



REWA ULTRA MEGA SOLAR LIMITED BHOPAL

VOLUME –II

PART-8

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**TECHNICAL SPECIFICATION FOR SUPPLY
OF EHV EQUIPMENTS AND MATERIAL FOR
SUB-STATIONS AND FEEDER BAYS**

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PART-8

TECHNICAL **SPECIFICATION FOR** **400/220/132/33KV** **EQUIPMENTS**

(BOOK I OF III)

VOLUME-II
PART-3
SECTION - I

1.1 SCOPE OF SUPPLY AND OTHER TECHNICAL REQUIREMENT

1. SCOPE:

The scope of this specification covers supply of EHV equipments for all the above works as brought out in Bill of quantity in **Volume VI** of this section. The scope also covers erection, testing and commissioning of power transformers except their supply, supervision of Erection & Commissioning portion as the same shall be in the **MPPTCL's scope**. The Design, Engineering, Manufacture, Testing, supply on FOR destination site basis including transportation, unloading storage, erection, testing and commissioning of all the equipments / items, complete in all for each substation, covered in this package are included in the scope of the Bid specification. The details of equipments / items covered in the scope of bid documents are:-

- i) All Power Transformer 33/220 KV 100 MVA,
- ii) All EHV/HV switchgear, viz. Circuit Breakers, Isolators with & without Earth Switch, Surge Arrester / Lightning Arresters & Capacitor Banks etc.
- iii) All EHV/HV Instrument Transformers, viz., Current Transformers, Potential Transformers, Capacitive Voltage Transformers.
- iv) Control & Relay Panels with Protection System for feeders, transformers, Bus Coupler, Bus tie, etc. complete in all respect.
- v) 200 KVA, 33/0.4 KV Station transformer alongwith all associated equipments as per Bill of Quantity for LT supply.
- vi) Complete PLCC system/ Optical Fibre Communication system for speech data and Protection signal transmission with associated equipments for all 220KV lines emanating from EHV substations and specified in the Bill of Quantity and technical specification at Section-II of this Part-I of Volume-II.
- vii) LT switch gear (AC/DC Distribution Boards)
- viii) Battery & Battery Charger
- ix) Control Cable alongwith complete accessories for auxiliary supply and control cable for control panels/ RTCC panels installed in Control Room, also to marshalling box of transformers/ reactors etc.
- x) Substation structures as per approved drawings of MPPTCL, except for Circuit Breakers structures which will be as per manufacturer's design.
- xi) Bus post insulators (including requirements for wave trap) stringing hardware, clamps & connectors. Equipment terminal connectors (excluding transformers & reactors), Conductors, Aluminium Tubes, Bus Bar and Earthing material. Bay marshalling box spacers cables supporting angle etc., Channels, Cable Trays, covers junction boxes, cable trenches etc.

- xii) For complete lighting and illumination for the switchyard and peripheral lighting, illumination system shall be designed and developed by the contractor based on requirement given in the specification.
- xiii) Complete main and auxiliary earth mat network including all associated works.
- xiv) Any other equipment /material required to complete the specified scope.
- xv) The various equipments offered against this bid shall be designed, manufactured as per standards mentioned in enclosed “**APPENDIX-A**”.
- xvi) The technical specification of each equipment to be supplied by bidder has been described in Part-I, II & III of Volume-II. The bidders shall offer all the equipments (covered under the package) of reputed make as per list of preferred vendors enclosed with this section at “**Annexure-1(A) and Annexure-1(B), Volume-VI of Bid specification**”.

The provisions under this section are to supplement common requirements for material, equipments and servicers covered under various sections of Bid document. The Section-II & III Part-I of Volume-II contains technical specification for all the equipments / materials covered under the scope of bid. The bidders may, therefore, refer the relevant portion of the technical specification applicable to this bid only for the items included in the Bill of Quantity as per Annexure-2 ,Volume VI of Bid specification. The bidders shall furnish catalogues, engineering data/ technical information, design documents, drawing etc. fully in conformity with the technical specification.

2.0 STANDARDS:

2.1 Bidders may please note that all offered EHV equipments and other items shall be manufactured, tested and supplied with all guaranteed technical particulars generally conforming to meet the requirement of technical specification as brought out in Part-I,II,III of Volume-II and latest revisions of relevant standards of international electro technical commission or equivalent national standards of India with latest amendments of relevant standards rules and codes. The relevant standards are specified under “Appendix-A” of this section.

2.2 If the equipment offered by Bidders conforms to any other standards, salient points of comparison between the standards adopted and the specific standards shall be clearly brought out in relevant schedule of technical deviation. It will be sole responsibility of Bidders to prove that the salient features of offered equipment are equivalent or better than IS.

2.3 The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules Laws and Regulations of India.

2.4 The bidder shall also note that list of standards presented in this specification is not complete. Wherever necessary the list of standards shall be considered in conjunction with specific IS/IEC.

2.5 When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

2.6 The equipment conforming to standards other than specified under “**Appendix-A**” individual sections for various equipments shall be subject to

Employer's approval.

3.0 TYPE TESTS:

3.1 The offered EHV equipments should be fully type tested as per the relevant standards. In case the equipment of the type and design offered, has already been type tested, Bidder shall invariably furnish type test reports from the reputed and approved national/international laboratory/Government approved test houses to prove that specifications of EHV equipments offered conform to the relevant standard. Test certificates shall clearly indicate the type and model number etc., so that relevant details of offered EHV equipments could be verified. While submitting bids the model and type etc., shall be clearly indicated. Type test reports so furnished should not pertain to the period earlier than five years from the date of opening of Bid. In case the type tests were carried out earlier than five years, the manufacturer will have to conduct these tests before commencement of supply. In both the above cases type test certificate must be submitted with the bid. The Bidders have to submit one complete set of Type Test reports for the offered EHV equipments.

4.0 DISCREPANCY IN TECHNICAL PARTICULARS:

It has been noticed that some of the information furnished in the schedule of guaranteed technical particulars, technical questionnaire and price schedule do not match with each other. In order to avoid any discrepancy, it may be noted that for the purpose of price evaluation the details brought out by the Bidders in "Schedule-III Technical Questionnaire" will be treated as final and evaluation will be done based on the information which will be given in this Schedule-III. In case of discrepancy in regard to information given in any other table, responsibility will rest solely on the Bidder. It may please be noted that while this condition shall be applicable for the purpose of price evaluation, at the time of acceptance of Bid, the Employer will have the right to take such of the values which are advantageous to the Employer.

5.0 CLIMATIC CONDITIONS:

EHV equipments to be supplied against this specification shall be suitable for satisfactory and continuous operation in the outside switchyard under the following tropical conditions.

S. No.	Particulars	Conditions
i	Location	Out door
ii	Maximum ambient air temperature	50° Centigrade
iii	Minimum ambient air temperature	1° Centigrade
iv	Average daily ambient temperature	35° Centigrade
v	Maximum Relative humidity	95% (sometime approaches saturation)
vi	Maximum altitude above mean sea level	1000 (Meters)
vii	Average Annual rainfall	1250 (mm)
viii	Maximum wind pressure	150 Kg/m ²
ix	Isoceraunic level	90 days per year
x	Seismic level (Horizontal acceleration)	0.3 g.
Moderately hot & humid tropical climate, conducive to rust & fungus growth.		

6.0 AUXILIARY POWER SUPPLY:

6.2.1 The equipments offered under this specification shall be suitable for the following auxiliary power supplies.

a.	Power Devices (like drive motors)	400 Volt, 3 phase, 4 wire, 50 Hz, neutral grounded AC supply.
b.	AC control and protective devices, lighting fixtures, spare heaters & fractional horse power motors.	250 Volt, single phase, 2 wire, 50 Hz, AC supply with neutral grounded.
c.	DC Alarm, Control and protective devices	220 Volt DC, 2 Wire for 400KV substation
d.	DC Alarm, Control and protective devices	110 Volt DC, 2 Wire for 220 & 132KV substation

The above supply voltages may vary as below and all devices shall be suitable for continuous operation over entire range of voltages.

i.	AC supply	Voltage +10 to -25%; frequency \pm 4%
ii.	DC supply	Voltage +10% to -20%

7 MANUFACTURER'S AUTHORISATION:

The bidders shall have to submit the documentation from the manufacturer of the goods on the format specified in Section-IV, Volume-I that they are authorised to supply the goods, indicated in their bids in the Employer's country.

8. SCHEDULE OF REQUIREMENT OF ACCESSORIES ETC.:

It is obligatory on the part of bidders to furnish Schedule of Requirement of Accessories provided with equipment in his offer.

9. GUARANTEE PERIOD:

9.1 All the EHV equipments & its accessories and mandatory spares covered under the Bid shall be guaranteed for performance and quality for a period of 24 months from the date of commissioning of substation/ Additional Transformer/ Feeder bay/ Extension works.

9.2 The following conditions shall also be applicable for the contract, to be placed against this Bid:

- (a) In case any defect in the equipment/ material is found within guarantee period, the same will be replaced/ repaired by the manufacturer on free of cost basis. The replacement/ repairing will have to be organized by contractor expeditiously and preferably within one month's time.
- (b) If for the purpose of replacement/ repairs, the equipment/ material is required to be dispatched to manufacturer's works, all charges towards transportation/ insurance/ packing and forwarding will have to be borne by the contractor for to and fro dispatches.
- (c) If the equipment/ material develops defect within guarantee period after installation at site, for the purpose of replacement/ repairs, the same will have to be dismantled and taken out by MPPTCL. In such cases, actual cost of

dismantling, any other incidental cost and cost of re-erection/ re-assembly and replacement of the equipment/ material will also be recoverable from the contractor.

- (d) In case it is observed that replacement/repairs of equipment/ material is not being provided to us within reasonable period and proper response is not received from the supplier, then apart from operating Clause of Penalty (which provides for imposition of liquidated damages, risk purchase at Contractor's cost and cancellation of contract) the MPPTCL may also take suitable penal action against the contractor which may include debarring him from all future business with the MPPTCL for a period which will be at the discretion of the MPPTCL.

10.0 SUBMISSION OF DRAWINGS AND INSTRUCTION MANUALS:

Within Two months after award of contract, Contractor shall submit the drawings of all the equipments for approval. The number of drawings received for approval and final drawings, operation and maintenance manual shall be submitted in accordance with the schedule which will be indicated in the Contract. Comments/ approval on drawings shall be given by the Employer within Two months of receipt of drawings. Any fabrication work done prior to approval shall be at the contractor's risk. The contractor shall make all indicated changes in the design which are necessary to make the equipment conforming to the provisions of specification without any additional cost. Approval of the contractor's drawings shall not relieve the contractor of his obligation to meet the requirement of the specification or the responsibility for the correctness of contractor's drawings.

11.0 INSPECTION AND TEST CERTIFICATES:

11.1 All machinery, apparatus or materials supplied will be subject to inspection and approval by the Employer's representative before despatch if possible otherwise on arrival at the destination. Inspection before despatch will not however relieve the contractor of his responsibility to supply strictly in accordance with the specifications.

11.2 All machinery, apparatus and materials shall conform to provisions of any statutory acts such as the Indian Electricity Act, Indian Factory Act, the Indian Boiler Act, etc. and corresponding rules and regulations as may be applicable.

11.3 The Employer's representatives shall be entitled at all reasonable time during manufacture to inspect, examine and test at the contractor's premises the material and workmanship of the material to be supplied under this contract.

11.4 For Inspection / testing, the contractor shall intimate the Employer 15 days in advance about readiness of material as per the scheduled delivery so that action may be taken for getting the material inspected. The material shall not be despatched unless waiver of inspection is obtained or the material is inspected by the Employer's authorised representative. When the material has passed the specified tests, the Employer's representative shall furnish a certificate jointly signed by him and contractor's representative to this effect in writing to the contractor in any case. While notifying the readiness of the equipment, the routine test certificates shall invariably be sent. The material shall not be despatched unless the test certificates are approved

11.5 These test certificates should be in accordance with latest issue of the relevant Indian Standards or as approved by the order placing authority.

12.0 COMPLETENESS OF EQUIPMENT:

12.1 All the equipments covered in the Bid shall be complete in every respect with all minor fittings and accessories even though those may not be specifically mentioned in

the Employer's specification or the Bidders offer. The contractor shall not be eligible for any extra price in respect of such minor fitting and accessories which can be considered as a mandatory part of the basic equipment even though not specifically mentioned in the specification or the bid.

12.2 If any minor accessory has not been stipulated but is mandatory required for satisfactory operation of the equipment, the same shall be deemed to have been included in the prices and shall be supplied by the successful bidder without any extra cost.

12.3 The bidder may please note that it shall be sole responsibility of them to ensure that offered equipments/ materials of various manufacturers are complete with all fitting & accessories as per technical specification of equipments. The offered equipments/ materials must comply to technical requirement as per stipulation in technical specification of each equipments/ materials.

13.0 WORKMANSHIP:

All equipments /materials shall be of the best class and quality most suitable for the conditions of operation under the climate conditions as per clause no. 5.0 above for supply of equipments / materials. The workmanship shall be of the best grade and the entire construction in accordance with the best modern practice.

14.0 REPLACEMENT OF DEFECTIVE SUPPLIES:

Please note that the following conditions shall be applicable:-

- (a) In case any defect in the equipment material is found within guarantee period, the same will be replaced / repaired on free of cost basis. The replacement / repairing will have to be organized by contractor expeditiously and preferably within one month's time. It may please be noted that if repair/replacement of equipment/material is not organized within 3 months of notice of defects/failure being sent, MPPTCL shall recover the cost of such equipment from available payments/S.D. as the case may be without further notice and with such penalty as it may deem appropriate for non-compliance of contractual obligations.
- (b) All other conditions, as described under **clause 8.0, "Guarantee Period"** shall be applicable for the purpose of replacement of defective supplies.

15.0 SCHEDULE OF QUANTITIES:

The works wise break-up of quantity of equipments/materials has been given in Volume VI of bid specification. In this annexure short description of material has been given. The details of all such description are given in, Part-I ,II and III of Volume-II of respective equipment. The bidder shall refer these detailed descriptions for clarity.

All equipment/items which have been indicated in bill of quantity in **"Volume VI of bid specification"** shall be payable on unit rate basis. During actual execution, any variation in such quantities shall be paid based on the unit rate under each item incorporated in Letter of award.

Although all the quantity of equipments/materials have been included in the bid as mentioned in **"Volume VI of bid specification"** . However there may be requirement of some minor nature items required for successful erection / commissioning of bays and substations work covered under this package. Bidder should include all such items in the bid proposal sheets which are not specifically mentioned but are mandatory for the execution of the contract. Item which explicitly may not appear in various schedules and required for successful commissioning of substation shall be included in the bid price and shall be provided at no extra cost to MPPTCL.

16.0 TECHNICAL DEVIATIONS:

In case of any deviation from the requirement indicated in our technical specification then the deviation shall be mentioned explicitly and clearly for respective equipment separately for equipment/material in Schedule-XI “**Volume VI of bid specification**” . While MPPTCL may consider and accept such minor deviations which may not affect overall performance of equipment/system; it may be noted that in case of any major deviation, MPPTCL reserves the right to reject the bid without assigning any reasons.

17.0 BASIC REFERENCE DRAWINGS:

17.1 Single line diagram and general arrangements, drawings are enclosed in Appendix B of this section for reference, which shall be further engineered by the bidder.

17.2 The bidder shall maintain the overall dimensions of the substation/ site, phase to earth clearance, phase to phase clearance and sectional clearances as per enclosed drawings / relevant applicable standards.

The enclosed drawings give the basic scheme, layout of substation, substation buildings, associated services etc. In case of any discrepancy between the drawings and text of specification, the requirements of text shall prevail in general. However, the Bidder is advised to get these clarified from MPPTCL.

17.3 The auxiliary transformers of rating 200 KVA shall be used for AC, 400 V supply at sub-stations.

18.0 SPECIAL TOOLS AND TACKLE:

The bidder shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately, packed and brought on to Site.

19.0 QUALITY ASSURANCE PLAN & STAGE INSPECTION:

19.1 The successful bidder shall ensure that for the purpose of supply of equipments, the manufacturer will have to follow strict quality assurance programme, which will include thorough verification of samples of critical assemblies and accessories, verification of sources of raw materials, detailed verification of drawing & design, checking up of relevant calculations, stage inspections at various critical stages of manufacture and minor modifications consequent to such stage inspections as per our requirements and all other related requirements, which have generally been brought out in bidding documents and the detailed contract. It is expected that bidder would be very serious and prudent in meeting these requirements without any loss of time, so that supply of equipments in line with quality assurance programme is ensured within targeted schedule.

The MPPTCL reserves the right to specify various stages for stage inspections and also for manufacture of a proto type unit for inspection & testing, before according clearance for bulk manufacturing.

19.2 The bidder shall ensure that manufacturer must establish that they are following a proper quality assurance programme for manufacture of offered equipments.

The bidder shall ensure that manufacturer invariably furnish following information:-

- i. Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of manufacturers 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. Levels 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 equipment available with the manufacturer for final testing of equipment specified and test plant limitations, if any vis-à-vis type, special, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

19.3 The successful bidder shall within 30 days of award of Contract shall arrange following information to the MPPTCL.

- i. Quality Assurance Plan (QAP) with hold points for Employer's inspection. The quality assurance plans and holds points shall be discussed between the Employer and Bidder before the QAP is finalized.

