 27 degree centigrade.
31	<ul style="list-style-type: none"> a. Maximum short circuit current per battery. b. Allowable duration of short circuit.
32	Short circuit current for a dead short across the Battery terminals when.
	<ul style="list-style-type: none"> a. Float at 2.1V per cell b. Boost charge to 2.75 V per cell.
33	Recommended floating voltage per cell and the Minimum variation.
34	Recommended interval at which battery should be Discharged at 10 hour rate and quick charged.
35	Recommended storage period of a fully charged battery.
36	Inter cell connector.
	<ul style="list-style-type: none"> a. Inter-cell connector furnished ? (Yes/No). b. Type of inter-cell connector (bolted or others)? c. Materials of inter cell connector.
37	Inter-row, inter tier connectors and end take- off furnished? Description. Size current rating type and material
38	Battery stack / rack.
	<ul style="list-style-type: none"> a. Outline dimensions. b. Type and material. c. Anti-acid coating type. d. Number of trays. e. Height of bottom tier from ground level. f. No. of cells which can be stacked in tray. g. Dimensions of each tray.
39	Total shipping weight of battery units.
40	A dimensional layout drawing of the battery stock / rack along with battery attached with the tender (yes /No)
41	The following characteristic curves to be furnished along with the tender (yes/No).
	<ul style="list-style-type: none"> a. Battery discharge curves at various rates between 1 minute and 10 hour rate. b. Curves showing the relation between the cell voltage and charging current, when charged at:
14.	<ul style="list-style-type: none"> Finishing rate. (ii) High starting rate. (iii) Two step charging by starting and finishing rate.

PART – B

CHARGER FOR PLANTE BATTERIES

B.1 BRIEF DESCRIPTION

Charging equipment comprising of a float charger and a Float cum boost & Float Cum Boost Charder suitable for 48 V Battery Type VRLA for Telecommunication Purpose) charger, is required to meet the D.C. power requirements of the sub-station under normal conditions, i.e., when AC auxiliary power supply is available and also to keep all the cells in the state of full charge. The float charger shall supply the continuous DC load at the bus bars in addition to keeping, the plante batteries floated in a healthy condition. In case of failure of A.C. mains or sudden requirement of additional DC power, the battery shall meet the demand as the battery shall be connected in parallel with the charger. After the battery has discharged to a considerable extent, it shall be fully recharged by the 'boost' charger unit in a short period so as to prepare it for the next emergency. Even during the 'boost' charging of the battery, the continuous DC load at the bus shall be met by the trickle-charging unit. The 'boost' charging unit shall however be provided with suitable control arrangement to function as a stand-by for float charging unit in case of necessity.

B.2 ARRANGEMENTS :

B.2.1 Trickle (Float) Charger :

The trickle charger shall have arrangement for regulation of D.C. output voltage by:-

- (i) automatic voltage regulation system.
- (ii) Shall be of thyristor control type with both 'auto/manual' control arrangement.

B.2.2. Quick (Boost) Charger :

The quick charger shall be similar type as trickle charging equipment, but shall have the following features.

- (i) Shall be of higher capacity to deliver D.C. output, as stipulated in this specification for quick charging of the plante batteries.

(ii) Shall be provided with control arrangement for 'auto/manual' current regulation features, necessary for quick charging

(iii) Shall also have 'auto/manual' voltage control arrangement for use when the charger will be utilised as a trickle charger.

B.3. The 'Trickle' and 'Quick' charger shall be self supporting cubicle type with front panels hinged and suitable for mounting instruments, incoming A.C., circuit breaker with thermal and instantaneous releases relays, contactors and control switches etc. The panels shall have access from the backside also. These cubicles shall also house transformers, rectifiers and other equipment's, accessories, as stipulated in this specification.