19.4 The successful Bidder shall also ensure that the manufacturer submits the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

20.0 SYSTEM PARAMETERS

S. No.	Description of Parameters	400 KV System	220 KV System	132 KV System	33 KV System
1.	System Operating Voltage	400 KV	220 KV	132 KV	33 KV
2.	Maximum operating voltage of the system (rms)	420 KV	245 KV	145 KV	36 KV
3.	Rated Frequency	50 Hz	50 Hz	50 Hz	50 Hz
4.	No. of phase	3	3	3	3
5.	Rated Insulation levels				

S. No.	Description of Parameters	400 KV System	220 KV System	132 KV System	33 KV System
(i)	Full wave impulse withstand voltage (1.2/50 microsecs.)	1425 kVP	1050kVP	650 kVP	250 kVP / 170 kVP
(ii)	Switching impulse withstand voltage (250/ 2500 micro sec.) dry and wet	1050kVP	-	-	-
(iii)	One minute power frequency dry / wet withstand voltage (rms)	630 KV / 520 KV	460 KV	275 KV	95 KV/ 70 KV
6.	Corona extinction voltage	320 KV	156 KV	105 KV	-
7.	Max. radio interference voltage for frequency between 0.5 MHz & 2 MHz at 508 kV rms for 765 kV, 320 kV rms for 400 KV system, 156 KV rms for 220 KV system & 92 KV rms for 132 KV system	1000 microvolt	1000 microvolt	500 microvolt	-
8.	Minimum creepage distance @ 25 mm/KV	10500 mm	6125 mm	3625 mm	900 mm
9.	Min. Clearances				
i.	Phase to phase spacing for installation	7000 mm	4500 mm	2500 mm	1400 mm
ii.	Ground clearances from lowest live terminal of equipment from ground level	8200 mm	7000 mm	4600 mm	4000 mm
10.	Rated short circuit current /for one sec. duration	40 KA for three seconds/ one second as applicable	40 KA for three seconds/ one second as applicable	40 KA for three seconds/ one second as applicable	25 KA for three seconds/ 26.2 KA for two seconds
11.	System Neutral earthing	Effectively Earthed	Effectively Earthed	Effectively Earthed	Effectively Earthed

APPENDIX-A
LIST OF STANDARDS
GENERAL

Indian Electricity Rules, Indian Electricity Act, Indian Electricity (Supply) Act, Indian
Factories Act

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
1	IS-5	Colours for Ready Mixed Paints & Enamels	-
2	IS-335	New Insulating Oils	-
3	IS-617 (P1 to P145)	Aluminium and Aluminium Alloy Ingots and Castings for General Engineering Purposes	-
4	IS-1448 (P1 to P145)	Methods of Test for Petroleum and its Products	-
5	IS-2071 (P1 to P3)	Methods of High Voltage Testing	-
6	IS-12063	Classification of degrees of Protection provided by enclosures of electrical equipment	-
7	IS-2165 1:1997 P2:1983	Insulation Coordination	-
8	IS:3043	Code of Practice for Earthing	-
9	IS-6103	Method of Test for Specific Resistance (Resistivity) of Electrical Insulating Liquids	-
10	IS-6104	Method of Test for Interfacial Tension of Oil against Water by the Ring Method	-
11	IS-6262	Method of Test for Power Factor & Dielectric Constant of Electrical Insulating Liquids	-
12	IS-6792	Method for Determination of Electric Strength of Insulating Liquids	-
13	IS-5578	Guide for Uniform System of Marking & Identification of Conductors & Apparatus Terminals	-
14	IS-11353	Methods for Radio Interference Test on High Voltage	-
15	IS-8263	Methods of Radio Interference Test on High Voltage Insulators	-
16	IS-9924 (Part 1,2 & 4)	Low Voltage Fuses	-
17	-	High Voltage Test Techniques	IEC-60060 (Part 1 to P4)
18	-	Environmental Test	IEC-60068

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
19		Graphical Symbols	IEC-60117
20	-	Methods for the Determination of the Electrical Strength of Insulation Oils	IEC-60156
21	-	Partial Discharge Measurements	IEC-60270
22	-	Specification and Acceptance of New Sulphur Hexafluoride	IEC-60376
23	-	Radio Interference Test on High Voltage Insulators	IEC-60437
24	-	Artificial Pollution Tests on High Voltage Insulators to be used on AC Systems	IEC-60507
25	-	Common Specification for High Voltage Switchgear & Control gear Standards	IEC-60694
26	-	Guide for the Selection of Insulators in respect of Polluted Conditions	IEC-60815
27	-	Short Circuit Current – Calculation of effects	IEC-60865 (P1 & P2)
28	-	National Electrical Code	ANSI-C.1/ NFPA.70
29	-	Guide for Surge Withstand Capability (SWC) Tests	ANSI-C37.90A
30	-	Specification for Electromagnetic Noise and Field Strength Instrumentation 10 KHz to 1 GHz	ANSI-C.6321, C63.3
31	-	Techniques for Dielectric Tests	C36.4 ANSI-C68.1
32	-	Standard General Requirements and Test Procedure for Outdoor Apparatus Bushings	ANSI-C76.1/EEE21
33	-	Specification for Sound Level Meters	ANSI-S14
34	-	Drawing Symbols	ANSI-Y32- 2/C337.2
34	-	11 Gray Finishes for Industrial Apparatus and Equipment No.61 Light Gray	ANSI-Z55.
35	-	General Standards for Industrial Control & Systems Part ICSI-109	NEMA-ICS-II
36	-	Specification for CISPR Radio Interference Measuring Apparatus for the frequency range 0.15 MHz to 30 MHz	CISPR-1
37	-	Quality Assurance Program Requirements	CSA-Z299.1-1978h

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
38	-	Quality Control Program Requirements	CSA-Z299.2-1979h
39	-	Quality Verification Program Requirements	CSA-Z299.3-1979h
40	-	Inspection Program Requirements	CSA-Z299.4-1978h
EQUIPMENT-WISE SPECIFICATION			
A) 400KV, 220KV, 132KV & 33KV CIRCUIT BREAKERS:			
1	-	Specification for alternating current circuit breakers	IEC-62271-100-2001
2	-	Specification and acceptance of new supply of SF6	IEC-376
3	IS-1885	Electro technical vocabulary	IEC-50
4	IS-375	Marking and arrangement for switchgear bus-bar, main connections and auxiliary wirings.	-
5	IS-2147	Degree of protection provided for enclosures for low voltage switchgear and control gear.	-
6	IS-325	Specification for three phase induction motors.	-
7	IS-13947	LV Switchgears & control gear.	IEC-947
8	IS-2629	Recommended practice for hot dip galvanizing of iron and steel.	-
9	IS-5	Colour for ready mix paints.	-
10	IS-2099	High voltage porcelain bushings.	IEC-137
11	IS-5561	Electric Power connectors	-
12	IS-2516	Specification for circuit breaker	-
13	-	Synthetic Testing of High Voltage alternating current circuit breakers	IEC-6047
14	-	Pressurised hollow column insulators	IEC-61264
15	IS-13118	Specification for alternating current circuit breakers	IEC-62271-100-2001 & IEC 60056 or latest amendment thereof
B) 400 KV, 220 KV, 132 KV & 33KV C&R PANELS:			
1	IS-3842	Application guide for electric relays for AC system	-
2	IS-3231, (P-3) 3231	Electric relays for power system protection.	-
3	IS-1885	Electric technical vocabulary electrical relays and Electrical power system protection	IEC 50
4	IS-1248/2419	Indicating instruments	-

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
5	IS-722, IS 1248	Energy meters, control switches (LV switching)	-
6	IS-2705	Current transformers.	IEC 186
7	IS-3156	Voltage transformers.	IEC 185
8	IS-4237	General requirements for Switchgears and control gear for voltage not exceeding 1 kV.	-
9	IS-375	Marking and arrangements for Switchgears, busbars main connection and auxiliary wiring,	-
10	IS-8686	Specification for static protective relays.	-
11	IS-4483	Preferred panels cut out dimensions for relays	-
12	IS-13947	LV Switchgears & control gear.	IEC-947
13	IS-5	Colour Shade.	-
14	IS-2147	Verification of degree of protection	
15	-	Protocol for communication for numerical relays	IEC61850
16	-	Recommendations for direct acting indicating analogue electrical measuring instruments and their accessories	IEC-60051 (P1 to P9)
17	-	Electrical relays	IEC-60255: (P1 to P23)
18	-	Dimensions of mechanical structures of the 482.6 mm (19 inches) series	IEC-60297: (P1 to P4)
19	-	Expression of the performance of electrical & electronics measuring equipment	IEC-60359
20	-	Symbols for alternating-current electricity meters	IEC-60387
21	-	Man machine interface (MMI) actuating principles	IEC-60447
22	-	Class 0.5, 1 and 2 alternating current watt hour metres	IEC-60521
23	-	Modular plug-in unit and standard 19 inch rack mounting unit based on NIM standard (for electronic nuclear instruments)	IEC-60547
24	-	Screw threads	ANSI-81
25	-	Bolts and nuts	ANSI-B18
26	-	Relays, Station Controls etc.	ANSI-C37.1
27	-	Manual and automatic station control, supervisory & associated telemetering equipment	ANSI-C37.2

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
28	-	Relays and relay systems associated with electric power apparatus	ANSI-C37.2
29	-	Requirements for electrical analog indicating instruments	ANSI-C39.1
(C) BATTERY SETS			
1	IS: 266-1977	Specification for sulphuric acid	-
2	IS: 652-1960	Specification for wooden separators for lead acid storage batteries	
3	IS: 1069-1964	Specification for water for storage batteries	-
4	IS: 1070-1960	Specification for water, distilled quality.	-
5	IS: 1146-1981	Specification for rubber and plastic containers for lead acid storage batteries.	-
6	IS: 1651-1979	Specification for stationary cells and Batteries lead acid type (with tabular positive plates).	-
7	IS: 3116-1965	Specification for scaling compound for lead acid batteries.	-
8	IS: 6304-1980	Specification for stationary batteries leads acid type with pasted positive plates.	-
9	IS: 8320-1976	General requirement and methods of tests for lead acid storage batteries.	-
10	IS:1652	Stationary cells and batteries, Lead-acid type (with plates positive plates)	-
11	IS:6071	Synthetic separators for lead –acid batteries	-
12	IS:1248	Indicating instruments	
13	IS:10918	Vented type nickel cadmium batteries	
14	-	Vented type nickel cadmium batteries	IEC:60623
15	-	Secondary cells & batteries-sealed Ni-Cd rechargeable single cell	IEC:60622
16	-	Secondary cells & batteries-sealed Ni-Cd rechargeable single cell	IEC:60623
17	-	Stationary lead acid batteries-vented type general requirements & method of tests	IEC:60896-11

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
18	-	Recommended practices of sizing of lead acid batteries	IEEE-485
19	-	Sizing of Ni-Cd batteries	IEEE-1115
20	-	Recommended practices for design & installation of VRLA batteries	IEEE-1187
21	-	Recommended practices for design & installation of VRLA batteries	IEEE-1188
22	-	Guide for selection of VRLA batteries	IEEE-1189
23	-	Recommended practice for design and installation of storage batteries	IEEE-484
24	-	Specification for stationary cells and batteries lead acid type with Plante positive plates.	IS:6071
25	-	High Performance Plante Cells	BS:6290(Part 2)
D) BATTERY CHARGER:			
1	IS: 1651	Specification for stationary cells and batteries, lead-acid type (with tubular positive plates)	-
2	IS: 3895	Specification for Rectifier equipment in general.	-
3	IS: 9224	Specification for HRC fuses.	-
4	IS: 1248	Indicating instruments.	-
5	IS: 2147	Degree of protection for cubicles.	-
6	IS: 375	Specification for wiring.	-
7	IS: 4540	Monocrystalline semiconductor rectifier assemblies and equipment.	-
8	IS: 6619	Safety code for semiconductor rectifier equipment.	-
9	IS: 2026	Transformers.	-
10	IS: 2959	A.C. Contactors for voltage not exceeding 1000V.	-
11	IS: 4237	General requirement for switchgear and control gear for voltage not exceeding 1000V.	-
12	IS: 4064	Air breaks switches and fuse combination units.	-
13	IS: 6005	Code of practice for phosphating of Iron and Steel.	-
14	IS: 5	Colour for ready mix paints.	-
15	IS: 5921	Printed circuit Board.	-
16	IS: 249	Printed circuit Board.	-
17	IS: 5578	Guide for making insulated conductor.	-

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
E) AC/DC BOARDS:			
1	IS-4237	General requirements for switchgear & control gear for voltage not exceeding 1000V.	-
2	IS-2147	Degrees of protection provided by enclosures for low voltage switchgear and control gear.	-
3	IS-375	Marking and arrangement for switchgear busbars main connection and auxiliary wirings.	-
4	IS-2208	HRC Cartridge fuse links upto 650V	-
5	IS-1248	Electrical Indicating Instruments.	-
6	IS-1554	PVC Insulated electrical cables.	-
7	IS-2516	AC Distribution Board breakers.	-
8	IS-2705	Current Transformers.	-
9	IS-3156	Voltage Transformers.	-
10	IS-4047	Heavy duty-Air break switches & composite units & fuses for voltage not exceeding 1000V.	-
11	IS-2208	HRC fuses	-
12	IS-13947 (Part-3)	Air break switches, air break disconnectors & fuse combination units for voltage not exceeding 1000V AC or 1200V DC	-
13	IS-3231	Electrical relays for power system protection	-
14	-	Recommended design for installation design and installation of large lead storage batteries for generating stations and substations	IEEE-484
15	-	Sizing large lead storage batteries for generating stations and substations	IEEE-485
F) JUNCTION BOXES:			
1	IS-4237	General requirements for switchgear & control gear for voltage not exceeding 1000V.	-
2	IS-2147	Degrees of protection provided by enclosures for low voltage switchgear and control gear.	-
3	IS-375	Marking and arrangement for switchgear busbars main connection and auxiliary wirings.	-
4	IS13947	Standard for manufacture of Junction boxes	-

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
5	IS:9537	Rigid steel conduits for electrical wiring	-
6	IS:3480	Flexible steel conduits for electrical wiring	-
7	IS:2667	Fittings for rigid steel conduits for electrical wiring	-
8	IS:3837	Accessories for rigid steel conduits for electrical wiring	-
9	IS:4649	Adaptors for flexible steel conduits	-
10	IS:5133	Steel and cast iron boxes	-
11	IS:2629	Hot dip galvanizing of iron & steel	-
G) LIGHTING FIXTURES:			
1	IS:1913	General and safety requirements for electric lightning fittings	-
2	IS:3287-1965	Industrial Lighting fitting with plastic reflectors	-
3	IS:1777-1978	Industrial Luminaries with metal reflectors	-
4	IS:9974-1981 (Part-I & II)	High Vacuum Sodium Vapour Lamp	-
5	IS:8019	Vitreous enameled reflectors for use with illuminating device.	-
6	IS:3528	Water proof electric lighting fittings	-
7	IS:4012	Dust proof electric lighting fittings	-
8	IS:4013	Dust tight proof electric lighting fittings	-
9	IS:10322	Industrial lighting fittings with metal reflectors	-
10	IS:10322	Industrial lighting fittings with plastic reflectors	-
11	IS:2206	Well glass lighting fittings for use under ground in mines (non- flameproof type)	-
12	IS:10322	Specification for flood light	-
13	IS:10322	Specification for decorative lighting outfits	-
14	IS:10322	Luminaries for street lighting	-
H) STATION TRANSFORMER 200 KVA, 33/0.4 KV			
1	i) Latest revision of IS 2026 & IS 1180 ii) IS 2099 iii) IS 335	For Transformer manufacturing & Testing etc. For Transformer bushing For Oil	REC specification, CBIP publication no. 275

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
I) CURRENT TRANSFORMERS & POTENTIAL TRANSFORMERS FOR 400 KV, 220 KV, 132 KV & 33KV			
1	IS:2165	Insulation Co-ordination for equipment of 100 KV and above.	-
2	IS:2705 (I to IV)	Current Transformers	IEC-60044-1
3	IS:2099	High voltage porcelain Bushings	IEC-60137
4	IS:3347	Dimensions of porcelain transformer bushings.	-
5	IS:2071	Method of High Voltage Testing	-
6	IS:335	Insulating oil for transformers and switchgears	-
7	IS:2147	Degree of protection provided by enclosures for low voltage, switchgear and control.	-
8	-	Partial Discharge Measurement	IEC-270
9	-	Instrument Transformer measurement of PDs	IEC-60044-4
10	-	Insulation co-ordination	IEC-171
11	-	High voltage testing techniques	IEC-60
12	-	Method for RIV test on high voltage insulators	IEC-8263
13	-	Indian Electricity Rules 1956.	-
14	IS:3156	Voltage Transformers	IEC-60044-2
15	-	First supplement to IEC Publication 186	IEC:186A
16	IS:5561	Electrical Power Connector	-
17	IS:4800	Enamelled Round Winding Wires	-
18	IS:2629	Recommended practice for hot dip galvanising of Iron & Steel	-
19	-	Fluids for electrotechnical applications - Unused mineral insulating oils for transformer & switchgear	IEC-296
20	-	Guide for selection of Insulators in polluted conditions	IEC-815
J) LIGHTNING ARRESTERS FOR 400 KV, 220 KV, 132 KV & 33KV			
1	-	Metal Oxide Surge Arrestors without gap for AC System	IEC-60099-4
2	IS: 3070: (Part-III) 1993	Specification for Lightning Arresters for alternating current system	-
3	IS: 4759	Hot dip zinc-coating on structural steel and other allied products	-
4	IS: 2633	Method for testing uniformity of coating on zinc coated articles	-

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
5	IS: 5621	Specification for large hollow porcelain for use in electrical installation	-
6	IS: 2147	Degree of protection provided by enclosures for low voltage switchgear and control	-
7	IS: 5561	Specification for Electric Power Connector	-
8	-	Indian Electricity Rules, 1956	-
K) ISOLATORS FOR 400 KV, 220 KV, 132 KV & 33KV VOLTAGE			
1	IS :9921	Alternating current isolators (disconnectors) & earthing switches	IEC-60129
2	IS:2544	Insulators	-
3	IS:2147	Degree of protection provided by enclosure	-
4	IS:4691	Degree of protection provided by enclosure	-
5	IS:4722	Rotating electrical machines	-
6	IS:2629	Recommended practice for hot dip galvanizing of iron and steel	-
7	IS:4759	Hot dip galvanization coating on structural steel	-
8	IS:2633	Method of testing weight thickness and uniformity of coating on fasteners.	-
9	IS:1573	Electroplated coating of zinc or iron and Steel	-
10	IS:5561	Electric Power Connectors	-
11	IS:3033	Spring washers	-
12	IS:2016	Plain washers	-
13	--	Indian Electricity Rules 1956.	-
L) SOLID CORE INSULATORS FOR 400 KV, 220 KV, 132 KV & 33KV VOLTAGE			
1	IS:2165	Insulation Co-ordination for equipment of 100 KV and above	-
2	IS:2544	Insulators	-
3	IS:5350	Post Insulators	-
4	-	Test on Post Insulators of nominal voltage greater than 1000 Volt	IEC – 168
5	-	Indian Electricity Rules 1956	-
M) 400KV & 220 KV CAPACITIVE VOLTAGE TRANSFORMERS			
1	IS- 3156	Voltage Transformers	-
2	IS- 9348	Coupling Capacitor	-
3	-	CVT/Coupling Capacitor	IEC- 358
4	-	Voltage Transformer	IEC- 186

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
5	-	Instrument Transformer Measurement of partial discharge	IEC- 6044-4
6	-	Coupling Capacitor and Capacitor Dividers	IEC-60358
N) 400 KV, 220 KV & 132 KV WAVE TRAPS			
1	IS- 8792	Line Trap For AC Power System	-
2	IS- 8793	Method For Test Line Trap	-
3	-	Line Traps for a. AC Power Systems	IEC-60353
4	IS-3070	Lightning Arresters for AC system	-
O) POWER LINE CARRIER COMMUNICATION EQUIPMENTS			
1		Single side band Power Line carrier terminals	IEC -60495
2	IS- 9482	Carrier Cabinet	IEC-60495
3	-	Carrier Cabinet	IEC-834-1
4	-	Protection Coupler	-
5	-	Guide on power line carrier	CIGRE
6	IS- 8997	Coupling Device for PLC system	-
7	IS- 8998	Methods of test for Coupling Device for PLCC System	-
8	-	Coupling Device for power line carrier systems	IEC- 60481
8	-	Impulse Voltage withstand test	IEC-255-4
9	-	High Frequency disturbance susceptibility test	IEC-255-22-1
10	-	Electrostatic discharge susceptibility test	IEC-801-2
11	-	Radiated susceptibility	IEC-801-3
12	-	Fast Transient Susceptibility Test	IEC-801-4
13	-	Power Line Coupling Voltage Transformers	ANSIC92.2
14	-	Planning of (Single side-band) power line Power Line Carrier Systems	IEC 60683
P) COAXIAL CABLE			
1	IS-11967	Coaxial Cable	-
2	IS- 1554	Armoured Cable	-
3	-	Telephone Cable	GR/WIR-06/03
Q) SUBSTATION SWITCHYARD STRUCTURES			
1	IS:209-1992	Zinc ingot- Specification.	-
2	IS:802-Part-II-1978	Code of practice for use of structural steel in overhead transmission line towers – Part – II: Fabrication, Galvanizing, Inspection & packing.	-

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
3	IS:1363 (Part-III)-1992	Specification for Hexagon head bolts, screws and nut for product grade – “C” Part-3 : Hexagon nuts (size range M5 to M64)	-
4	IS:1367-1979	Technical supply conditions for threaded fasteners (1 st Revision).	-
5	IS:1367 (Part-III)-1991	Technical supply conditions for threaded steel fasteners – Part-3: Mechanical properties of fasteners made of carbon steel and alloy steel – bolts, screws & studs.	-
6	IS:1367 (Part-VI)-1994	Mechanical properties and test method for nuts with specified proof loads.	-
7	IS-1367 (Part-XIII)-1983	Technical supply conditions for threaded steel fasteners – Part-XIII: Hot dip galvanized coating on threaded fasteners.	-
8	IS:1573-1991	Specification for electroplated coating of zinc on Iron & steel.	-
9	IS:1586-1968	Methods of Rock well hardness test (‘B’ & ‘C’ scales) for steel (first revision).	-
10	IS:1852-1991	Rolling and Cutting Tolerances for Hot Rolled Steel Products.	-
11	IS:2016-1992	Specification for Plain Washers.	-
12	IS:2062-1992	Hot Rolled low, medium and high tensile structural steel.	-
13	IS:2614-1969	Method for sampling of fasteners.	-
14	IS:2629-1990	Recommended practice for hot dip galvanizing of iron and steel.	-
15	IS:2633-1992	Method of testing uniformity of coating of zinc coated articles.	-
16	IS:3063-1994	Fasteners- Single Coil Rectangular Section spring lock washers – Specification.	-
17	IS:3203-1972	Methods for testing local thickness of electro plated coatings.	-
18	IS:3218(Part-V) -1979	Isometric screw threads “Tolerance”.	-
19	IS:3757-1992	Specification for high Strength Structural Bolts.	-
20	IS:4072-1975	Specification for steel for spring washers.	-
21	IS:4218 (Part-VI)-1978	Isometric screw threads – Part-VI: limits of sizes for commercial bolts & nuts(diameter range 1 to 52 mm).	-