B.4 DESIGN AND CONSTRUCTION DETAILS:

B.4.1 The 'trickle' charger and 'quick' charger shall be complete with silicon controlled rectifier units, dry type air-cooled transformers, control electronics, smoothing filters etc. suitable for operation from $415V \pm 10\%$, $50 \text{ HZ} \pm 5\%$, 3 phase A.C. supply. The charger output shall be stabilized to $\pm 1\%$ of set value for $\pm 10\%$ input voltage variations and 0-100% load variation.

B.4.2 The battery charger shall have full-wave, Half-controlled thyristor controlled bridge rectifier circuit. The charger output voltage shall suit the battery offered. The float voltage shall be adjustable from 80% to 115% of nominal voltage. The boost voltage shall be adjustable from 80% to 135% of nominal voltage. Ripple voltage shall be less than 3% RMS voltage.

B.4.3 Each float charger shall be capable of floating each cell of the battery bank at the specified voltage and supplying specified float current continuously under normal system operation.

B.4.4 Under normal operation, the float charger shall be supplying the DC load current and at the same time trickle charge the station battery. When the battery voltage goes down considerably, automatic transfer arrangement shall be provided such that the battery is disconnected from the float charger and gets connected to the boost charger. However, when battery is on boost charge, DC load shall be fed from the float charger. In addition, means shall be provided to ensure interruption free availability of control power from the battery whenever there is a power failure irrespective of whether the battery is on boost charge or float charge.

B. 4. 5 The selection of electronic components shall be used on ambient temperature of 50 degree C. and shall be of worst-case design to ensure continuous and trouble

free service. The control electronics shall be built on plug in type glass epoxy printed circuit boards of modular design.

B. 4. 6 The maximum temperature, attained by any part of trickle charger and quick charger, when in service at site under continuous full load conditions shall not exceed the permissible limits as fixed by relevant standards and as corrected to site condition.

B. 4. 7 Charger Panel :

B. 4. 7. 1 Charger panels shall be rigid, self supporting structures, completely assembled and totally enclosed cubicle type construction, made out of structural steel members with sheet steel-coverings.

B. 4. 7. 2 The enclosure of the charger shall be made of CRCA sheet steel of thickness not less than 2 mm for load bearing members, 1.6mm for door and non-load bearing members and 3 mm for gland plates. Panels shall be offered with base frame of 3.0 mm thick CRCA sheet, painted black all around, suitable for bolting/ welding/ grouting on to the foundation. Gaskets on doors and inter panel gaskets shall be of neoprene rubber.

B. 4. 7. 3 The panel shall have hinged front and back doors with concealed type hinged locks and latches.

B. 4. 7. 4 The panel shall have adequate cross -ventilation arrangement to avoid any undue rise in temperature.

B. 4. 7. 5 All equipment' s and wiring used in the panel shall be tropicalised dust proof and vermin-proof.

B. 4. 7. 6 Power wiring for the chargers shall be done with 1.1KV grade, heavy duty, single core, stranded copper conductor PVC insulated cables or suitable sized PVC sleeved copper bus bars. Control wiring for the charger shall be done with 1.1 KV grade PVC insulated copper wires of cross section 2.5 sq. mm for all control connection. Wire of 2.5 sq. mm cross section shall be used for control bus. All control wiring shall be ferruled.

B. 4. 7. 7 Necessary terminals for grounding the panel with two separate earthings shall be arranged for bottom entry and suitable cable glands shall be provided for the cables.

- B. 4. 7. 8 Each charger panel shall incorporate all the necessary controls, Indications, interlocks, protective devices and timing features to ensure any operation.

Provision shall be made with necessary contact / relays for annunciation in the event of alternating current power failures to the charger and automatic shut down of the charger by over-voltage / current devices. Annunciation shall however be prevented when the charger is manually shutdown or when A.C. power supply is momentarily interrupted for adjustable period of 1 to 5 seconds.