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
22	IS:4759-1990	Specification for Hot dip Zinc coatings on Structural Steel and other Allied products.	-
23	IS:5358-1969	Hot dip galvanized coatings on fasteners.	-
24	IS:5369-1991	General Requirements for Plain Washers.	-
25	IS:6610-1991	Specification for Heavy Washers for Steel Structures.	-
26	IS:6623-1992	High Strength Structural Nuts - Specification.	-
27	IS:6821-1973	Methods for sampling of non threaded fasteners.	-
28	IS:10238-1989	Fasteners – Threaded steel fasteners - Step Bolts for Steel Structures.	-
29	IS:12427-1992	Fasteners – Threaded steel fasteners – Hexagon Head Transmission Tower Bolts – Specification.	-
R) MS FLATS			
1	IS:1852	Rolling and cutting tolerances for Hot rolled steel products.	-
2	IS:2062	Hot Rolled Low, Medium and High Tensile Structural Steel.	-
3	IS:2830	Carbon steel cast billet ingots, billets, blooms and slabs for re-rolling into steel for general structural purposes.	-
S) CLAMPS AND CONNECTORS			
1	IS 2121	Specification for conductors and earth wire accessories for overhead power lines.	-
2	IS 5561	Specification for Electrical power connectors.	-
3	IS 2633	Method of testing uniformity of coating of zinc coated articles.	-
4	IS 2629	Recommended practice for hot dip galvanizing of iron & steel	-
5	IS 5082	Specification for wrought Aluminium and Aluminium Alloy bars, Rods, Tubes and sections for electrical purposes.	-
6	IS 617	Specification for Aluminium and Aluminium Alloy Ingots and Castings for General Engineering Purposes.	-
7	IS 10162	Specification for Spacer and Spacer dampers for Twin Horizontal bundle conductors.	-

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
T) COPPER CONTROL AND ALUMINIUM POWER CABLE			
1	IS: 1554	Specification for PVC insulated (Heavy Duty) Control cables for working voltage up to & including 1100 Volts.	-
2	IS: 3961	Recommended current ratings for PVC insulated and PVC sheathed heavy duty cables.	-
3	IS: 3975	Mild steel wires, strings and tapes for armouring of cables.	-
4	IS: 4905	Methods of random sampling.	-
5	IS: 5831	Specification for PVC insulation and sheath of electric cables.	-
6	IS: 8130	Specification for Conductors for insulated electric cables and flexible cords.	-
7	IS: 10418	Specification for Drums for electric cables.	-
8	IS: 10810	Methods of test for cables.	-
U) TUBULAR BUS CONDUCTOR			
1	IS 5082	Specification for wrought Aluminium and Aluminium Alloy bars, Rods, Tubes and sections for electrical purposes.	-
2	-	Specification for Dimensions of steel pipe for the petroleum industry.	B.S.1600
V) ACSR CONDUCTOR			
1	IS:209	Specification for Zinc	
2	IS:398 Part I to Part V (as relevant)	Specification for Aluminium Conductors for overhead Transmission purpose	
3	IS:1778	Reels and drums for Bare wires	
4	IS:1521	Method of Tensile Testing of Steel wire	
5	IS:2629	Recommended practice for Hot Dip Galvanising Iron and Steel	
6	IS:2633	Method of Testing Uniformity of Zinc coating of Zinc coated Articles.	
7	IS:4826	Galvanised coating on Round Steel wire	
8	IS:6745	Method of Determination of weight of Zinc coating of zinc coated Iron and Steel Articles	
9	IS:8263	Method of Radio Interference Tests	
10	IS:1841	EC Grade Aluminium Rod produced by rolling	

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
11	IS:5484	EC grade Aluminium Rod produced by continuous casting and rolling	
12	IS: 2141	Method of Elongation test of steel wire	
W)	SCREENING CONDUCTOR (HIGH TENSILE GALVANISED STEEL EARTH WIRE)		
1	IS:209	Specification for Zinc	
2	IS:2141	Specification for Earth wire for overhead Transmission purpose	
3	IS:1778	Reels and drums for Bare wires	
4	IS:1521	Method of Tensile Testing of Steel wire	
5	IS:2629	Recommended practice for Hot Dip Galvanising Iron and Steel	
6	IS:2633	Method of Testing Uniformity of Zinc coating of Zinc coated Articles.	
7	IS:4826	Galvanised coating on Round Steel wire	
8	IS:6745	Method of Determination of weight of Zinc coating of zinc coated Iron and Steel Articles	
9	IS: 12776	Method of Testing of Ground wire	
X)	70 KN, 90 KN, 120 KN & 160 KN ELECTROMECHANICAL STRENGTH PORCELAIN DISC INSULATORS		
1	IS:209-1992	Specification for Zinc	
2	IS:206-1991	Method for Chemical Analysis of Slab Zinc	
3	IS:731-1991	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000V	
4	IS:2071 Part(I)-1993 Part(II)-1991 Part(III)-1991	Method of High Voltage Testing	
5	IS:2121 Part(I)	Specification of Conductors and Earth wire Accessories for Overhead Power Lines. Armour Rods, Binding Wires & Tapes for Conductors	
6	IS:2486 Part I-1993 Part II-1989 Part III -1991	Specification for insulator fittings for overhead power lines with a nominal voltage greater than 1000V General Requirements & Tests Dimensional Requirements Locking Devices	

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
7	IS:2629-1990	Recommended practice for Hot Dip Galvanization for iron & steel	
8	IS:2633-1992	Testing for Uniformity of Coating of Zinc coated articles	
9	IS:3188-1988	Dimensions for Disc Insulators	
10	IS:6745-1990	Determination of Weight of Zinc coating on Zinc coated iron and steel articles	
11	IS : 8263-1990	Methods of RIV Test of HV Insulators	
12	IS:8269-1990	Methods for Switching impulse test on HV insulators	
Y)	SUBSTATION HARDWARE		
1	IS:209-1992	Specification for Zinc Ingot	
2	IS:206-1992	Tee and Strap Hinges	
3	IS:7814-1985	Phosphor Bronze Sheet and Strip	
4	IS:2071	Method of high voltage testing	
5	IS:731	Porcelain Insulator for Overhead Power Lines with a Nominal Voltage Greater than 1000 V.	
6	IS:961	Structural Steel	
7	IS:1385	Phosphor Bronze Rods & Bar Sheet and Strips and Wire	
8	IS:2004	Carbon Steel Forgings for General Engineering Purpose	
9	IS:2107	White Hearth Malleable Iron Castings	
10	IS:2108	Black Hearth Malleable Iron Castings	
11	IS:2121(Part-I & II)	Specification for Conductors and Ground wire Accessories for Overhead Power Line, Armour Rods Binding Wires and Tapes for Conductor	
12	IS:2486	Specification for Insulator Fittings for Overhead Power Lines with a Nominal Voltage Greater than 1000 V.	
13	IS:2629	Recommended Practice for Hot Dip Galvanization of Iron and Steel.	
14	IS:2633	Testing of Uniformity of Coating of Zinc coated Articles	
15	IS:3138	Hexagon Bolts and Nuts	
16	IS:6639	Hexagon Bolts for Steel Structures	
17	IS:6745	Determination of Weight of Zinc Coating on Zinc Coated Iron and Steel Articles	
18	IS:3188	Characteristic of String Insulators Units	
19	IS:4218	ISO Metric screw Threads	

S. No.	Indian Standard Number	Title	International & Internationally Recognised Standards
20	IS:4172	Dimensions for Radii under the Heads of Bolts & Screws	
21	IS:4206	Dimensions for nominal lengths and Thread length for Screws and Studs (with amendment)	
22	IS:4759	Hot Dip Zinc Coatings on Structural Steel and other Allied Products	
23	IS:1573	Electroplated Coatings of Zinc on Iron and Steel	
24	IS: 398	Specification for Aluminium Conductor Steel Reinforced for overhead transmission purpose.	
25	IS: 1327-1966	Methods for determination of weight of tin Coating on Tin Plates	
26	IS: 4826-1979	Hot Dip Galvanised Coating on Round Steel Wires	
27	IS: 1363	Hexagon Head Bolts, Screws & Nuts.	
28	IS: 1367	Technical supply conditions for threaded Steel Fasteners	
29	IS: 9708	Stockbridge Vibration Dampers for Overhead Power lines.	
30	IS: 8263	Method of Radio Interference Tests on High Voltage Insulators.	
31	IS:10162	Spacers and Spacer Dampers for twin horizontal bundle Conductors.	
32	IS: 2004	Carbon Steel Forgings for general engineering purposes.	
33	BS:970 (Part-I)	General Instructions and Testing Procedures Specific Requirements for Carbon and Carbon Manganese Alloy and Stainless Steels.	
Z	OIL FILTER PLANTS		
1	IS: 6034	Oil filter plants of all GPH	
2	IS: 1866	For testing of oil filter plant	
AA	FRP OIL STORAGE TANK		
1	IS: 10661	For oil storage tank	



REWA ULTRA MEGA SOLAR LIMITED BHOPAL

VOLUME –II

PART-8

Technical Book Serial No.
MPPTCL/TECH/PROC/09/MAY16/RUMS

**TECHNICAL SPECIFICATION FOR SUPPLY
OF EHV EQUIPMENTS AND MATERIAL FOR
SUB-STATIONS AND FEEDER BAYS**

**OFFICE OF CHAIRPERSON, RUMS
LIMITED,
URJA BHAWAN, SHIVAJI NAGAR,
LINK ROAD NO. 2, BHOPAL 462016**

PART-8

TECHNICAL SPECIFICATION FOR 400/220/132/33KV EQUIPMENTS

(BOOK II OF III)

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SECTION – II

2.1.1 TECHNICAL SPECIFICATION OF CIRCUIT BREAKERS

1.0 SCOPE:

The scope of this bid covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Bid means “Original Equipment Manufacturer (OEM)”. The purchaser means the ‘MPPTCL’.

In case bidder is not OEM, sole responsibility of offering equipments/material of manufacturer as per this bid requirement shall rest on the bidder.

2.0 STANDARDS:

2.1 Applicable Standards for the offered equipments/items shall be as per Section-I Volume-II.

2.2 If the equipment offered by Bidders conforms to any other standards, salient points of comparison between the standards adopted and the specific standards shall be clearly brought out in relevant schedule of technical deviation. It will be sole responsibility of Bidders to prove that the salient features of offered equipment are equivalent or better than IS.

2.3 ACCEPTANCE OF OTHER AUTHORITATIVE STANDARDS:

In the preceding paragraph relevant Indian standard /IEC standard bid have been shown. However, the equipment meeting any other authoritative international standard, which ensures equal or better quality than the standards, mentioned shall also be acceptable. Equipment for which Indian Standards are not available, the relevant British standards and IEC recommendations will be applicable. Please attach photocopy of all such standards according to which the equipment has been offered.

2.4 TYPE TESTS:

Circuit Breakers should be suitable to close and open successfully for specified idle line charging current without developing dangerous over voltages. All offered circuit breakers should be fully type tested as per the relevant standards. In case the equipment of the type and design offered, has already been type tested, Bidders shall invariably furnish type test reports from the reputed and approved national/international laboratory/Government approved test houses to prove that bids of Circuit breakers offered conform to the relevant standard. Test certificates shall clearly indicate the type and model number etc., so that relevant details of offered circuit breakers could be verified. While submitting offers the model and type etc., shall be clearly indicated. Type test reports so furnished should not pertain to the period earlier than five years from the date of opening of Bid. Bidders have to submit one complete set of Type Test reports for the offered circuit breakers for the following tests:

S.NO.	TYPE TESTS REPORTS TO BE FURNISHED BY BIDDERS
1	Mechanical Operation Test (Mechanical endurance test)
2	Temperature rise test
3	Dielectric tests(Dielectric properties should be tested with the closing resistor)
	a) Lighting impulse voltage withstand test
	b) Power frequency voltage withstand test
	c) Switching impulse voltage withstand test (wet)(for 400KV CB)
4	Power frequency voltage withstand test.
5	Making and breaking capacity test
6	Basic short circuit test (duties for terminal faults)
7	Critical Current Test
8	Short line fault test
9	Short time current test
10	Evolving Fault Test
11	Out of phase breaking test
12	Idle Line charging current breaking tests:
13	Seismic withstand test:
14	Corona inception and extinction voltage test (for 400 KV Breakers only)
15	Capacitor current switching test
16	Shunt reactor current-switching test
17	IP 55 test on marshalling box

Seismic withstand test on the complete equipment shall be carried out along with the supporting structure etc. Seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the terminal pad of the equipment. Seismic test shall be carried out in all possible combination of the equipments.

2.5 DISCREPANCY IN TECHNICAL PARTICULARS:

Regarding discrepancy in technical particulars stipulation under Section-I Volume-II shall be applicable.

3.0 SYSTEM CONDITIONS:

3.1 Applicable climatic conditions shall be as per Section-I Volume-II.

3.2 AUXILIARY POWER SUPPLY:

Auxiliary Power Supply for offered EHV equipments shall be as per Section-I Volume-II.

4.0 DUTY REQUIREMENT

4.1 Circuit breakers shall be totally restrike free under all duty conditions and shall be capable of performing specified duties.

4.2 Circuit breakers shall meet the duty requirements for all type of phase to phase and ground fault, irrespective of fault location. Breakers shall also meet idle line charging and

dropping when used on an effectively grounded system and perform make and break operations as per stipulated duty cycles satisfactorily.

4.3 Circuit breakers shall be capable of following duty requirement as mentioned in Appendix-A1 "Principal Parameters":

- i. Interrupting the steady and transient magnetizing inrush current of power transformer.
- ii. Interrupting line charging current.
- iii. Clearing short line faults (kilometric faults) with source impedance behind the bus equivalent to symmetrical fault current specified.
- iv. Breaking inductive currents of upto 10 Amp.
- v. Out of phase breaking capacity.
- vi. Various voltage class circuit breakers should be capable for capacitor switching as per IEC.

4.4 Breakers shall satisfactorily withstand high stresses imposed during fault clearing, load rejection and re-energisation of lines with trapped charges. Breakers shall also withstand the voltage specified in Appendix-A1 "Principal Parameters":

5.0 GENERAL TECHNICAL REQUIREMENTS OF CIRCUIT BREAKERS:

5.1 Exposed live parts shall be placed high enough above ground to meet the requirement of local safety codes.

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

5.3 Complete circuit breaker with all the necessary items for successful operation shall be supplied.

5.4 Circuit breakers shall be suitable for hot line washing.

5.5 All breakers shall be supplied with 1 set (6 nos.) terminal connectors. Details of terminal connector required with each circuit breaker are given in clause 18.0 hereunder and the Bidders are required to note that the terminal connectors shall form a part of scope of supply.

5.6 Current density adopted for the design of the terminal pads shall in no case exceed the following values:

- i. For copper pads - 1.6 Amp/sq.mm.
- ii. For others - 1.0 Amp/sq.mm.

5.7 Provisions shall be made for attaching operation analyzer after installation at site to record contact travel & speed and for making measurement of operation timings, synchronization of contacts of all poles.

6.0 CONTACTS:

6.1 Main contacts shall have ample area and contact pressure for carrying rated current continuously and also the short time rated current of Breakers without excessive temperature rise, which may cause their pitting or welding. Contacts shall be adjustable to allow for wear, easily replaceable and shall have a minimum of moveable parts and adjustments to accomplish desired results.

6.2 All external and internal make and break contacts shall be sealed and shall be free from atmospheric effects. Contacts shall be designed to have adequate thermal and current carrying capacity for the duty specified and to have long life expectancy so that frequent replacement due to excessive burning is minimized. Provision shall be made for rapid dissipation of heat generated by the arc on opening.

6.3 Main contacts shall be first to open and last to close to minimize contact burning and wear.

6.4 Any device provided for voltage grading to damp oscillations or to prevent restrike prior to the complete interruption of Circuit or to limit over voltages on closing shall have a life expectancy compatible to that of Breakers as a whole.

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

7.0 PORCELAIN HOUSING:

7.1 Porcelain housing shall be of single piece construction without any joint or coupling. It shall be homogeneous, free from lamination, cavities and other flaws or imperfections that might affect high mechanical and dielectric strength and shall be thoroughly vitrified tough and impervious to moisture.

7.2 Glazing of porcelain shall be uniform, brown or dark brown coloured, free from blisters, burns and similar other defects with a smooth surface arranged to shed away rainwater or condensed water particles (fog).

7.3 Housing shall be designed to have ample insulation, mechanical strength and rigidity for satisfactory operation for the conditions under which they will be used. All housing of identical ratings shall be interchangeable.

7.4 Puncture strength of housing shall be greater than the dry flashover value. When operating at normal rated voltage there shall be no electric discharge between the conductors and housing which would cause corrosion or injury to conductors, insulators or supports by the formation of substance produced by electro-chemical action. These housing when operating at the normal rated voltage shall cause no radio interference/disturbance.

7.5 All iron parts shall be hot dip galvanised and all joints shall be airtight. Surfaces of the joint shall be trued-up by grinding porcelain parts and by machining metal parts. Housing

design shall be such as to ensure a uniform compressive pressure on the joints.

7.6 Interrupter housing insulator and support insulator shall satisfactorily withstand insulation level of circuit breaker specified in Appendix-A1 "Principal Parameters" and shall also be suitable for contaminated and polluted atmosphere as per relevant standard.

8.0 AUXILIARY CONTACTS:

8.1 Auxiliary switches (contacts) required for satisfactory operation of Circuit breaker including automatic reclosing (single shot, single and 3 phases), ON/OFF indicators both in control room and cubical switchyard, semaphore indicators in the mimic diagram in the control room and anti pumping feature shall be provided on each circuit breaker. All these auxiliary switches and required relays with their scheme shall be included in the scope of supply.

8.2 In addition to the auxiliary switches mentioned above, Bidders shall provide as spares twenty auxiliary contact each of the normally open and Normally closed types in case of 400 KV circuit breaker whereas for other categories of Circuit breaker ten auxiliary contacts each of the "normally-open" and "normally-closed" types which shall operate with the closing or opening of all the three poles of circuit breakers and further ten auxiliary contacts each of "normally closed" and "normally open" type which shall operate with each of three individual poles of circuit breakers. These spare contacts shall be utilised for additional safety interlocking and other monitoring devices by the purchaser.

8.3 All auxiliary contacts shall be placed in a weatherproof casing and current rating of the switches shall be mentioned in the Bid. Provision shall be available to convert these spare "normally-open" contacts to "normally-closed" type and vice versa.

8.4 Auxiliary switch of Breakers shall be preferably driven by breaker operating rod. However in case due to some constraint same is not possible then a plug-in device shall be provided to simulate the opening and closing operations of circuit breaker for the purpose of testing control circuits.