- B. 4. 7. 9. The float and equaliser charging rates shall both be adjustable from the front of the charger control panel. Each charger shall be protected against any damage from over voltage/ load currents and shall be so designed that it can continuously deliver at least rated current output without operation of the protective over-load device for abnormal conditions of low battery voltage down to 175V (80%) of the rated voltage). But the chargers shall be disconnected from A.C. input supply through an over-voltage relay, if the input voltage exceeds 10% of the rated voltage of the equipment. Necessary selector switches for 'Trickle Charging' and 'Quick charging' shall be provided. There shall be 'make before break' type blocking Diodes and other equipments to be shown in the drawing or otherwise found necessary for charging or otherwise found necessary for charging the battery without increasing the voltage beyond safe value across the load shall also be supplied by the tenderer.

- B. 4. 8 The rectifier units of the chargers shall be capable of supplying an impulse load of 6/7 times its rated capacity. The trickle charger in conjunction with automatic voltage regulators shall have drooping characteristics, So as to transfer the load beyond its capacity to the battery.

- B. 4. 9 The incoming and outgoing circuits shall be provided with MCCBs with static releases for overload, short circuit and earth fault protections. The incoming power supply to the chargers will be from two sources with a facility of changeover switch. The change over facility shall be provided in the charger itself.

- B. 4. 10 The battery circuit shall be provided with HRC fuse protection over a suitably rated load break isolator switch and reverse protection circuits.

- B. 4. 11 Input volt meter and ammeter shall be of moving iron type and shall be 96 x 96 mm. Square. These meters shall be of accuracy class not less than 1.0 and shall be of flush mounting type with required PTs and CTs and selector switches. Output voltmeter and ammeter shall be moving iron type and shall be 96 x 96 mm square. The meter shall be of accuracy class not less than

1.0 and shall be flush mounting type. The ammeter shall be centre zero type for measurement of charging and discharging current from the battery.

B. 4. 12 Cluster LED lamps for indicating 'Input on' condition and 'Output on' condition, float status on / off, boost status on / off etc. shall be provided. Annunciation with audiovisual alarms shall be provided for the following.

- Input mains failure.
- Input phase failure.
- Input fuse failure.
- Rectifier fuse failure.
- Filter fuse failure
- DC over voltage
- DC under voltage
- Output fuse failure
- Charger over-load
- Earth leakage
- Alarm supply fuse failure
- Charger trip
- Output MCCB tripped
- AC under voltage
- Battery low condition

ACCEPT, TEST AND RESET push buttons shall be provided. 20% spare annunciation windows shall be provided.

B. 4. 13 : Any other item(s), not stipulated in this specification, but required for installation, operation and maintenance of the battery charger is / are included in the scope of supply without any extra charge on OPTCL.

B. 5 **TRANSPORT** : The chargers alongwith its accessories shall be suitably packed and transported to site in ready to use condition.

B. 6 **TESTS**

B. 6. 1 **Type Tests** : The bidder shall submit the test reports alongwith his offer for the following type tests conducted on the offered samples (both float charger and boost charger) as per relevant National Standard (s) within five years from the date

of opening of the bid and test-witnessed by any Government Department /Government undertaking, failing which the offer is liable for rejection.

- (a) Measurement of voltage regulation / AVR regulation
- (b) Efficiency and power factor measurement test
- (c) Temperature rises test so as to determine the temperature rise of SCR, Transformer primary, Secondary and core, Diode, capacitor, choke and cabinet etc.
- (d) Measurement of insulation resistance.
 - i) AC input to earth.
 - ii) AC input to DC output.
 - iii) DC output to earth
- (e) Test for rectifier transformer.
- (f) DC voltage current characteristic
- (g) High Voltage Tests.
- (h) Determination of regulation
- (i) Measurement of ripple
- (j) Reverse leakage test.

B. 6. 2 Acceptance Tests : Followings shall constitute the acceptance tests which shall be tested by the purchaser' s representative at the works of the manufacturer at the cost of the supplier (both for FC & FCBC) for each charger. No sampling is allowed.