8.5 Arrangement proposed for connecting control cables to the auxiliary switches shall be clearly stated. Provision shall be made for suitable cable glands fitted on gland plate for receiving control cables required for inter connecting assemblies and the auxiliary switches of the breaker. Additional Gland plates shall be supplied duly drilled and fitted with cable glands. Gland plate and operating mechanism doors shall be provided with gasket properly. These cable glands shall be suitable for armoured copper control cables. The cable glands with suitable blanking arrangement shall be fitted on the gland plate that shall be fastened suitably at the bottom of each control cabinet for connecting copper control cables provided by the purchaser.

8.6. Bidders may please note that 1.1 KV grade unarmoured copper control cables shall be used by the purchaser and, therefore, the offered cable glands shall be suitable for the sizes of these cables as specified under Appendix-A1 "Principal Parameters"

8.7. The position of rotating Aux. switches in mechanism box should be such that there should not be any difficulty in cable connection and tracing particular terminal. All terminals marking should be clearly visible from front/outside the switch.

9.0 TOTAL BREAK TIME:

9.1 "Total Break Time" as specified in Appendix-A1, "Principal Parameters" shall not exceed under any circumstances for the following duties:

(i) Test duties 1,2,3,4,5 (with TRV) as per IEC-62271-100 /IEC56

(ii) Short line fault L90, L75 (with TRV) as per IEC-62271-100 /IEC56

9.2 Bidders may please note that specified break time of Breakers shall not exceed under any duty conditions, variation of the trip coil voltage, pneumatic/ hydraulic pressure and SF6 gas pressure etc.

10.0 OPERATING MECHANISM AND ASSOCIATED QUIPMENTS:

10.1 GENERAL REQUIREMENTS:

Bidders may please note that both closing and tripping mechanisms for all rating of breakers need necessarily be of spring type. This is mandatory requirement.

10.1.1 Each circuit breaker shall be designed for remote control operations from the control room. In addition, there shall be provision for local tripping & closing operations both by electrical & mechanical control. Mechanical arrangement should be provided to facilitate manual tripping of circuit breaker for emergency trip under emergent conditions e.g. failure of DC supply, trip coil is burnt, trip coil mechanism is defective etc., while arc quenching medium is healthy.

10.1.2 Operating mechanism shall be of spring type only, remotely operated by electrical signal. Mechanism shall be adequately designed & capable of performing satisfactorily all specified tripping and reclosing duty within the specified time. Entire operating mechanism control circuitry including electrical controls & monitoring devices and all other accessories, as required, shall be housed in an outdoor type, hot dip galvanised steel enclosure. This enclosure shall conform to the degree of protection IP-55 of latest version of IS:2147. The enclosure shall be invariably mounted on a separate concrete plinth of 300 mm height. However, in case due to IP-55 protection limitations. **If operating mechanism is mounted below the pole housing. in that case it should be possible for the operating personnel to manually charge closing spring / mechanism from ground level including ON/OFF operation without using any stool or otherwise. However. due to any reason if operating platform is absolutely necessary, the same shall be deemed to be included in scope of supply.**

10.1.3 All working parts in the mechanism shall be made of corrosion resistant material. All bearings which require greasing shall be equipped with pressure grease fittings. Bearing pins, bolts, nuts and other parts shall be adequately pinned or blocked to prevent loosening or changing of adjustment with repeated operation of the breaker.

10.1.4 Design of the operating mechanism shall be such that it shall be practically maintenance free. Guaranteed years of maintenance free operation, the number of full load and full rated short circuit current breaking/operation without requiring any maintenance or overhauling, shall be clearly stated in the Bid. As far as possible the need for lubricating the operating mechanism shall be kept to the minimum and eliminated altogether, if possible.

10.1.5 The operating mechanism shall be non-pumping and trip free electrically and mechanically. A latch checking switch shall be provided on mechanically trip free mechanism to prevent reclosing before Breakers latches have reset. There shall be no objectionable rebounds in the mechanism and it shall not require any critical adjustments at site. It shall be rigid, positive and fast in operation. Mechanism shall be such that the failure of any auxiliary spring shall not cause false tripping or closing. Operation of the power operated closing device, when Circuit breaker is already closed, shall not cause damage to Circuit breaker or endanger the operator's life. Provision shall be made for attaching an operation analyzer to facilitate speed test after installation of Breakers at site. ON-OFF indicating lamps shall be provided on the mechanism box.

10.1.6 A mechanical indicator shall be provided to show "open" and "close" position of Breakers in addition to facilitate for remote electrical indication. An operation counter shall also be provided in the central control cabinet. Mechanical indicator and operation counter shall be located in a position where it shall be visible to a man standing on the ground level with the mechanism housing closed.

10.1.7 Circuit breaker operating mechanism shall incorporate an electrically achieved positive acting anti-pumping feature to prevent Circuit breaker from reclosing after an automatic opening when the initiating closing device is maintained in the position for closing. Necessary anti-pumping relay shall be included in the scope of supply.

10.1.8 All material for making connection between Circuit breaker and its local control cabinet shall be included in the scope of supply.

10.1.9 All the similar contacts of 3 pole circuit breaker shall be designed to touch or open essentially simultaneously & in any case shall close or open within a period of half a cycle or less. Auxiliary circuit through resistors shall be closed in sufficient time before the main contacts closes to ensure that the over-voltage will be held to guarantee value under most favorable sequence of contact closing.

10.1.10 Bidders shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual for Circuit breaker.

10.1.11 The mechanism shall be rated for minimum mechanical operations which is covered under M2 class test with IEC 62271- 100.

10.1.12 The parts of the CBs like operating mechanism, links, operating arm etc. should not be exposed to atmosphere. It means various parts of CBs should be properly covered and should be tested for IP 55 are equivalent test.

10.2 MOTOR OPERATED SPRING CHARGING MECHANISM:

10.2.1. Spring operated mechanism shall be complete with motor, opening & closing spring with visual indication for spring charged/ discharged condition and all necessary accessories to make the mechanism a complete operating unit. Each mechanism shall be so designed as to enable a continuous sequence of "opening" and "closing" operations to be obtained as long as power is available to the motor and at least one "opening" and "closing" operation

after failure of power supply to the motor. Breaker operation shall be independent of the motor which shall be used solely for the purpose of compressing the closing spring. Motor rating shall be such that it requires only about 30 seconds for charging the closing spring fully. Closing action of Circuit breaker shall compress the opening spring ready for tripping. Spring charging motor shall be AC motor (Single or 3 phase DC Motors are not acceptable. Mechanism shall be capable of performing the rated operating duty cycle of 0-0.3 seconds-CO-3 minutes-CO. In the event of failure of power supply to spring charging motor, the mechanism shall be capable of performing one sequence of 0-0.3 seconds -CO duty. The mechanism shall undergo olive green passivation.

10.2.2. For Manual spring charging operation through operating handle. it is desired that mechanism box may be mounted at adequate height and gear ratio shall be so chosen that one man standing at ground level is able to manually charge the spring without much effort. The handle shall be either at normal operable height or otherwise a suitable 3ft x 3ft platform nearly 4ft below the manual operating handle with foldable ladder shall be provided to facilitate manual charging of spring. The operating handle for charging the spring shall be inserted from side of mechanism box and not from bottom. The spring charging facility shall have ease of operation and the movement of handle shall be in vertical plane only. The Bidder should enclose G.A. Drawings with their offer.

10.2.3 The mechanism shall be strong, rigid positive and fast in operation. Provision shall be made for local electrical control and local / remote selection with enough contacts in the cubicle of the breaker. Manual emergency local tripping arrangement shall be provided on the breaker for use in emergency during maintenance. This emergency trip is intended for use, shall a failure of any part of DC control circuits including trip coil takes place preventing remote electrical tripping.

10.3 MOTORS:

10.3.1 Motors shall be of self ventilated type having TEFC (totally enclosed fan cooled) enclosure.

10.3.2 Depending upon the capacity and loading conditions supplier shall design suitable grease lubricated or oil lubricated bearings for above motors. Bearing shall be so constructed that the loss of grease and its creeping along with shaft into motor housing is prevented. It shall also prevent dirt and water from getting into the motor.

10.3.3 Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point & the motor shall not be overloaded at any operating point of driven equipment that will arise in service.

10.3.4 Motors shall be capable of giving rated output without reduction in expected life span when operated continuously in the system having the particulars as given in principle parameters.

10.3.5 All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed along with the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 75% of the rated voltage.

11.0 CONTROL:

11.1 Close and trip circuits shall be designed to permit use of momentary contact switches and trip/neutral/close switch.

11.2 Each breaker pole shall be provided with two independent trip circuits, valves and coils or two independent trip circuits with trip coils each connected to a different set of protective relays using dedicated main and duplicate DC supplies. At no point mixing of two trip circuit supplies shall be made. Trip coil circuits shall be suitable to trip circuit supervision in pre & post closing conditions. Purchaser would provide the trip circuit supervision relays. Bidders shall provide necessary terminals in the central control cabinet of Circuit breaker for pre & post closing trip circuit supervision.

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

11.4 A conveniently located manual mechanical tripping lever or latch shall also be provided for tripping Breakers and simultaneously opening the reclosing circuit.

11.5 Shunt trip coils shall operate correctly under all operating conditions of Circuit breaker up to the rated breaking capacity of Circuit breaker and at all values of D.C. supply voltage between 70% and 110% of rated voltage. However, at 50% of rated voltage, Breakers shall be able to perform closing and opening operations. If additional elements are introduced in the trip coil circuits, their successful operation and reliability for similar applications shall be ensured.

11.6 For maintenance purposes, a local manual closing device along with a detachable handle shall also be provided. Device should be easily operable by one man standing on the ground. Direction of rotation of handle shall be clearly marked. Suitable arrangement for safe storage of handle shall be provided.

11.7 Closing coil shall operate correctly at all values of voltage between 85% and 110% of the rated voltage of closing coil.

12.0 SURFACE FINISH PAINTING & GALVANISING:

12.1 All interiors and exteriors of tanks, mechanism, enclosures, cabinets and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil, as far as accessible shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paint.

12.2. All ferrous metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner or hot dip galvanized or two packs of aliphatic polyurethane finished paint. All metal parts not accessible for

painting shall be made of corrosion resistant material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limits specified. Paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external paintings shall be as per shade no. 697 of IS:5 or Polyurethane paint having shade Siemens gray RAL 7032. All ferrous parts & steel structure including all sizes of nuts, bolts, plain and spring washers, support channels, structures, etc. shall be hot dip galvanized or stainless steel or electro-galvanized.

13.0 EARTHING:

Operating mechanism housing, control cabinets, dead tanks, support structure etc. shall be provided with two separate earthing terminals suitable for connection to earth mat of substation switchyard.

14.0 NAME AND RATING PLATES:

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

- a) Manufacturer's name & trade mark.
- b) Serial number or type designation making it possible to get all the relevant Information from the manufacturer.
- c) Year of manufacture.
- d) Rated nominal/highest voltage.
- e) Rated insulation level.
- f) Rated frequency.
- g) Rated normal current.
- h) Rated capacitive/inductive breaking current
- i) Rated short circuit breaking current.
- j) First pole to clear factor.
- k) Rated duration of short circuit current.
- l) Rated out of phase breaking current.
- m) Rated auxiliary d.c supply voltage of closing and opening devices.
- n) Rated pressure of compressed air / gas for operation and interruption.
- o) Rated AC supply voltage of auxiliary circuits
- p) Mass of circuit breaker.
- q) Purchase's order no. & date

Rating plate shall be visible in position of normal service and installation. The rating plate shall be engraved, weather proof and corrosion proof. Description on the rating plate should be given in "legible English letters".

15.0 TERMINAL CONNECTORS:

15.1. Terminal connector shall conform to the latest version of IS:5561 or equivalent International Standard. Standard drawing for terminal connectors is enclosed. Clamps shall be designed adequately to take care of any bimetallic effect. Temperature at the clamp shall

not exceed 80 deg C. Corona rings shall be provided at the breaker terminals to control the radio interference. Terminal connectors shall be tested for short circuit current capability, temperature rise, Corona inception etc.

15.2. The design of clamp shall be to our approval. The details of current take off as required by us shall be detailed out in drawing and shall be submitted along with the bid. In respect of the terminal connectors following should be ensured:-

- (a) The terminal connector should be made of A6 Aluminum Alloy and by pressure / gravity die cast only. Sand casted terminal connectors are not acceptable.
- (b) All castings shall be free from blow holes, surface blisters, cracks and Cavities. All sharp edges should be rounded off.
- (c) No part of clamp shall be less than 12 mm thick.
- (d) The bimetallic strips / sleeve shall be 2 mm thick.
- (e) All nuts, bolts & washers shall be of Hot Dip Galvanised mild steel.
- (f) The conductor should be tightened by six bolts. Conductor hold length must not be less than 100 mm.
- (g) The surface of clamps to be tightened by six bolts should be flat in shape so that it may be possible to open the nuts and bolts by normal flat spanners. Therefore, any type of groove in the clamp body for fixing of nuts should be avoided.
- (h) The portion of clamp to hold the conductor should be flat and straight and not zig-zag in construction, at both the sides, so that holding of clamp by throttling action of current may be avoided.
- (i) Space of at least 50% of diameter of nuts should be available after the hole at both the sides of conductor holding portion for better mechanical strength.
- (j) All current carrying parts shall be designed and manufactured to have minimum contacts resistance.
- (k) The clamp for Twin Moose ACSR Conductor shall be in three pieces so that each conductor may be tightened separately.
- (l) Size of terminal connector for which the clamp is designed and also rated current under site conditions shall be embossed / punched on each part of clamps except hardware.

15.3 400KV bus shall be of quadruple 'MOOSE' conductor. All circuit breakers shall be provided with flexible terminal connectors, which shall be of expansion type to receive 4 inch IPS tube or Twin Moose ACSR conductor and suitable for horizontal take off.

16.0 FITTINGS AND ACCESSORIES:

16.1 Following is the list of the major fittings and accessories to be included by manufacturers as an integral part of equipment. Number and exact location of these parts shall be indicated in the Bid.

S. No.	Particulars	Type of Circuit Breakers	
		SF6	Vacuum
1	Hollow insulator columns for poles of Circuit Breaker	Yes	Yes
2	Operating mechanism housing in accordance with clause no.10.0 shall		

S. No.	Particulars	Type of Circuit Breakers	
		SF6	Vacuum
	complete with ;		
	a) Pistol grip circuit breaker control switch having trip/ normal/close position.	Yes	Yes
	b) Trip coils/ closing coil	Yes	Yes
	c) Space heater equipped with industrial grade switch	Yes	Yes
	d) Cable glands	Yes	Yes
	e) Industrial grade receptable type 3 pin 15 Amps power plug & socket with switch.	Yes	Yes
	f) Local/remote changeover switch.	Yes	Yes
	g) Manually operated tripping push button/lever (mechanical device convenient located to trip all three phases simultaneously).	Yes	Yes
	h) Padlocks and duplicating keys	Yes	Yes
	i) Terminal Boards.	Yes	Yes
	j) Spring charged discharged indicator.	Yes	Yes
	k) Operation counter.	Yes	Yes
	l) Facility for manual charging of spring.	Yes	Yes
	m) Fuses/MCBs as required for AC & DC supply.	Yes	Yes
	n) The number of terminals provided shall be adequate enough to wire out all contacts and control circuits plus 20% spare terminals for owner's use.	Yes	Yes
	o) Manual charging spring operating handle for maintenance.	Yes	Yes
	p) Auxiliary switch	Yes	Yes
	q) Mechanical ON & OFF Indicator.	Yes	Yes
	r) Cubicle lamp with cage & switch.	Yes	Yes
	s) Antipumping relay.	Yes	Yes
	t) Out-of-Step relay.	Yes	-
	u) Set of 6 nos. terminal connector clamps	Yes	Yes
	v) Name & Rating plate in accordance with IEC incorporating year of manufacture.	Yes	Yes
	w) Damping resistors	Yes	-
	x) Pressure Gauge for N2 Pressure	-	Yes
3	Portable/hand held SF6 gas leakage detector.	Yes	-
4	SF6 Gas filling adapter	Yes	-

17.0 FOUNDATION & SUPPORT STRUCTURES FOR BREAKER STRUCTURES:

17.1 Support Structure: Support structures along with the foundation bolts required for

mounting the breaker shall be within the scope of the bidder and prices for the same shall be quoted inclusive of all the items of structures, hardware and accessories for mounting so as to put circuit breaker in to service. The support structures for circuit breakers shall be designed to maintained minimum ground clearance form the lowest live terminal to breaker structure base plate (to be fix on concrete plinth) as per Appendix-A1 principal parameter of the bid.

17.2. Foundation:- Bidders shall furnish a drawing showing foundation plan for breakers offered by them clearly indicating the i) Dynamic upward and downward loads for which it is designed ii) static load iii) total weight of breaker considered for foundation design & iv) all spacing and dimensional details alongwith details of foundation bolts. MPPTCL have standardized foundation plan drawing for circuit breakers. The bidders shall have to match their breaker structure dimensions strictly with this enclosed drawing for respective rating of circuit breakers. The static and dynamic loading for foundation have been specified under Appendix-A1 of this bid.

18.0 ESSENTIAL SPARE ITEMS:

The bidder may please note that the name of essential items required for operation & maintenance of circuit breakers may please be included while offering the prices for circuit breakers covered under the package.

19.0 TYPE TESTS & TEST REPORTS:

19.1. All the equipment offered, shall be fully type tested as per the relevant standards. In case the equipment of the type and design, offered, has already been type tested, Bidders shall furnish two sets of the type test reports along with the Bid. For any change in the design/type already type tested and the design/type offered against this Bid the purchaser reserves the right to demand repetition of tests without any extra cost on the first or any one unit of any rating included in the Bid. In case the equipment has not been type tested earlier, all the type tests as per relevant standards shall be carried out by the successful Bidder/supplier in the presence of purchaser's representative without any extra cost. The test reports submitted with the offer shall not be older than five years, prior to the date of opening of Bid for various tests indicated in Clause 2.4 of this bid document.

19.2. Bidders shall indicate the manufacturer's standard routine tests. Bidders shall completely assemble and test each breaker to ensure satisfactory working of all components and also assembled breakers as a whole.

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

19.4. Speed curves for each breaker shall be obtained with the help of a suitable operational analyzer to determine Breaker contact movement during opening, closing, auto-reclosing and trip free operation under normal as well as limiting operating conditions (control voltage, pneumatic pressure etc.). Tests shall show the speed of contacts directly at various stages of operation, travel of contacts, opening time, closing time, shortest time between separation and meeting of contacts at break/make operation etc. This test shall also be performed at

site for which the necessary operation analyzer along with necessary transducers, cables, console, etc. shall be provided if required.

19.5. Preliminary copy of the test results shall be supplied for approval before dispatch/shipment of Circuit breakers. 4 copies of complete test results shall be furnished with Circuit breakers. These shall include complete reports and results of the routine test and type tests carried out on circuit breakers of identical design.

19.6. ADDITIONAL TESTS:

Purchaser reserves the right for carrying out any other tests of a reasonable nature at the works of the supplier / laboratory or at any other recognized laboratory/research institute in addition to the above mentioned type, acceptance and routine tests at the cost of the purchaser to satisfy that the material complies with the intent of this bid. Bidders may please note that Insulation Resistance test by 5KV or 10KV megger at manufacturer's works shall be invariably carried out on each circuit breaker to record following IR values.

- (a) Insulation resistance between top terminal to earth (for open and closed condition of circuit breaker) in --- Mega Ohms.
- (b) Insulation resistance between both top Terminals in open and close condition of circuit breaker in --- Mega Ohms.
- (c) Insulation resistance between both top Terminals to earth in open and close Condition of circuit breaker --- Mega Ohms

20.0 INSPECTION:

20.1 Purchaser shall have access at all times to the works and all other places of manufacture where Circuit Breaker are being manufactured and Bidders shall provide all facilities for unrestricted inspection of the Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein. Purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. Supplier shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembled breaker

20.2 No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested. Successful Bidder shall within 30 days of placement of order, submit it's of bought out accessories and the names of sub-suppliers.

20.3 Bidders shall indicate the inspections and checks carried out at various stages of the manufacture of Circuit Breaker. Complete record of stage inspection would be kept by the supplier and this record should be made available for inspection by the representative of the Purchaser. The supplier should indicate the manufacturing programme and the Purchaser will have a right to depute inspecting officers during the manufacture of the equipment. Purchaser reserves the right to carry out stage inspections at all stages, for which advance intimation shall be given and all necessary cooperation shall be rendered by the manufacturer.

20.4 At the time of inspection, the supplier shall identify each and every item/accessories of the particular Circuit Breaker under testing. Unless all the items are identified, the

manufacture will not be treated as complete. Various tests stipulated in IS/IEC shall be performed in the presence of purchaser's engineers or when the inspection waiver has been given, in such a case, the testing shall be done at the manufacturer's works as per IS/IEC stipulations and same should be confirmed by documentary evidence by way of Test Certificate which shall be got approved by the purchaser.

20.5 It is expected that before a Circuit Breaker is finally offered for inspection, internal testing of the same for various important parameters are already done. Routine test report for such tests shall also accompany the letter of inspection call so that the Inspecting Officer at the time of inspection may verify the parameters brought out in the preliminary report. Details of all tests should be clearly brought out.

20.6 In case for any reasons inspection is not completed or equipment is not found to be complete with all accessories as per confirmation given with the letter of inspection call, purchaser will reserve the right to recover the complete cost of deputation of inspecting team to the works of the manufacturer.

20.7 Acceptance of any quantity of circuit breaker & its accessories shall in no way relieve the successful Bidder of his responsibility for meeting all the requirement of this bid and shall not prevent subsequent rejection if such equipments are later found to be defective.

21.0 QUALITY ASSURANCE PROGRAMME:

21.1 Bidders must establish that a proper quality assurance program is being followed by them for manufacture of circuit breakers. In order to ensure this, suitable QAP should form a part of the technical Bid, which will be submitted against this Bid. Quality Assurance Program must have a structure as detailed in the following paragraphs.

21.2 Quality assurance and failure prevention starts with careful study and scrutiny of our technical bids and requirements. Supplier shall carefully study all the technical parameters and other particulars & the supplier shall categorically give his confirmation that these requirements shall be met in a satisfactory manner.

21.3 Supplier shall furnish the checks exercised in design calculations. The salient features of design will have to be made available to the Purchaser.

21.4 Supplier shall indicate the various sources of the items being procured. The type of checks, quantum of checks and acceptance norms shall be intimated and random test and check results should be made available for inspection whenever so desired. Vendor list for various bought out items shall be submitted with the Bid and the same shall be subject to purchaser's approval. However, no change in vendor list shall be acceptable after placement of order and list of vendors shall be freeze at the time of placement of order.

22.0 DOCUMENTATION:

22.1 LIST OF DRAWINGS AND DOCUMENTS:

Bidders shall furnish four sets of relevant descriptive and illustrative published

literature pamphlets and the following drawings for preliminary study, along with the Bid.

- (a) General outline drawings showing dimensions and shipping weights, quantity of insulating media, air receiver capacity etc.
- (b) Sectional views showing the general constructional features of Circuit breaker including operating mechanism, arcing chambers, contacts with lifting dimensions for maintenance.
- (c) All drawings & data typical and recommended schematic diagram for control Supervision & reclosing shall be annotated in English.
- (d) Schematic diagrams of breaker offered for control supervision and reclosing.
- (e) Structural drawing, design calculations and loading data for support structures.
- (f) Short circuit oscillogram & certificates for similar type tested breakers. General arrangement of foundation and structure mounting plan including weights of varnish components and impact loading data for foundation design.
- (g) Type test reports.

22.2 Successful Bidder shall, within two weeks of placement of order, submit four sets of final version of all the above drawings for purchaser's approval. Purchaser shall communicate his comments/approval on the drawings to the supplier within two weeks. Supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for purchaser's approval within two weeks from the date of comments. After receipt of purchaser's approval, the supplier shall, within three weeks, submit two prints of approved drawings and two sets of good quality reproducible of the approved drawings for purchaser's use.

22.3 Successful Bidder shall also furnish two sets each of bound manuals covering erection, commissioning, operation and maintenance instructions and all relevant information and drawings pertaining to the main equipment as well as auxiliary devices alongwith each breaker. Marked erection drawings shall identify the component parts of the equipment as shipped to enable erection by purchaser's own personnel. Each manual shall also contain one set of all the approved drawings, type test reports as well as acceptance reports of the corresponding consignment dispatched. Similar bound manuals for breakers shall be made available to the office of ED(T&P) on one per breaker basis.

Manufacturing of equipments shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser.

22.4 Approval of drawings/work by the purchaser shall not relieve Bidders of any of his responsibility and liability for ensuring correctness and correct interpretation of the drawings for meeting the requirements of the latest revision of the applicable standards rules and codes of practices. Equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of supply and purchaser reserves the right to reject any work or materials which, in his judgment, is not in full accordance therewith.

22.5 Additional data to be furnished along with the Bid:

- (a) Drawing, showing contacts in close, arc initiation, full arcing, arc extinction and open position.

- (b) Temperature v/s pressure curves for each setting of density monitor along with details of density monitor.
- (c) Method of checking the healthiness of voltage distribution devices (condensers) provided across the breaks at site.
- (d) Data on capabilities of circuit breakers in terms of time and number of operations at duties ranging from 100% fault currents to load currents of the lowest possible value without requiring any maintenance or checks.
- (e) Effect of non-simultaneity between contacts within a pole or between poles and also how it is covered in the guaranteed total break time.
- (f) Sectional view of non return couplings if used for SF6 pipes.
- (g) Details and type of filters used in interrupter assembly and also operating experience with such filters
- (h) Details of SF6 gas:
 - i) Test methods used in controlling the quality of gas used in Circuit breakers particularly purity and moisture content.
 - ii) Proposed tests to assess the conditions of SF6 within a circuit breaker after a period of service particularly with regard to moisture contents in the gas.
 - iii) Precise procedure to be adopted by maintenance personnel for handling equipment who are exposed to the products of arcing in SF6 gas so as to ensure that they are not affected by possible irritants of the skin and respiratory system.

23.0 PACKING AND FORWARDING:

Equipment shall be packed in suitable crates in such a manner to protect it from damage and withstand handling during transit. Bidders shall be responsible for and make good at his own expense, any or all damage to the equipment during transit. Fragile materials shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided.

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

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

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

24.0. COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS:

Bidders must furnish the following information along with technical Bid:

24.1 Complete details of all the accessories which will be supplied with Circuit breaker

should be furnished. While furnishing these details, items which will be manufactured by Bidders and balance items, which will be procured from sub-suppliers should be clearly identified and indicated in the Bid.

24.2 It is obligatory on the part of Bidder to ensure that supply of all accessories along with Main equipment are simultaneously delivered to avoid any holdup in erection and commissioning. The responsibility for obtaining timely supplies of bought out items will rest on Bidders and only on this basis, delivery period will be offered in the Bid.

24.3 It may be noted that in case of damages/shortages due to improper packing or any other negligence, replenishment shall be arranged within one month time. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and also in case defective supply of any item is reported, will rest with the Bidder. In case for attending to defects in any accessory or inspection/ replacement of the accessory, which may be bought out item for the Bidder; if services of engineer of original manufacturer is required, the same will be organized on immediate basis by Bidder at his cost.

25.0 SPECIFIC TECHNICAL REQUIREMENTS OF SF6 CIRCUIT BREAKERS:

25.1 Offered circuit breakers shall be of sulphur hexafluoride (SF6) gas filled.

25.2 **Circuit breakers shall comprise of three identical single pole units. The duty of circuit breakers for various KV class has been indicated in the “Principle parameters and other requirement for circuit breakers” Appendix-A1 of bid document”. Circuit Breakers shall be operated by spring charged mechanism for both opening and closing. The mechanism shall be housed in a dust proof and weather proof control cabinet.**

25.3 Breaker assemblies with base, support structure for circuit breaker as well as for control cabinet, central control cabinet and foundation bolts for main structure as well as control cabinet and central control cabinet (except concrete foundations), Breaker terminals and operating mechanisms. Support structures shall be hot dip galvanized.

25.4 Compressed SF6 gas, in each pole with provision of density monitor.

25.5 One central control cabinet and one control box for each pole with all the required electrical devices mounted therein and the necessary terminal blocks for termination of inter pole wiring. Necessary inter pole cables shall be in the scope of supply and the purchaser based on the schematic, wiring diagram and termination schedule to be supplied by the Bidder, shall do cabling at site.

25.6 Instruments, gauges for SF6 gas pressure with suitable number of NO/NC contacts of required quantity for interlocking and other formalities as per schematics.

25.7 All necessary parts to provide a complete and ready to use circuit breaker installation such as main equipment, terminal connectors, control parts, cable connector, pipe lines and other devices, whether specifically called for herein or not.

25.8 Circuit breakers shall be single pressure type, the design and construction of Circuit

beaker shall be such that there is minimum possibility of gas leakage and entry of moisture. There should not be any condensation of SF₆ gas on the internal insulating surface of circuit breaker.

25.9 All gasketed surfaces shall be smooth, straight and reinforced to minimize distortion and to make a tight seal. Operating rod connecting the operating mechanism to the arc chamber (SF₆ media) shall have adequate seals, single "O" ring seals without test holes Double "O" ring seals or Double lip seals and test holes for leakage test of the internal seal shall be provided on each static joint. A suitable pressure-monitoring device on each pole may be provided to ensure pressure of insulating media for the entire assembly.

25.10 In the interrupter assembly there shall be an absorbing product box to eliminate mixing of SF₆ decomposition products and moisture. Material used in the construction of Circuit breakers shall be fully compatible with SF₆ gas.

25.11 Each pole shall form an enclosure filled with SF₆ gas independent of two other poles. The SF₆ gas density of each pole shall be monitored and regulated by individual density monitors.

25.12 SF₆ gas density monitor shall be adequately temperature compensated. Density monitor shall meet the following requirements:

- i) It shall be possible to dismantle the density monitor for checking/ replacement without draining the SF₆ gas by using suitable interlocked non-return couplings.
- ii) It shall damp the pressure pulsation while filling the gas in service so that the flickering of the pressure switch contacts does not take place.
- iii) Gas pressure indicators should be provided for each breaker pole. These pressure indicators shall have uniform graduated dial.

25.13 Suitable arrangement for pressure relief shall be provided in the gas chamber of circuit breaker to avoid the damages or distortion during occurrence of abnormal pressure increase or shock waves generated by internal electric fault arcs. Position of pressure relief devices (e.g. vents, diaphragms, etc.) shall be arranged to minimize danger to operating personals in the event of gas or vapour escaping under pressure.

25.14 Facility shall also be provided to reduce the gas pressure within Breakers to a value not exceeding 8 millibars within 4 hours or less. Each circuit breaker shall be capable of withstanding this degree of vacuum without distortion or failure of any part.

25.15 Sufficient SF₆ gas shall be provided to fill all circuit breaker poles after erection. Additional 20% of the total SF₆ gas requirement for each breaker shall be supplied in separate cylinders.

25.16 Portable/hand held SF₆ gas leakage detector shall also be supplied along with each SF₆ breaker.

25.17 Contacts shall be kept permanently under pressure of SF₆ gas. Gap between the

open contacts shall be such that it can withstand atleast the rated phase to ground voltage continuously at zero gauge pressure of SF6 gas due to profuse and sudden leakage.

25.18 If multi break interrupters are used, these shall be so designed and augmented, that uniform voltage distribution is developed across breaking contacts. Calculations/test reports in support of this requirement shall be furnished along with the Bid. Thermal and voltage withstand capability of the grading element shall be adequate for the specified duty and service conditions.

25.19 Special contacts for use with the trip coils and single shot reclosing operation, which permit the relative adjustment with respect to the travel of Circuit breaker, shall also be provided.

25.20 Operating mechanism shall be suitable for high speed single/three phase tripping & reclosing as per duty cycle indicated for various class of CBs in "Principle parameters and other requirement for circuit breakers" Appendix-A1.

25.21 Should the settings of the three breaker poles not be the same (e.g. due to failure of an operating or closing coil) all three poles shall trip simultaneously on appropriate electrical command. An out of step relay shall be supplied with each breaker to give a remote trip discrepancy alarm.

25.22 A non return valve should be provided so that in case of substantial pressure loss in a pole the main interrupting chambers remain pressurised and can retain their full insulating capacity for several more hours.

25.23 Motors shall be "squirrel cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for driving equipment.

25.24 If arcing contacts are used they shall be first to close and the last to open. These shall be easily accessible for inspection and replacement. If separate arcing contacts are not mounted, in that case main contacts shall be easily accessible for inspection and replacement. Tips of arcing contacts and main contacts shall either be made of graphite or silver-plated or of tungsten alloy.

25.25 SULPHUR HEXAFLUORIDE GAS (SF6 GAS):

25.25.1 SF6 gas shall comply with latest version of IEC-376, 376A and 376B and shall be suitable in all respects for use in the switchgear under the worst operating conditions.

25.25.2 High pressure cylinders in which the SF6 gas is shipped and stored at site shall comply with latest version of IS:4379 (Identification of the contents of industrial gas cylinders) and IS:7311 (Seamless high carbon steel cylinders for permanent and high pressure liquefiable gases). These gas cylinders shall also meet Indian Boiler regulations.

25.25.3 SF6 gas shall be tested for purity, dew point, break down voltage, water contents as per latest version of IEC-376, 376A and 376B and test certificates shall be furnished for each lot of SF6 gas.

25.26 CONTROL CABINETS:

- a.** Control cabinets shall be of the free standing floor mounting type.
- b.** Operating mechanism and all accessories shall be enclosed in weather & vermin proof mechanism cabinet of hot dip galvanized sheet steel construction, the thickness of which shall not be less than 3 mm intended for outdoor operation. Control cabinets shall be provided with a hinged door. Door hinges shall be of union joint type for easy access to the mechanism at the front. Sides shall be properly braced to prevent wobbling. Suitable gasket shall be provided to make the mechanism housing waterproof and dust proof. Housing latch shall accommodate padlock requiring a 12mm dia hole. Padlock and duplicate keys are also included in the scope of supply.
- c.** Bus bars shall be of tinned copper of adequate cross-section to carry the normal current, without exceeding the permissible temperature rise over an ambient temperature of 50°C outside the cubicle. Buses shall be braced to withstand forces corresponding to short circuit current of 25 kA.
- d.** Motors rated 1 kW and above being controlled from the control cabinet would be suitable for operation on a 433 V, 3 phase 50 Hz system. Fractional kW motors would be suitable for operation on a 230 V, 1-phase, 50 Hz supply system.
- e.** Isolating switches shall be group operated units (3 pole for use on 3-phase supply system and 2 pole for single phase supply systems) quick make quick break type, capable of breaking safely and without deterioration, the rated current of the associated circuit. Control cabinet door shall be interlocked with the operating handle of the switch so as to prevent opening of the door when the switch is closed. A device for bypassing the door interlock shall also be provided. Switch handle shall have provision for locking in both fully open and fully closed positions.
- f.** Fuses shall be HRC cartridge link type having prospective current rating of not less than 4.6kA (rms). They shall be provided with visible operation indicators to show when they have operated. One fuse pulling handle shall be supplied for every ten fuses or a part thereof.
- g.** Push button shall be rated for not less than 6 Amps, 433 V A.C. or 2 Amps, 220V DC and shall be flush mounted on the cabinet door and provided with appropriate nameplates. Red, Green and Amber indicating lamps shall be flush mounted and provided with series resistors to eliminate the possibility of short circuiting of control supply in the event of fusing of lamps.
- h.** For motors upto 5 kW, contactors shall be direct-on-line, air break, single throw type and shall be suitable for making and breaking the switching current of the associated motor which shall be assumed equal to 6.5 times the full load current of the motor. For motors above 5 kW, automatic star delta type starters shall be provided. 3 pole contactors shall be furnished for 3 phase motors and 2-pole contactors for single phase motors. Reversing contactors shall be provided with electrical interlocks between forward and reverse contactors. If possible, mechanical interlocks shall also be provided. Contactors shall be

suitable for uninterrupted duty and shall be of duty category class AC4 as defined in IS:2959. The main contacts of the contactors shall be silver plated and the insulation class for the coils shall be class E or better. Dropout voltage of the contactors shall not exceed 70% of the rated voltage.

i. Contactors shall be provided with a three element, positive acting, ambient temperature compensated, time lagged, hand reset type thermal overload relay with adjustable setting alternatively MCB for motor protection. Hand reset button shall be flush with the front door of the cabinet and suitable for resetting with starter compartment door closed. Relays shall be either directly connected or CT operated depending on the rated motor current.

j. Single phasing prevention relay shall be provided for 3 phase motors to provide protection against single phasing.

k. Mini starters shall be provided with no volt coils whenever required.

l. Purchaser's power cables will be of 1100/650 volts grade stranded aluminum conductor. PVC insulated, PVC sheathed single steel wire armoured and PVC jacketed. All necessary cable terminating accessories such as glands, crimp type tinned copper lugs etc. for power as well as control cables shall be included in Bidder's scope of supply. Requisite number of suitable brass cable glands shall be provided for cable entry at the bottom of the operating cabinet to receive purchaser's control cables. These shall be mounted in accessible position and floor level so that the cable joints can be made easily. Cable glands shall be double compression type.

m. Separate terminal blocks shall be provided in the mechanism housing for terminating circuits of various voltage classes. Terminals for DC & AC shall be provided separately and isolated from each other. CT loads shall be terminated on a separate block and shall have provision for short circuiting the CT secondary terminals. Terminals for the control & other circuits shall be suitable for accommodating 3mm stranded conductor cable leads. A minimum of six spare terminals for control wiring shall be provided. Housing shall be complete with all necessary wiring in the housing.

n. Wiring for all control circuits shall be carried out with 1100/650 volts grade PVC insulated tinned copper stranded conductors of sizes not smaller than 2.5 mm. Atleast 20% spare terminal blocks for control wire terminations shall be provided on each panel. All terminals shall be provided with ferrules indelibly marked or numbered and these identifications shall correspond to the designations on the relevant wiring diagrams. Terminals shall be rated for adequate capacity which shall not be less than 10 Amps.

o. Control cabinet shall be provided with 230 V, 1-phase 50 Hz, 20 W fluorescent light fixture and a suitably rated 230V, 1 phase, 5 amps, 3 pin socket for hand lamps. Suitably rated power plug with switches shall be provided to enable the control supply to Breakers to be cut off from the mechanism housing.

p. Suitable strip heaters shall be provided inside each cabinet complete with thermostat to prevent moisture condensation. Heaters shall be controlled by suitably rated double-pole miniature Circuit Breakers and by differential thermostat so that the cubicle

temperature is always maintained approximately 10 deg./ above the outside air temperature. On-Off switch and fuse shall be provided. Heater shall be suitable for 230 volts AC supply unless otherwise specified.

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

r. Electric measuring instruments shall be of moving iron type Ammeters for measuring current up to 30 Amps shall be directly connected while those for measuring above 30 Amps shall be connected through suitable CTs Ammeters shall be provided with selector switches.

s. Voltmeters shall be protected by HRC fuses and provided with selector switches.

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

u. All doors, panels removable covers and breaker openings shall be gasketed all around. All louvers shall have screen and filters. Cabinet shall be dust, moisture, and vermin proof.

v. All cabinets/boxes shall be designed for the entry of cables from bottom by means of weatherproof and dust-proof connections. Suitable cable gland plate (at least 150 mm above the base of cabinet/box) of HDG having minimum thickness of 3 mm, with necessary cable glands shall be provided. The cable gland plate shall be re-movable type and shall have provision for additional glands for future. The glands shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall be cadmium plated. The cabinet/box shall be designed generously for clearance so as to avoid interference between the wiring entering from below and any terminal block or accessories mounted within the box or cabinet.

w. Suitable relay for monitoring of DC supply voltage to the control cabinet shall be provided. Pressure switches used for interlock purposes shall have adequate contact ratings to be directly used in the closing and trip circuits. In case the contacts are not adequately rated and multiplying relays are used then the interlock for closing/ opening operation shall be independent of the relay logic i.e. if the DC supply to the interlock circuit fails then operation lockout shall take place.