- (a) Measurement of voltage regulation / AVR Regulation
- (b) Efficiency and power factor measurement
- (c) Temperature rise test so as to determine the temperature rise of SCR, Transformer primary, secondary and core, diode, capacitor, choke and cabinet etc.
- (d) Measurement of insulation resistance.
 - (1) AC input to earth
 - (2) AC input to DC output
 - (3) DC output to earth
- (e) Test for rectifier transformer (all relevant tests as per corresponding ISS)
- (f) DC voltage current characteristic
- (g) High voltage tests.
- (h) Determination of regulation.
- (i) Measurement of ripple
- (j) Tests for indications and alarms as per this specification

- (k) Tests for indicating instruments.
- (l) Determination of system set points.
- (m) Soft start test

N.B. : The supplier shall provide arrangements for monitoring the temperature across the elements, as stipulated above, continuously during the temperature rise test without disconnection of any of the temperature measuring devices across the hottest spot of each of the above elements.

All other tests, as may be necessary to ensure that all equipment's are satisfactory shall also be carried out. In addition to the above tests, manufacturer's test certificates, vendor's test certificates for different equipment's, accessories, instruments etc. shall be submitted, whenever required by the purchaser.

B.7. DRAWINGS / DOCUMENTS

The tenderer shall submit the following drawings / documents alongwith his offer failing which the offer is liable for rejection.

- (a) OGA of the battery chargers
- (b) General layout with overall dimensions
- (c) Electrical schematic diagram showing connections and controls.
- (d) Leaflets and technical literature giving detailed information of the panels offered.

The manufacturer shall submit the following drawings / documents in 7 (seven) copies within 15 (fifteen) days from the date of issue of the purchase order for purchaser's approval.

- (a) OGA of the battery chargers
- (b) General layout with overall dimensions marked alongwith sectional views showing cable entry position etc.
- (c) Rating calculations for transformer, rectifiers, diode, capacitor, inductor etc.
- (d) Detailed schematic and connection and control wiring diagram for all the equipments.
- (e) Complete bill of materials
- (f) Technical excerpts on operation.
- (g) The circuit diagram of charger including circuit diagrams of all cards to facilitate the maintenance of chargers

B. 8 SPECIAL TOOLS, PLANTS AND SPARES

The tender shall quote for recommended special tools, plants and spares, considered necessary for installation and maintenance of batteries and charges for a minimum period of 5 (five years.)

The following mandatory spares are to be quoted by the bidder in the price bid:-

- a) Voltage regulator cards- 1 No/Charger.
- b) protection card (if any)- 1 No/ Charger.
- c) Thyristor (SCR)- 2 Nos. for F.C. + 2 Nos. for B.C. / Charger.
- d) Rectifier Diode- 2 Nos. for F.C, + 2 Nos. for B, .C./Charger.
- e) Blocking Diode- 1 No. for F.C. + 1 No. for B.C. / Charger.
- f) Filter Capacitor- 1 Set/Charger.
- g) Auto-manual switch- 1 No. for F. C. + 1 No. for B.C. / Charger.
- h) Indicating LED- 10 Nos./Charger
- i) Indicating fuse (if any)- 10 Nos./Charger
- j) Input A.C. contactor- 1 No. for F.C, . + 1 No. for B.C. / Charger
- k) Rectifier H.R.C. fuses- 4 Nos. for F.C. + 4 Nos. for B.C./Charger.

B. 9 GUARANTEED TECHNICAL PARTICULARS

The guaranteed technical particulars of this specification shall be furnished alongwith the tender. Any tender, lacking complete information in this respect is likely to be rejected.

B. 10 DEVIATION FROM SPECIFICATION

All deviations from the specification shall be separately listed in the technical deviation sheet, in the absence of which it will be presumed that the provisions of these specifications are complied with by the tenderer.