25.27 SERVICES FOR SUPERVISION OF ERECTION & COMMISSIONING OF CIRCUIT BREAKERS:

25.27.1 SERVICES FOR SUPERVISION OF ERECTION & COMMISSIONING:

It is obligatory on the part of the Bidder to provide "free services" of their erection & commissioning team to supervise erection & commissioning of each Circuit Breaker.

Although erection works shall be done by us, services of erection engineer will have to be provided for supervision and guidance. It may be clarified that the breaker shall be made ready for commissioning in all respect and services of your engineer will be required for checking and final commissioning of the breaker. Normally MPPTCL has trained staff for erection of breaker based on guidelines, which are to be furnished by the manufacturer. While undertaking erection work the purchaser will require services of supervision engineer for suitable period depending upon design of equipment and these

services for required period will have to be made available on free of cost basis. In case any manufacturer feels that their experienced engineer for final supervision of erection and testing will need assistance of any junior grade supervisor also, services of the same should also be provided on free of cost basis. In any case free services by way of deputation of required number of personnel for sufficient period will have to be ensured by the bidder on free of cost basis. The intention is that the services are made available until supervision of erection & commissioning is completed. These services shall be provided for each unit. It will be obligatory on the part of bidders to depute their erection supervisor and commissioning engineer positively within one week of telephonic intimation from MPPTCL.

26.0 SPECIFIC TECHNICAL REQUIREMENTS OF VACUUM CIRCUIT BREAKERS:

26.1 Circuit breakers shall comprise of three identical pole units linked together mechanically suitable for operation with a centrally located common operating mechanism box i.e. Normal Duty type. Vacuum circuit breakers with all integral parts required for satisfactory operation shall be supplied with all accessories in position and complete internal wiring connected and terminated in the operating mechanism housing. Offered equipment shall be complete in all respect.

26.2 For 33 KV circuit breaker, all contacts shall be of Butt type.

26.3 VACUUM INTERRUPTERS:

26.3.1 Design of vacuum interrupter shall be such that it gives trouble free operation under normal load and fault condition throughout the life of the equipment. As the efficiency of breaker depends on degree of vacuum inside the interrupter, manufacturer shall ensure that the same is maintained consistently during service.

26.3.2 Insulating ceramic body of interrupter shall have high mechanical strength and it shall be capable of withstanding high temperature without any significant deterioration in mechanical and electrical properties.

26.3.3 Interrupter design shall ensure rapid deionization of the gap so that normal electrical strength of the gap is restored instantaneously.

26.3.4 Vacuum interrupters which are used shall be so designed and augmented that a uniform voltage distribution is developed across them. Calculation/ test reports in support of the same shall be furnished along with the tender. Thermal and voltage withstand values of the grading elements shall be adequate for the service conditions and duty specified.

26.3.5 Metallic bellow or the other sealing arrangement should be provided at the moving contact and should have long fatigue free life. Manufacturers' catalogue on vacuum bottle, indicating all such details shall essentially be submitted with the tender.

APPENDIX-A1**PRINCIPAL PARAMETERS AND OTHER REQUIREMENT FOR
CIRCUIT BREAKERS:**

The 400, 220, 132 and 33KV Circuit Breakers shall conform to the specific technical requirements mentioned hereunder:

S. No.	Items	Requirements			
		400KV	220KV	132KV	33KV
1	Nominal system voltage(KV rms)	400	220	132	33
2	Highest System voltage (KV rms)	420	245	145	36
3	Rated frequency (Hz.)	50	50	50	50
4	Rated normal current (Amperes rms)at 50°C ambient temperature.	2500	2000	2000	1250
5	Type	Outdoor SF6-Gas			Outdoor, Vacuum
6	Duty Requirements	SPR duty	SPR duty	Normal Duty	Normal Duty
6	Mounting Structure Details	Hot dip galvanized lattice steel support structure.			
7	System Neutral earthing.	Effectively earthed.			
8	Number of Poles	3	3	3	3
9	Type of Operation	Suitable for single pole tripping and reclosing i.e. SPR duty	Suitable for single pole tripping and reclosing i.e. SPR duty	Suitable for three pole tripping and closing i.e. normal duty	Suitable for three pole tripping and closing i.e. normal duty
10	Minimum clearances – (mm) a) Between phases b) Between live parts and earth c) Centre to Centre distance between phases	6000 3500 7000	-- -- 4500	-- -- 1700	-- -- 430
11	Ground clearance from the lowest live terminal to breaker structure base plate (to be fixed on concrete plinth)	8000	5500	4600	3700
12	Height of concrete plinth provided by purchaser (mm)	300	300	300	300
13	Operating mechanisms	Spring operating mechanism with electrical controls			

S. No.	Items	Requirements			
		400KV	220KV	132KV	33KV
14	Rated operating sequence	0-0.3 sec-CO-3min-CO ('O' stands for opening and 'C' stands for closing)			
15	"First Pole to clear" factor	1.3	1.3	1.3	1.5
16	Type of tripping	Trip free	Trip free	Trip free	Trip free
17	Maximum closing time not exceeding (milli-seconds)	<160 ms	150 ms	130 ms	80 ms
18	Maximum total break time (milli seconds)	<60 ms	<60 ms	<60 ms	<60 ms
19	Circuit breaker opening time	< 40 ms	< 40 ms	< 40 ms	< 40 ms
20	Insulation level of breaker-				
	a) 1.2 / 50 micro second lightning impulse withstand voltage (kVP)	1425	1050	650	170
	b) 250 / 2500 micro second switching withstand voltage (kVP)	1050	-	-	-
c) One minute power frequency withstand voltage (kVrms)	i. Across earth	520	460	270	70
	ii. Between terminals	610	-	-	-
21	Maximum radio interference voltage at 266 kV rms line to ground voltage (both in close and open condition) (micro volt)	1000	1000	1000	-
22	Rated breaking current capacity:				
	i. Line charging at rated voltage at 90 deg. Leading power factor (This should be possible with temporary over voltage as high as 1.5 PU without restrike) (Amp)	600	280	250	-
	ii. Rated small inductive current without switching o/v exceeding 2.3 p.u (Amp)	0 to 10	0-10	0-10	-
	iii. Rated Short circuit breaking current (AC component) Kilo Amp	40	40	40	25
	iv. Out of phase breaking current capacity Kilo Amp	10	10	10	6.25
23	Reactor loaded transformer-interrupting capacity.	Bidder may state Limiting values, if applicable.			
24	Rated short circuit making current capacity) (Kilo Amp)	100	100	79	62.5

S. No.	Items	Requirements			
		400KV	220KV	132KV	33KV
25	Power Xmer duty requirement	315 MVA	315 & 160MVA	160 & 63MVA	63MVA (Max.)
26	Permissible limit of temperature rise	As per table given in Annexure-I			
27	Maximum acceptable difference in the instance of closing/opening of contacts:				
	i. Within a pole (milli-second)	2.5	5	5	5
	ii. Between poles (milli-second)	3.3	10	10	10
28	Total creepage distance of support insulator (mm)	10500	6125	3625	900
29	Short time current carrying capability for three seconds (Kilo Amp)	40 KA	40 KA	40 KA	25 KA
30	Breaking capacity of auxiliary contacts	10 Amp DC with Circuit time constant less than 20 ms	10 Amp DC with Circuit time constant less than 20 ms	10 Amp (With circuit time constant less than 20 ms)	10 Amp DC with circuit time constant less than 20 ms)
31	Maximum Noise level at base and upto 50 meters (dB)	140	140	140	140
32	Rated line charging current breaking capacity (Amps)	400	-	-	-
33	Trip coil and closing coil voltage	220 V DC	220/110VDC	110V DC	110V DC
34	No. of openings circuit breaker is capable of performing without inspection, replacement and maintenance				
	i. at No load	-	-	-	10000
	ii. at 50% of rated current	-	-	-	10000
	iii. at 100% of rated current	-	-	-	10000
	iv. at 50% of breaking current	-	-	-	100
	v. at 100% of breaking capacity	-	-	-	30
35	Rated single shunt capacitor bank, breaking current at 36KV Voltage in line with IEC 62271-100. (1 x 24 MVAR Capacitor Bank)	-	-	-	400 Amps (rms)
36	Terminal Connector				

S. No.	Items	Requirements			
		400KV	220KV	132KV	33KV
a.	Connection	4 inch IPS tube	Twin Zebra	Twin Zebra	Twin Zebra
b.	Type	Expansion type to receive 4 inch IPS tube	Suitable to receive Twin Zebra ACSR	Suitable to receive Twin Zebra ACSR	Suitable to receive Twin Zebra ACSR
C	Quantity	6 Nos.	6 Nos.	6 Nos.	6 Nos.
d.	Arrangement	suitable for horizontal take off	both vertical as well as horizontal take off	both vertical as well as horizontal take off	both vertical as well as horizontal take off
37	Control cable for CBs				
a	4 Core x 2.5sq.mm (15mm dia)	8	8	8	2
b	8 Core x 2.5sq.mm (19mm dia)	4	4	4	2
c	12 Core x 2.5sq.mm (22mm dia)	2	2	2	1
d	19 Core x 2.5sq.mm (25mm dia)	2	2	2	2
38	Auto reclosing	Breaker shall be suitable for single phase and 3 phase high speed auto reclosing		NA	NA
39	Static and dynamic load on foundation	-			
a.	Static load (in Kg)	Bidder may state loading	3000	1500	900
b.	Dynamic load (i) Upward (in Kg) (ii) Down ward (in Kg)		1500 2200	2000 2000	500 500
40.	Drawing Reference				
a.	For Foundation	-	JICA/MPPTCL/TR-101 TO 107/ 220KV CB Foundation	JICA/MPPTCL/ TR-101 TO 107/ 132KV CB Foundation	JICA/MPPTCL/ TR-101 TO 107/ 33KV CB Foundation
b.	For Terminal Connector	-	JICA/MPPTCL/TR-101 TO 107/ Terminal Connector		

APPENDIX-A2

LIMITS OF TEMPERATURE RISE

Temperature rise and maximum temperature attained by on any part of equipment when in service at site under continuous full load conditions and exposed continuously to the direct rays of the sun shall not exceed the maximum temperature rise specified below under conditions specified in test clauses. Permissible temperature rise indicated is for a maximum ambient temperature of 50°C. If maximum ambient temperature rises, permissible values shall be reduced accordingly.

S. No.	Nature of the Part or of the liquid	Maximum Value of	
		Temp.	Rise in temp. at Max. ambient air temp. not exceeding 50deg C
1	Contacts in air, silver-faced copper, copper alloy or aluminum alloy (see notes (i) and(ii))	105	55
	Bare copper or tinned aluminum alloy	75	25
2	Contacts in oil: Silver-faced copper, copper alloy or aluminum alloy(see note ii)	90	40
	Bare copper or tinned aluminum alloy	80	30
3	Terminals to be connected to external conductors by screws or bolts silver faced (see note iii)	105	55
4	Metal parts acting as springs	(See note iv)	
5	Metal parts in contact with insulation of the following classes:		
	a) Class Y : (for non-impregnated materials)	90	40
	b) Class A : (for materials immersed in oil or impregnated)	100	50
	c) Class E: in air in oil	120	70
		100	50
	d) Class B: in air in oil	130	80
		100	50
	e) Class F: in air in oil	155	105
100		50	
f) Oil base Enamel Synthetic Enamel in air Synthetic Enamel in oil	100	50	
	120	70	
	100	50	
6	Any part of metal or of insulating material in contact with oil, except contacts	100	50
7	Oil	90	40

Notes:

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

- ii) Quality of the silver facing shall be such that a layer of silver remains at the points of contact after the mechanical endurance test. Otherwise, contacts shall be regarded as "bare".
- iii) Values of temperature and temperature rise are valid whether or not conductor connected to the terminals is silver-faced.
- iv) Temperature shall not reach a value where the elasticity of the material is impaired. For pure copper, this implies a temperature limit of 750°C.

2.1.2 TECHNICAL SPECIFICATION FOR 33 KV VACUUM CIRCUIT BREAKERS (For 2500Amps)

1.0 SCOPE:

The scope of this specification covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the ‘MPPTCL’.

In case bidder is not OEM, sole responsibility of offering equipments/material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS:

Applicable Standards for the offered equipments/items shall be as per Section-I Volume-II.

2.1 TYPE TESTS:

The 33kV Vacuum Circuit Breaker shall be type tested for the following tests as per relevant Standards applicable for breakers as detailed out in Section-I Volume-II.

S. No.	TYPE TESTS REPORTS TO BE FURNISHED BY THE BIDDER
1	Mechanical & environmental Test
2	Temperature rise test
3	Dielectric tests
4	Power frequency voltage withstand test.
5	Making and breaking capacity tests
6	Basic short circuit test duties (for terminal faults)
7	Short time withstand current test
8	Capacitor bank current switching test
9	Seismic withstand test

Seismic withstand test on the complete equipment shall be carried out along with the supporting structure etc. Seismic level specified shall be applied at the base of the structure. Accelerometers shall be provided at the terminal pad of the equipment. Seismic test shall be carried out in all possible combination of the equipments.

Non-submission of relevant type test reports for the breakers offered by the Bidders shall be treated as disqualification.

2.2 DISCREPANCY IN TECHNICAL PARTICULARS:

Regarding discrepancy in technical particulars stipulation under Section-I Volume-II shall be applicable.

3.0 SYSTEM CONDITIONS:

Applicable climatic conditions shall be as per Section-I Volume-II.

3.1 AUXILIARY POWER SUPPLY:

Auxiliary Power Supply for offered EHV equipments shall be as per Section-I Volume-II.

4.0 PRINCIPAL PARAMETERS:

33 kV Vacuum Circuit Breakers shall conform to the specific technical requirements mentioned hereunder:

S. No.	Item	Requirements
1	Nominal system voltage(KV rms)	33
2	Highest System voltage(KV rms)	36
3	Rated frequency (Hz.)	50
4	Rated normal current (Amperes rms) at 50°C ambient temperature.	Minimum 2500 Amps
5	Type	Outdoor VCB, Normal duty type
6	Mounting Structure Details	Hot dip galvanized lattice steel support structure.
7	System Neutral earthing.	Effectively earthed.
8	Number of Poles	3
9	Type of Operation	Suitable for three pole reclosing i.e. normal duty
10	Phase to phase spacing i.e. inter pole spacing for breaker(mm)	430
11	Ground clearance from the lowest live terminal to breaker structure base plate (to be fixed on concrete plinth)(mm)	3700
12	Height of concrete plinth provided by purchaser (mm)	300
13	Operating mechanism	Motor operated spring charged operating mechanism with electrical control
14	Rated operating sequence	O-0.3 sec-CO-3min-CO
15	“First Pole to clear” factor	1.5
16	Type of tripping	Trip free
17	Closing time not exceeding	65 ± 15 milliseconds
18	Total break time	<60 milliseconds
19	Circuit breaker opening time	45 (+15 /-10) milliseconds
20	Rated insulation level with 1.2/50 microsecond lightning impulse (LI) withstand voltage(kVp)	170
21	One minute power frequency withstand voltage kV rms	70

S. No.	Item	Requirements
22	Transient Recovery voltage for terminal fault	As per IEC
23	Rated making current capacity(KA)	78 kA
24	Rated single shunt capacitor bank, breaking current at 36KV Voltage in line with IEC 62271-100. (1 x 24 MVAR Capacitor Bank)	400 Amps (rms)
25	Rated breaking current capacity: Short circuit breaking current KA (AC component)	31.5kA
26	Permissible limit of temperature rise	As per table given in Annexure-I
27	Maximum acceptable difference in the instance of closing/opening of contacts: i. Within a pole(milli-second) ii Between poles(milli-second)	5 10
28	Total creepage distance of support insulator	900 mm
29	Short time current carrying capability for 3 sec	31.5kA
30	Breaking capacity of auxiliary contacts	10 Amp DC with the circuit time constant less than 20 ms
31	Maximum Noise level at base and up to 50 meters (dB)	140
32	No. of openings circuit breaker is capable of performing without inspection, replacement and maintenance vi. at No load vii. at 50% of rated current viii. at 100% of rated current ix. at 50% of breaking current x. at 100% of breaking capacity	10000 10000 10000 100 30

5.0 DUTY REQUIREMENT:

5.1 Circuit breakers shall meet the duty requirements for all type of phase to phase and ground fault, irrespective of fault location. Breaker shall also meet idle line charging and dropping when used on an effectively grounded system and perform make and break operations as per stipulated duty cycles satisfactorily. Bidders may clarify if the 33 KV VCB offered by them are suitable for switching Shunt Capacitor Bank of 1x 24 MVAR . Bidders may furnish Test certificates to support their claim.

5.2 Critical current which gives the longest arc duration at lockout pressure of extinguishing medium i.e. vacuum and the arc duration, shall be indicated by the Bidder.

5.3 Breakers shall satisfactorily withstand high stresses imposed during fault clearing, load rejection and re-energisation of lines with trapped charges. Breakers shall also withstand the voltage specified in "Principle Parameters".

6.0 GENERAL TECHNICAL REQUIREMENTS:

6.1 Offered circuit breakers shall be of porcelain clad fitted with vacuum interrupters, suitable for outdoor operation under all tropical climatic conditions as specified.

6.2 Exposed live parts shall be placed high enough above ground level to meet the requirement of local safety codes.

6.3 Circuit breakers shall comprise of three identical pole units linked together mechanically suitable for operation with a centrally located common operating mechanism box i.e. Normal Duty type. Vacuum circuit breakers with all integral parts required for satisfactory operation shall be supplied with all accessories in position and complete internal wiring connected and terminated in the operating mechanism housing. Offered equipment shall be complete in all respect.

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

6.5 Circuit breakers shall provide rapid and smooth interruption of current under all operating conditions, completely suppressing all undesirable phenomena, even under most severe and persisting short-circuit condition or when interrupting small current or leading/lagging reactive current.

6.6 Over voltage caused by the circuit breaker switching on inductive /capacitive load should not exceed 2.5 times the normal phase to ground voltage. Total breaking time throughout the operating duty range, shall be stated and guaranteed by the Bidder.

6.7 Design and construction of vacuum circuit breaker shall be such that there is no possibility for entry of moisture. There should not be any condensation or accumulation of moisture on the internal insulating surfaces and operating rod of the circuit breaker. For this purpose complete interrupter housing and support insulator should be filled either with SF6 gas or with Nitrogen or some other dielectric medium duly pressurized to avert condensation. For monitoring positive gas pressure monitoring device shall be provided by supplier for each pole. Bidder may please note that any other devices like heater, fan etc. which requires operation monitoring on continuous basis are not acceptable to the purchaser

6.8 Circuit breakers shall be suitable for mounting on steel structure. Cost of mounting steel structure shall be included in the scope of supply. All steel structures shall be hot dip galvanized.

6.9 Bidders may please note that in MPPTCL system, the Vacuum circuit breaker will have to switch in/ switch out single 33KV Class 3 phase shunt capacitor bank of 24MVAR capacity (400 Amps at 36KV Voltage) and therefore, the offered circuit breaker shall be capable to handle ON/OFF Switching duties of the single shunt capacitor bank in line with IEC 62271-100-2001.

6.10 Circuit breakers shall be suitable for hot line washing.

6.11 All breakers shall be supplied with 1 set (6 nos) terminal connectors. Details of terminal connector required with each circuit breaker are given in para 17.0 hereunder enclosed and Bidders are required to note that the terminal connectors shall form a part of scope of supply.

6.12 Current density adopted for design of the terminal pads shall in no case exceed the following values;

- (i) For copper pads - 1.6 Amp/sq.mm.
- (ii) For Aluminium - 1.0 Amp/sq.mm.

6.13 All gasketed surfaces shall be smooth, straight and reinforced to minimize distortion and to make a tight seal. The operating rod connecting the operating mechanism to the vacuum interrupter shall have adequate seals Single "O" ring seals without test holes or Double "O" ring seals or Double lip seals and test holes for leakage test of the internal seal shall be provided on each static joint. Suitable pressure-monitoring device on each pole may be provided to ensure pressure of insulating media filled in each pole unit.

6.14 A moisture absorbing bag of adequate capacity shall also be placed in side the support insulator housing. In case SF-6 gas is used for pressurizing support insulator and interrupter insulator housing, adequate provision shall be made to eliminate mixing of SF6 decomposition products and moisture. Material used in the construction of the circuit breakers shall be fully compatible with SF6 gas.

6.15 Circuit breakers shall be provided with trip free mechanism so that trip command can over ride closing command.

6.16 Provisions shall be made for attaching operation analyzer after installation at site to record contact travel & speed and for making measurement of operation timings, synchronization of contacts of all poles.

7.0 CONTACTS:

7.1 Main contacts shall have ample area and contact pressure for carrying rated current continuously and also the short time rated current of the breaker without excessive temperature rise, which may cause their pitting or welding. Contacts shall be adjustable to allow for wear, easily replaceable and shall have a minimum of moveable parts and adjustments to accomplish desired results.

7.2 All external and internal make and break contacts shall be sealed and shall be free from atmospheric effects. Contacts shall be designed to have adequate thermal and current carrying capacity for the duty specified and to have long life expectancy so that frequent replacement due to excessive burning is minimized. Provision shall be made for rapid dissipation of heat generated by the arc on opening.

7.3 All contacts shall be of Butt type.

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

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

8.0 PORCELAIN HOUSING:

8.1. Porcelain housing shall be of single piece construction without any joint or coupling. It shall be homogeneous, free from lamination, cavities and other flaws or imperfections that might affect high mechanical and dielectric strength and shall be thoroughly vitrified, tough and impervious to moisture.

8.2. Glazing of porcelain shall be uniform, brown or dark brown coloured free from blisters, burns and similar other defects with a smooth surface arranged to shed away rainwater or condensed water particles (fog).

8.3. Housing shall be designed to have ample insulation, mechanical strength and rigidity for satisfactory operation for the conditions under which they will be used. All housing of identical ratings shall be interchangeable.

8.4 Puncture strength of housing shall be greater than the dry flashover value. When operating at normal rated voltage there shall be no electric discharge between the conductors and housing which would cause corrosion or injury to conductors, insulators or supports by the formation of substance produced by electro-chemical action. These housing when operating at the normal rated voltage shall cause no radio interference/disturbance.

8.5. All iron parts shall be hot dip galvanised and all joints shall be airtight. Surfaces of the joint shall be trued-up by grinding porcelain parts and by machining metal parts. Housing design shall be such so as to ensure a uniform compressive pressure on the joints.

8.6 Interrupter housing insulator and support insulator shall satisfactorily withstand insulation level of circuit breaker specified in para 4.0. Principal Parameters shall also be suitable for contaminated and polluted atmosphere as per relevant standard.

9.0 AUXILIARY CONTACTS:

9.1 Auxiliary switches (contacts) required for satisfactory operation of the circuit breaker, ON/OFF indicators, both in control room and cubicle in switchyard and anti pumping feature shall be provided on each circuit breaker. All these auxiliary switches and required relays with their scheme shall be included in the scope of supply.

9.2 In addition to the auxiliary switches mentioned above, the Bidder shall provide as spares ten auxiliary contacts each of the "normally-open" and "normally-closed" types which shall operate with the closing or opening of all the three poles of circuit breakers. These spare contacts shall be utilized for additional safety inter-locking and other monitoring devices by the purchaser.

9.3 All auxiliary contacts shall be placed in a weather proof casing and current rating of the switches shall be mentioned in the Bid. Provision shall be available to convert these spare "normally-open" contacts to "normally-closed" type and vice versa.

9.4 Arrangement proposed for connecting control cables to the auxiliary switches shall be clearly stated. Provision shall be made for suitable cable glands fitted on gland plate for receiving control cables required for inter connecting assemblies and the auxiliary switches of the breaker. Additional Gland plates shall be supplied duly drilled and fitted with cable glands. Gland plate and operating mechanism doors shall be provided with gasket properly. These cable glands shall be suitable for unarmoured copper control cables. Following quantities of cable glands with suitable blanking arrangement shall be fitted on the gland plate that shall be fastened suitably at the bottom of each control cabinet for connecting copper control cables provided by the purchaser :-

- (i) Suitable for 8 core x 2.5 sqmm cable : 2 nos.
- (ii) Suitable for 4 core x 2.5 sqmm cable : 2 nos.
- (iii) Suitable for 12 core x 2.5sqmm cable : 1 no.
- (iv) Suitable for 2 core x 2.5 sq.mm cable : 2 nos.

9.5 Bidders may please note that 1.1 KV grade unarmored copper control cables shall be used by purchaser and, therefore, the offered cable glands shall be suitable for above sizes of these cables.

10.0 VACUUM INTERRUPTERS:

Each pole of the circuit breaker shall be provided with Vacuum interrupter, one for each phase, hermetically sealed for life and encapsulated by ceramic insulators.

The vacuum interrupter shall be encapsulated with silicone material for long service life and avoid moisture condensation which may lead to flashover from VI's external surface. The interrupter should be such that contact gap setting is not required to be done during service life. VI with contridge cup arrangement of main contacts are not allowed. The VI should be capable of C2 class operations and should be capable of handling fault currents upto 31.5kA for 3 sec.

10.1 Design of vacuum interrupter shall be such that it gives trouble free operation under normal load and fault condition throughout the life of the equipment. As the efficiency of breaker depends on degree of vacuum inside the interrupter, manufacturer shall ensure that the same is maintained consistently during service.

10.2 Insulating ceramic body of interrupter shall have high mechanical strength and it shall be capable of withstanding high temperature without any significant deterioration in mechanical and electrical properties.

10.3 Interrupter design shall ensure rapid deionization of the gap so that normal electrical strength of the gap is restored instantaneously.

10.4 Vacuum interrupters which are used shall be so designed and augmented that a uniform voltage distribution is developed across them. Calculation/ test reports in support of the same shall be furnished along with the Bid. Thermal and voltage withstand values of the grading elements shall be adequate for the service conditions and duty specified.

10.5 Metallic bellow or the other sealing arrangement should be provided at the moving contact and should have long fatigue free life. Manufacturers' catalogue on vacuum bottle, indicating all such details shall essentially be submitted with the Bid.

11.0 TOTAL BREAK TIME:

11.1 "Total Break Time" as specified in clause 4.0, "Principal Parameters" shall not exceed under any circumstances, for the Test duties 1,2,3,4,5 (with TRV) as per IEC-62271-1

11.2 Bidders may please note that specified break time of the breaker shall not exceed under any duty conditions, variation of the trip coil voltage and arc extinguishing medium pressure etc.

11.3 Values guaranteed shall be supported with type test reports.

12.0 OPERATING MECHANISM AND ASSOCIATED EQUIPMENTS:

12.1 GENERAL REQUIREMENTS:

Bidders may please note that both trip and close mechanisms need necessarily be of spring type.

12.1.1 Each circuit breaker shall be designed for remote control operations from the control room. In addition, there shall be provision for local tripping & closing operations both by electrical & mechanical control. Mechanical arrangement should be provided to facilitate manual tripping of circuit breaker for emergency trip under emergent conditions i.e. failure of DC supply, trip coil is burnt, and trip coil mechanism is defective etc., while arc quenching medium is healthy.

12.1.2 Operating mechanism shall be spring charged type operated electrically. Mechanism shall be adequately designed & capable of performing satisfactorily all specified tripping and reclosing duty within the specified time. Entire operating mechanism control circuitry including electrical controls & monitoring devices and all other accessories as required, shall be housed in an outdoor type, hot dip galvanised steel enclosure or in an outdoor type Aluminium Enclosure. This enclosure shall conform to the degree of protection IP-55 of latest version of IS: 2147. Enclosure shall be invariably mounted on a separate concrete plinth of 300 mm height. However in case due to IP-55 protection limitations **if operating mechanism is mounted below the pole housing, in that case it should be possible for the operating personal to manually charge closing spring/mechanism from ground level including ON/OFF operation without using any stool or otherwise. However, due to any constraint if operating platform is absolutely necessary, the same shall deemed to be included in the scope of supply.**

12.1.3 All working parts in the mechanism shall be made of corrosion resistant material. All bearings which require greasing shall be equipped with pressure grease fittings. Bearing pins, bolts, nuts and other parts shall be adequately pinned or blocked to prevent loosening or changing of adjustment with repeated operation of the breaker.

12.1.4 Design of operating mechanism shall be such that it shall be practically maintenance free. The guaranteed years of maintenance free operation, number of full load and full rated short circuit current breaking/operation without requiring any maintenance or overhauling, shall be clearly stated in the Bid. As far as possible need for lubricating the operating mechanism shall be kept to the minimum and eliminated altogether, if possible.

12.1.5 Operating mechanism shall be non-pumping and trip free electrically and mechanically. A latch-checking switch shall be provided on mechanically trip free mechanism to prevent reclosing before the breaker latches have reset. There shall be no objectionable rebounds in the mechanism and it shall not require any critical adjustments at site. It shall be rigid, positive and fast in operation. Mechanism shall be such that the failure of any auxiliary spring shall not cause false tripping or closing. Operation of the power operated closing device, when the circuit breaker is already closed, shall not cause damage to the circuit breaker or endanger the operator's life. Provision shall be made for attaching an operation analyser to facilitate speed test after installation of the breaker at site. ON-OFF indicating lamps shall be provided on the mechanism box.

12.1.6 A mechanical indicator shall be provided to show open and close position of the breaker in addition to facilitate for remote electrical indication. An operation counter shall also be provided in the common operating mechanism. Mechanical indicator and operation counter shall be located in a position where it shall be visible to a man standing on the ground level with the mechanism housing doors are in closed position.

12.1.7 Circuit breaker operating mechanism shall incorporate an electrically achieved positive acting anti-pumping feature to prevent the circuit breaker from reclosing after an automatic opening when the initiating closing device is maintained in the position for closing. Necessary anti-pumping relay shall be included in the scope of supply.

12.1.8 Bidders shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual for the circuit breakers.

12.2. MOTOR OPERATED SPRING CHARGING MECHANISM:

12.2.1 Spring operated spring charging mechanism shall be complete with motor, opening & closing spring with visual indication for spring charged/ discharged condition and all necessary accessories to make the mechanism a complete operating unit. Each mechanism shall be so designed as to enable a continuous sequence of "opening" and "closing" operations to be obtained as long as power is available to the motor and at least one "opening" and "closing" operation after failure of power supply to the motor. Breaker operation shall be independent of the motor which shall be used solely for the purpose of compressing the closing spring. Motor rating shall be such that it required only about 30 seconds for charging the closing spring fully. Closing action of the circuit breaker shall compress the opening spring ready for tripping. Spring charging motor shall be AC motor (Single or 3 phase). DC Motors are not acceptable. The mechanism shall be capable of performing the rated operating duty cycle of O-0.3 Seconds -CO-3 minutes-CO. In the event of failure of power supply to spring charging motor, the mechanism shall be capable of performing one sequence of O-0.3 Seconds-CO duty. The mechanism shall undergo olive green passivation.

12.2.2 For Manual spring charging operation through operating handle, it is desired that mechanism box may be mounted at adequate height and gear ratio shall be so chosen that one man standing at ground level is able to manually charge the spring without much effort. The handle shall be either at normal operable height or otherwise a suitable 3 ft x 3 ft platform nearly 4 ft below the manual operating handle with

foldable ladder shall be provided to facilitate manual charging of spring. The operating handle for charging the spring shall be inserted from side of mechanism box and not from bottom. The spring charging facility shall have ease of operation and the movement of handle shall be in vertical plane only. The Bidder should enclose G.A. Drawings with their offer.

12.2.3 The mechanism shall be strong, rigid positive and fast in operation. Provision shall be made for local electrical control and local / remote selection with enough contacts in the cubicle of the breaker. Manual emergency local tripping arrangement shall be provided on the breaker for use in emergency during maintenance. This emergency trip is intended for use, shall a failure of any part of DC control circuits including trip coil takes place preventing remote electrical tripping. **The mechanism shall be rated for minimum 10,000 mechanical operations which are covered under M2 class test with IEC 62271- 100.**

12.3 MOTORS:

12.3.1 Motors shall be single phase self-starting induction motor of sufficient size capable of satisfactory operation for the application and duty as required for driving equipment.

12.3.2 Motors shall be of self ventilated type having TEFC (totally enclosed fan cooled) enclosure.

12.3.3 Depending upon the capacity and loading conditions supplier shall design suitable grease lubricated or oil lubricated bearings for above motors. Bearing shall be so constructed that the loss of grease and its creeping along with shaft into motor housing is prevented. It shall also prevent dirt and water from getting into the motor.

12.3.4 Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be overloaded at any operating point of driven equipment that will arise in service.

12.3.5 Motors shall be capable of giving rated output without reduction in expected life span when operated continuously in the system having the particulars as given in principle parameters.

12.3.6 All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed along with the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 85% of the rated voltage.

13.0 CONTROL:

13.1 Close and trip circuits shall be designed to permit use of momentary contact switches and trip/neutral/close switch.

13.2 Each breaker shall be provided with two independent trip circuits and coils each connected to a different set of protective relays using dedicated main and duplicate DC supplies. At no point mixing of two trip circuit supplies shall be made. Trip coil circuits shall

be suitable for trip circuit supervision in pre & post closing conditions. Purchaser would provide the trip circuit supervision relays. Bidders shall provide necessary terminals in the central control cabinet of the circuit breakers.

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

13.4 A conveniently located manual mechanical tripping lever or latch shall also be provided for tripping the breaker and simultaneously opening the reclosing circuit.

13.5 Closing coil shall operate correctly at all values of voltage between 85% and 110% of the rated voltage of closing coil. Shunt trip coils shall operate correctly under all operating conditions of the circuit breaker up to the rated breaking capacity of the circuit breaker and at all values of D.C. supply voltage between 70% and 110% of rated voltage. However, at 50% of rated voltage, the breaker shall be able to perform opening operations. If additional elements are introduced in the trip coil circuits, their successful operation and reliability for similar applications shall be ensured.

13.6 For maintenance purposes a local manual closing device alongwith a detachable handle shall also be provided. Device should be easily operable by one man standing on the ground. Direction of rotation of handle shall be clearly marked. Suitable arrangement for safe storage of handle shall be provided.

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

14.0 SURFACE FINISH PAINTING & GALVANISING:

14.1 All interiors and exteriors of tanks, mechanism, enclosures, cabinets and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil, as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paint.

14.2. All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner or hot dip galvanized or two packs of aliphatic polyurethane finished paint. All metal parts not accessible for painting shall be made of corrosion resistant material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. Paints shall be carefully selected to withstand tropical heat and extremes of weather within the limits specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external paintings shall be as per shade no. 697 of IS:5 or polyurethane paint having shade siemens graph RAL7032. All ferrous parts & steel structure including all sizes of nuts, bolts, plain and spring washers, support channels, structures, etc. shall be hot dip galvanized or stainless steel or electrogalvanised..

15.0 EARTHING:

Operating mechanism housing, control cabinets, dead tanks, support structure etc. shall be provided with two separate earthing terminals suitable for connection to earth system of substation switchyard.

16.0 NAME AND RATING PLATES:

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

- (a) Manufacturer's name & trade mark.
- (b) Serial number or type designation making it possible to get all the relevant information from the manufacturer.
- (c) Year of manufacture.
- (d) Rated nominal/highest voltage.
- (e) Rated insulation level.
- (f) Rated frequency.
- (g) Rated normal current.
- (h) Rated capacitive/inductive breaking current
- (i) Rated short circuit breaking current.
- (j) First pole to clear factor.
- (k) Rated duration of short circuit current.
- (l) Rated auxiliary DC supply voltage of closing and opening devices.
- (m) Rated out of phase breaking current.
- (n) Rated AC supply voltage of auxiliary circuits.
- (o) Mass of circuit breaker.
- (p) Rated capacitor Switching capacity.
- (q) Purchasers order no. & date.

Rating plate shall be visible in position of normal service and installation. Rating plate shall be engraved, weather proof and corrosion proof. Description on the rating plate should be given in "legible English letters".

17.0 TERMINAL CONNECTORS:

All circuit breakers shall be provided with terminal connectors suitable to receive 4' IPS Aluminium tube with arrangement for horizontal takeoff. Our standard drawing for terminal connectors is enclosed. Clamps shall be designed adequately to take care of any bimetallic effect. Temperature at the clamp shall not exceed 80°C. Terminal connectors shall be tested for short circuit current capability, temperature rise etc.

17.1. 220kV bus shall be of quadruple 'MOOSE' conductor. All circuit breakers shall be provided with flexible terminal connectors, which shall be of expansion type to receive 4 inch IPS tube or Twin Moose ACSR conductor and suitable for horizontal take off. The terminal connector shall conform to the latest version of IS:5561 or equivalent International Standard. Standard drawing for terminal connectors is enclosed. Clamps shall be designed adequately to take care of any bimetallic effect. Temperature at the clamp shall not exceed 80 deg C. Corona rings shall be provided at the breaker terminals to control the radio interference. Terminal connectors shall be tested for short circuit current capability, temperature rise, Corona inception etc.

17.2. The design of clamp shall be to our approval. The details of current take off as required by us shall be detailed out in drawing and shall be submitted along with the bid. In respect of the terminal connectors following should be ensured:-

- (a) The terminal connector should be made of A6 Aluminum Alloy and by pressure / gravity die cast only. Sand casted terminal connectors are not acceptable.
- (b) All castings shall be free from blow holes, surface blisters, cracks and Cavities. All sharp edges should be rounded off.
- (c) No part of clamp shall be less than 12 mm thick.
- (d) The bimetallic strips / sleeve shall be 2 mm thick.
- (e) All nuts, bolts & washers shall be of Hot Dip Galvanized mild steel.
- (f) The conductor should be tightened by six bolts. Conductor hold length must not be less than 100 mm.
- (g) The surface of clamps to be tightened by six bolts should be flat in shape so that it may be possible to open the nuts and bolts by normal flat spanners. Therefore, any type of groove in the clamp body for fixing of nuts should be avoided.
- (h) The portion of clamp to hold the conductor should be flat and straight and not zig-zag in construction, at both the sides, so that holding of clamp by throttling action of current may be avoided.
- (i) Space of at least 50% of diameter of nuts should be available after the hole at both the sides of conductor holding portion for better mechanical strength.
- (j) All current carrying parts shall be designed and manufactured to have minimum contacts resistance.
- (k) The clamp for Twin Moose ACSR Conductor shall be in three pieces so that each conductor may be tightened separately.
- (l) Size of terminal connector for which the clamp is designed and also rated current under site conditions shall be embossed / punched on each part of clamps except hardware.

18.0 FITTINGS AND ACCESSORIES:

18.1. Following is the list of the major fittings and accessories to be included by the bidders as an integral part of equipment. Number and exact location of these parts shall be indicated in the Bid.

- (a) Operating mechanism housing shall be complete with
 - i. Padlocks and duplicating keys.
 - ii. Trip coils/ closing coil.
 - iii. Space heater equipped with industrial grade switch.
 - iv. Cable glands.
 - v. Industrial grade receipt able type 3 pin15 Amps, power plug & socket with switch.
 - vi. Local/remote changeover switch.
 - vii. Manually operated tripping push button/lever (mechanical device convenient located to trip all three phases simultaneously).
 - viii. Pistol grip circuit breaker control switch having trip/ normal/close position.