**B11. GENERAL TECHNICAL REQUIREMENTS FOR BATTERY CHARGER SUITABLE FOR 220 V/48 V
LEAD ACID PLANTE BATTERY**

1	Type	Float & Float cum boost charger for 220 V & Float Cum Boost Charger for 48 V DC full wave, full controlled type.	
2.	RATINGS	<p>>220V : 350 AH Plante Battery: 35A/60A Float & Float cum Boost Charger.</p> <p>>48V : 350 AH & 550 AH Plante Battery: 35A/70A & 50A/100 : Float cum Boost Charger.</p> <p>>220 V : 645 AH Plante Battery:70/100 A Float & Float cum Boost Charger.</p>	
3.	AC INPUT		
	(a) Voltage	415VAC \pm 10%	
	(b) Frequency	50Hz \pm 5%	
	(c) Phase	3-phase-4 wire	
4.	D. C. OUTPUT VOLTAGE SETTINGS	FC	BC
	Nominal	220V/48V	220V/48V
	Float	253V/54.5V (adj. By + 20%, - 5%)	302V/66.5V (adj. By + 2%, - 5%)
5.	OUTPUT CURRENT LIMIT	35A 70 A 70 A for 48 V, 350 AH	60A (for 350AH) 100A(for 645AH)
6.	POWER CONVERSION	AC to DC by means of three phase full wave, Half controlled bridge rectifier consisting of thyristors and diodes.	
7.	VOLTAGE REGULATION AT BRIDGE OUTPUT.	\pm 1% of set value for \pm 10% Input Voltage Variations, 0-100% Load variation.	
8.	RIPPLE VOLTAGE	Less than 3% RMS without battery connected.	
9.	EFFICIENCY	More than 75% at full load	
10.	PROTECTIONS		
	(a) Input side	AC input MCCB with input ON/OFF switch and fuses, contactor (for source-1&2 with interlocking)	
	(b) Output side	DC output MCCB with output ON/OFF switch and fuses contactor.	
	(c) Protection	Current limit protection, soft start feature, surge suppressor. Fast semiconductor fuses for rectifier bridge.	
	(d) control circuit	Fuses	
	(e) Capacitor	Rectifier HRC fuses.	

	circuit		
	(f)	Over-voltage cut-back	
	(g)	Charger over load / short circuit	
	(h)	Blocking diode	
11.	CONTROLS AND SWITCHES	<p>Followings controls and switches are provided in the system</p> <p>a) AC input source MCCBs with interlocking</p> <p>b) DC output MCCB</p> <p>c) Auto/Manual float/boost mode selector switch.</p> <p>d) Float and boost voltage variable potentiometers.</p> <p>e) Manual voltage adjustment Potentiometer</p> <p>f) Test push button</p> <p>g) Reset push button</p> <p>h) Battery current adjustment potentiometers</p> <p>i) Heater' s power supply switch</p> <p>j) Socket power supply switch</p>	
12.	FEATURES	<p>The following features are provided in the systems:</p> <p>a) Soft start on DC side</p> <p>b) Class-F insulation for all magnetic</p> <p>c) Automatic voltage regulation.</p> <p>d) Automatic changeover from float to boost and vice versa based on current, drawn by battery.</p> <p>e) Filter circuit to eliminate ripple.</p> <p>f) Charger current limit</p> <p>g) Separate battery path current limit.</p> <p>h) Built-in auto phase reversal of operation.</p>	
13.	Meters	<p><u>F. C.</u></p> <p>(i) Input Voltmeter</p> <p>(ii) Input Ammeter</p> <p>(iii) Output Voltmeter</p> <p>(iv) Output Ammeter</p>	<p><u>B. C.</u></p> <p>(i) Common</p> <p>(ii) Input Ammeter</p> <p>(iii) Output Voltmeter</p> <p>(iv) Output Ammeter.</p>
		<p>Battery volt meter</p> <p>Battery ammeter</p> <p>Earth leakage ammeter</p>	
14.	Indications	<p>(i) R, Y, B Phase 'ON' lamps</p> <p>(ii) Output 'ON' lamp</p>	<p>(i) R. Y. B. phase 'ON' lamps</p> <p>(ii) Output 'ON' lamp.</p> <p>(iii) Charger 'ON' float LED</p> <p>(iv)Charger 'ON' boost LED.</p>
15.	Annunciation with audiovisual alarms.	<p>(i) AC input mains failure</p> <p>(ii) Input phase failure</p> <p>(iii) AC under voltage</p> <p>(iv) Input phase failure</p>	

		(iii) Rectifier fuse failure (iv) Output fuse failure (v) Filter fuse failure (vi) DC under voltage (vii) DC over voltage (viii) Charger trip (ix) Capacitor fuse fail (x) Output MCCB tripped (xi) Charger over load (xii) Earth leakage (xiii) DC earth fault (xiv) Alarm supply fuse failure (xv) Battery low condition.	v) Rectifier fuse failure vi) Output fuse failure vii) Filter fuse failure viii) DC under voltage ix) DC over Voltage x) Charger trip xi) Capacitor fuse fail xii) Output MCCB tripped.
Note : All the alarms shall be provided through electronic display cards. Audio alarm through buzzer, visual indication through 10 mm LEDS & alarm ackn. / reset and LED provision is through push buttons.			
16.	Operating ambient temperature surrounding the panel	0 ^o to 50 ^o C	
17.	Surrounding the panel Relative humidity.	0-95% non-condensing	
18.	<u>PANEL</u> (a) Protective grade (b) Cooling (c) Paint	(a) IP - 42 (b) Natural air-cooled (c) Smoke Grey of ISS-692 shade	
19.	<u>MAGNETICS :</u> (a) Average winding temperature rise over ambient temperature (b) Insulation class (c) Insulation breakdown voltage.	As per relevant ISS. 'F' 3 KV for 1 min withstand.	
20.	<u>CABLES</u>	1100 V grade PVC insulated copper. Ferrules shall be provided for identification of connection.	

N.B. : - Besides the above general technical requirements, all other stipulations, as enumerated in this technical specification shall be followed. Any deviation should be clearly brought out with clear explanation.

Any extra feature/ equipment / instrument as necessary for operation and performance of the battery charger for the 220V /48 V battery set as per this specification shall be provided without any extra cost to OPTCL..

**ANNEXURE – IV-A
(For Testing of Battery)
(To be filled in by the bidder)**

CALIBRATION 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 fulfil 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 the calibrating agency has put any limitation towards the use of the particular meter/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

**ANNEXURE – IV-B
(For Testing of Battery Charger)
(To be filled in by the bidder)**

CALIBRATION 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 fulfil 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 the calibrating agency has put any limitation towards the use of the particular meter/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

ANNEXURE V – A (To be filled in by the bidder) CHECK LIST TOWARDS TYPE TEST REPORTS FOR BATTERY

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 as per Spn.	Whether the Test report in complete shape alongwith	Whether the type tested Plante lead acid battery fulfills the	If the type tested battery does not fulfill the technical requirements as per this specification, whether the bidder agrees to conduct he particular type test again at their	Remarks

					drawings etc. furnished or not ?	technical requirements as per TS	own cost without any financial liability to OPTCL in the presence of OPTCL's representative within the specified delivery period	
1	2	3	4	5	6	7	8	9

Signature of the tenderer with seal & date

ANNEXURE V – B

(To be filled in by the bidder)

CHECK LIST TOWARDS TYPE TEST REPORTS FOR BATTERY CHARGER

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 as per Spn.	Whether the Test report in complete shape alongwith drawings etc. furnished or not ?	Whether the type tested battery charger fulfills the technical requirements as per TS	If the type tested battery charger does not fulfill the technical requirements as per this specification, whether the bidder agrees to conduct he 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

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Signature of the tenderer with seal