- ix. Terminal Boards.
- x. Spring charged discharged indicator.
- xi. Operation counters.
- xii. Facility for manual charging of spring.
- xiii. Fuses/MCBs as required for AC & DC supply.
- xiv. The number of terminals provided shall be adequate enough to wire out all contacts and control circuits plus 20% spare terminals for owner's use.
- xv. Manual charging spring operating handle for maintenance.
- xvi. Auxiliary switch.
- xvii. Mechanical ON & OFF Indicator.
- xviii. Cubicle lamp with cage & switch.
- xix. Antipumping relay.
- xx. Gas pressure monitoring device for each pole with suitable glass window to monitor the pressure without opening of CB.

(b) Set of 6 nos. terminal connector clamps.

(c) Name & Rating plate in accordance with IEC incorporating year of manufacture.

18.2 FOUNDATION FOR BREAKER STRUCTURES:

MPPTCL has standardized foundation plan drawing for 33KV Vacuum circuit breaker structures and a copy of the same is enclosed. Bidders shall have to necessarily match their breaker structures with this drawing wherein centre to centre distances between bolts are indicated as 1280mm and 360mm respectively. This Foundation is designed considering for a static load of 900 Kg and dynamic load of 500 Kg. Bidders may confirm about suitability of breakers offered by them with MPPTCL Drawing no. ST/1317. Deviations if any shall be clearly brought out with justification.

19.0 VACUUM INTERRUPTERS FOR 33KV VCBs:

The requirement of Type Testing of 33KV VCB with offered interrupter is mandatory which may please be noted carefully by the Bidders. Based on feed back from the field offices, purchaser has reservations on certain makes of Vacuum bottles. The make of Vacuum bottle shall be subject to purchaser's approval.

20.0 TESTS & TEST REPORTS:

20.1 All the equipment offered, shall be fully type tested as per the relevant standards. In case the equipment of the type and design, offered, has already been type tested, Bidders shall furnish two sets of the type test reports along with the Bid. For any change in the design/type already type tested and the design/type offered against this Bid the purchaser reserves the right to demand repetition of tests without any extra cost on the first or any one unit of any rating included in the lot. . In case the equipment has not been type tested earlier, all the type tests as per relevant standards shall be carried out by the successful Bidders /supplier in the presence of purchaser's representative without any extra cost. The test reports submitted with the offer shall not be older than five years, prior to the date of opening of Bid.

20.2 Bidders shall indicate manufacturer's standard routine tests. Bidders shall completely assemble and test each breaker to ensure satisfactory working of all component parts and also assembled breakers as a whole.

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

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

20.5 A preliminary copy of the test results shall be supplied for approval before dispatch/shipment of the circuit breakers. 4 copies of complete test results shall be furnished with the circuit breakers. These shall include complete reports and results of the routine test and type tests carried out on circuit breakers of identical design.

20.6 ADDITIONAL TESTS:

Purchaser reserves the right for carrying out any other tests of a reasonable nature at the works of the supplier / laboratory or at any other recognised laboratory/research institute in addition to the above mentioned type, acceptance and routine tests at the cost of the purchaser to satisfy that the material complies with the intent of this specification. Bidders may please note that Insulation Resistance test by 5KV or 10KV megger at manufacturer's works shall be invariably carried out on each circuit breaker to record following IR values.

- (a) Insulation resistance between top terminal to earth (for open and closed condition of circuit breaker) in --- MΩ.
- (b) Insulation resistance between top and bottom Terminal in open condition of circuit breaker in --- MΩ.
- (c) Insulation resistance between bottom terminals to earth in open condition of circuit breaker --- MΩ.

21.0 INSPECTION:

21.1 Purchaser shall have access at all times to the works and all other places of manufacture where the Circuit Breakers are being manufactured and the Bidder shall provide all facilities for unrestricted inspection of the Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein. Purchaser reserves the right to insist for witnessing acceptance/routine testing of the bought out items. Supplier shall submit the routine test certificates of bought out items and raw material also, at the time of routine testing of the fully assembled breaker

21.2 No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested. Successful Bidder shall within 30 days of placement of order, submit its bought out accessories and the names of sub-suppliers.

21.3 Bidders shall indicate the inspections and checks carried out at various stages of the manufacture of the Circuit Breakers. Complete record of stage inspection would be kept by the supplier and this record should be made available for inspection by the representative of the Purchaser. Supplier should indicate the manufacturing programme and the Purchaser will have a right to depute inspecting officers during the manufacture of the equipment. Purchaser reserves the right to carry out stage inspections at all stages, for which advance intimation shall be given and all necessary cooperation shall be rendered by the manufacturer.

21.4 At the time of inspection, Supplier shall identify each and every item/accessories of the particular Circuit Breaker under testing. Unless all the items are identified, the manufacture will not be treated as complete. Various tests stipulated in IS/IEC shall be performed in the presence of purchaser's engineers or when the inspection waiver has been given, in such a case, testing shall be done at the manufacturer's works as per IS/IEC stipulations and same should be confirmed by documentary evidence by way of Test Certificate which shall be got approved by the purchaser.

21.5 It is expected that before a Circuit Breaker is finally offered for inspection, internal testing of the same for various important parameters are already done. Routine test report for such tests shall also accompany the letter of inspection call so that the Inspecting Officer at the time of inspection may verify the parameters brought out in the preliminary report. Details of all tests should be clearly brought out.

21.6 In case for any reasons inspection is not completed or equipment is not found to be complete with all accessories as per confirmation given with the letter of inspection call, Purchaser will reserve the right to recover complete cost of deputation of inspecting team to the works of the manufacturer.

21.7 Acceptance of any quantity of circuit breaker & its accessories shall in no way relieve the successful Bidder of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipments are later found to be defective.

22.0 QUALITY ASSURANCE PROGRAMME:

The Quality Assurance Programme of this specification shall be as per Section-I Volume-II.

23.0 DOCUMENTATION:

23.1 List of Drawings and Documents:

Bidders shall furnish four sets of relevant descriptive and illustrative published literature, pamphlets and following drawings for preliminary study, along with their offers;

- (a) General outlines drawings showing dimensions and shipping weights, quantity of insulating media, air receiver capacity etc.

- (b) Sectional views showing the general constructional features of the circuit breaker including operating mechanism, arcing chambers, contacts with lifting dimensions for maintenance.
- (c) All drawings & data typical and recommended schematic diagram for control supervision & reclosing shall be annotated in English. .
- (d) Schematic diagrams of breaker offered for control supervision and reclosing.
- (e) Structural drawing, design calculations and loading data for support structures.
- (f) Short circuit oscillogram & certificates for similar type tested breakers. General arrangement of foundation and structure mounting plan including weights of varnish components and impact loading data for foundation design.
- (g) Type test reports.

23.2 Successful Bidders shall, within two weeks of placement of order, submit four sets of final version of all the above drawings for purchaser's approval. Purchaser shall communicate his comments/approval on the drawings to the supplier within two weeks. Supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for purchaser's approval within two weeks from the date of comments. After receipt of purchaser's approval, the supplier shall, within three weeks, submit 4 prints per breaker and two set of good qualities reproducible of the approved drawings for purchaser's use.

23.3 Successful Bidders shall also furnish two sets each of bound manuals covering erection, commissioning, operation and maintenance instructions and all relevant information and drawings pertaining to the main equipment as well as auxiliary devices alongwith each breaker. Marked erection drawings shall identify the component parts of the equipment as shipped to enable erection by purchaser's own personnel. Each manual shall also contain one set of all the approved drawings, type test reports as well as acceptance reports of the corresponding consignment dispatched.

23.4 Manufacturing of equipments shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser.

23.5 Approval of drawings/work by purchaser shall not relieve the Bidders of any of his responsibility and liability for ensuring correctness and correct interpretation of the drawings for meeting the requirements of the latest revision of the applicable standards rules and codes of practices. Equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of supply and reserve the right to reject any work or materials which, in his judgment, is not in full accordance therewith.

23.6 Additional data to be furnished along with the Bid:

- (a) Drawing, showing contacts in close, arc initiation, full arcing, arc extinction, and open position.
- (b) Temperature v/s Pressure curves for each setting of density monitor, along with details of density monitor.
- (c) Data on capabilities of circuit breakers in terms of time and number of operations at duties ranging from 100% fault currents to load currents of the lowest possible value without requiring any maintenance or checks.

- (d) Effect of non-simultaneity between contacts within a pole or between poles and also how it is covered in the guaranteed total break time.

24.0 PACKING AND FORWARDING:

Equipment shall be prepared for ocean shipment (foreign equipment) or rail road transport (local equipment). Equipment shall be packed in suitable crates in such a manner to protect it from damage and withstand handling during transit. Supplier shall be responsible for and make good at his own expense any or all damage to the equipment during transit, due to improper and inadequate packing and handling. Easily damageable materials shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost. Each consignment shall be accompanied by a detailed packing list containing the following information:

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

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

25.0 COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS:

Bidders must furnish following information along with technical bid.

25.1 A list of all the accessories which will be supplied with the breakers should be furnished. While furnishing the list of accessories, items which will be manufactured by the Bidders and balance items, which will be procured from sub-suppliers should be clearly identified and stipulated in the Bid.

25.2 It is obligatory on the part of Bidders to ensure that supply of all accessories along with Main equipment are simultaneously delivered so that erection and commissioning work of equipment can be completed properly. Responsibility for obtaining timely supplies of bought out items will rest with the Bidders and only on this basis, delivery period will be offered in the Bid.

26.0 It may be noted that in case of damages/shortages due to improper packing or any other negligence, replenishment shall be arranged within one month time. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and also in case defective supply of any item is reported will rest on the Bidders. In case for attending to defect in any accessory or inspection/ replacement of the accessory,

which may be bought out item for the Bidders; if services of engineer of original manufacturer is required, the same will be organized on immediate basis by the Bidders at their cost.

27.0 PREFERRED EXPERIENCED MANUFACTURER:

Based on our past experience for this item we will accept equipment manufactured by M/s ABB/ Andrew Yule /Areva/ BHEL/CGL/ Megawin as far as this item is concerned.

ANNEXURE-A

LIMITS OF TEMPERATURE RISE

Temperature rise and the maximum temperature attained by on any part of equipment when in service at site under continuous full load conditions and exposed continuously to the direct rays of the sun shall not exceed the maximum temperature rise specified below under the conditions specified in test clauses. Permissible temperature rise indicated is for a maximum ambient temperature of 50°C. If maximum ambient temperature rises, permissible values shall be reduced accordingly.

S. No.	Nature of the Part or of the liquid	Maximum Value of	
		Temp.	Rise in temp.at max ambient air temp. not exceeding 50°C
1	Contacts in air, silver-faced copper, copper alloy or aluminum alloy (see notes (i) and (ii)).	105	55
	Bare copper or tinned aluminum alloy.	75	25
2	Contacts in oil: Silver-faced copper, copper alloy or aluminum alloy (see note ii).	90	40
	Bare copper or tinned aluminum alloy.	80	30
3	Terminals to be connected to external conductors by screws or bolts silver faced (see note iii).	105	55
4	Metal parts acting as springs.	(See note iv)	
5	Metal parts in contact with insulation of the following classes:		
a.	Class Y : (for non-impregnated materials)	90	40
b.	Class A : (for materials immersed in oil or impregnated)	100	50
c.	Class E : in air in oil	120	70
		100	50
d.	Class B : in air in oil	130	80
		100	50
e.	Class F : in air in oil	155	105
		100	50
f.	Oil base Enamel	100	50
	Synthetic Enamel in air	120	70
	Synthetic Enamel in oil	100	50
6	Any part of metal or of insulating material in contact with oil, except contacts	100	50
7	Oil	90	40

Notes:

- i. When applying the temperature rise of 55°C , care should be taken to ensure that no damage is caused to the surrounding insulating materials.
- ii. Quality of silver facing shall be such that a layer of silver remains at the points of contact after the mechanical endurance test. Otherwise, the contacts shall be regarded as "bare".
- iii. Values of temperature and temperature rise are valid whether or not the conductor connected to the terminals is silver-faced.
- iv. Temperature shall not reach a value where the elasticity of the material is impaired. For pure copper, this implies a temperature limit of 75°C .

ANNEXURE-I

**DESCRIPTION OF EQUIPMENT INCLUDED IN THE SCHEDULE-I OF
PRICES FOR EACH PACKAGE**

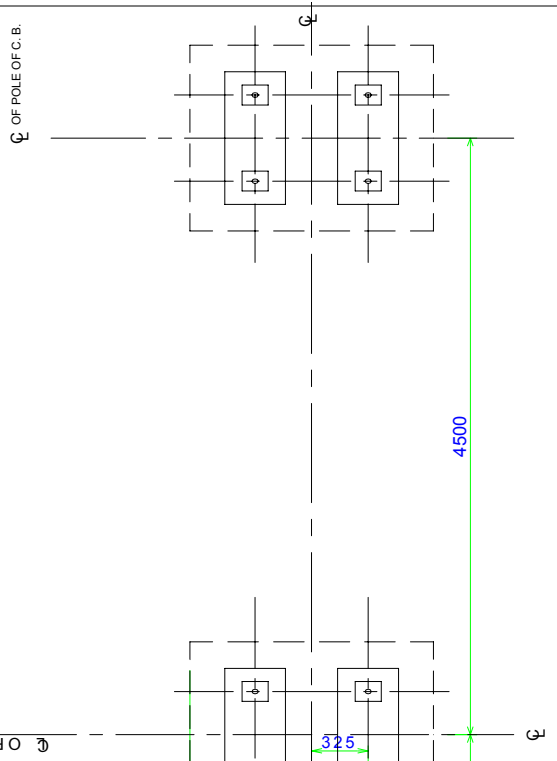
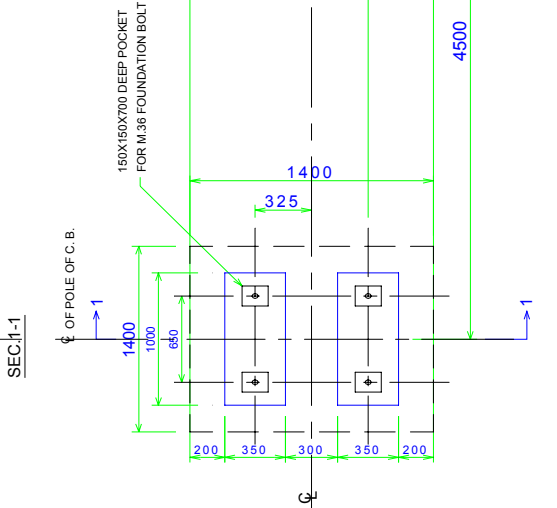
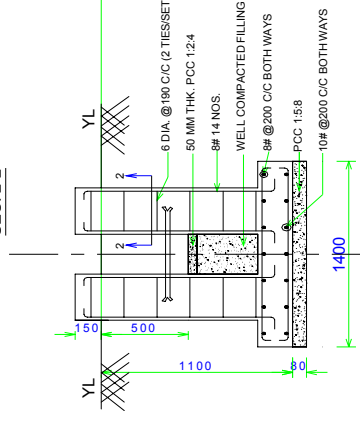
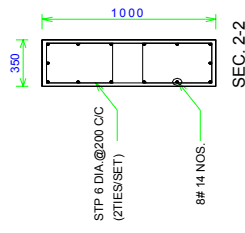
S.No.	Particulars of equipment/ Item
1	Supply of 33KV Vacuum Circuit Breaker suitable for 2500A nominal current complete with all accessories including mounting structures, terminal connectors, etc. conforming to all technical requirements as described in the Bid document but including foundation bolts.

NOTE: The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment

APPENDIX-B
DRAWINGS

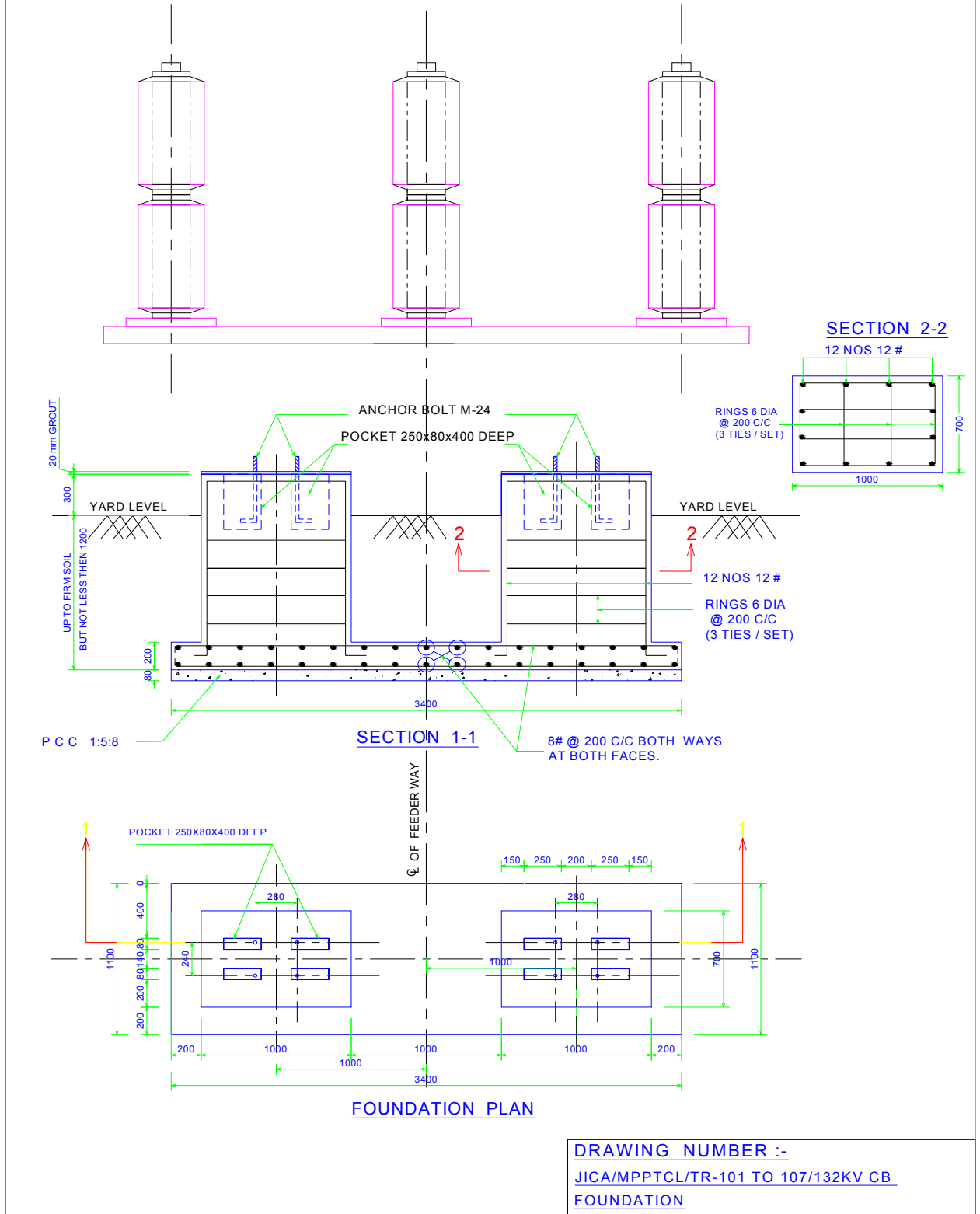
S. No.	Drawing No.	Description
1	JICA/MPPTCL/TR-101 TO 107/ 220KV CB FOUNDATION	Foundation Drawing for 220KV SF6 Circuit Breaker
2	JICA/MPPTCL/TR-101 TO 107/ 132KV CB FOUNDATION	Foundation Drawing for 132KV SF6 Circuit Breaker
3	JICA/MPPTCL/TR-101 TO 107/ 33KV CB FOUNDATION	Foundation Drawing for 33KV VCB.
4	JICA/MPPTCL/TR-101 TO 107/ TERMINAL CONNECTOR	Drawing for Terminal connector for 220/132/33 KV CB

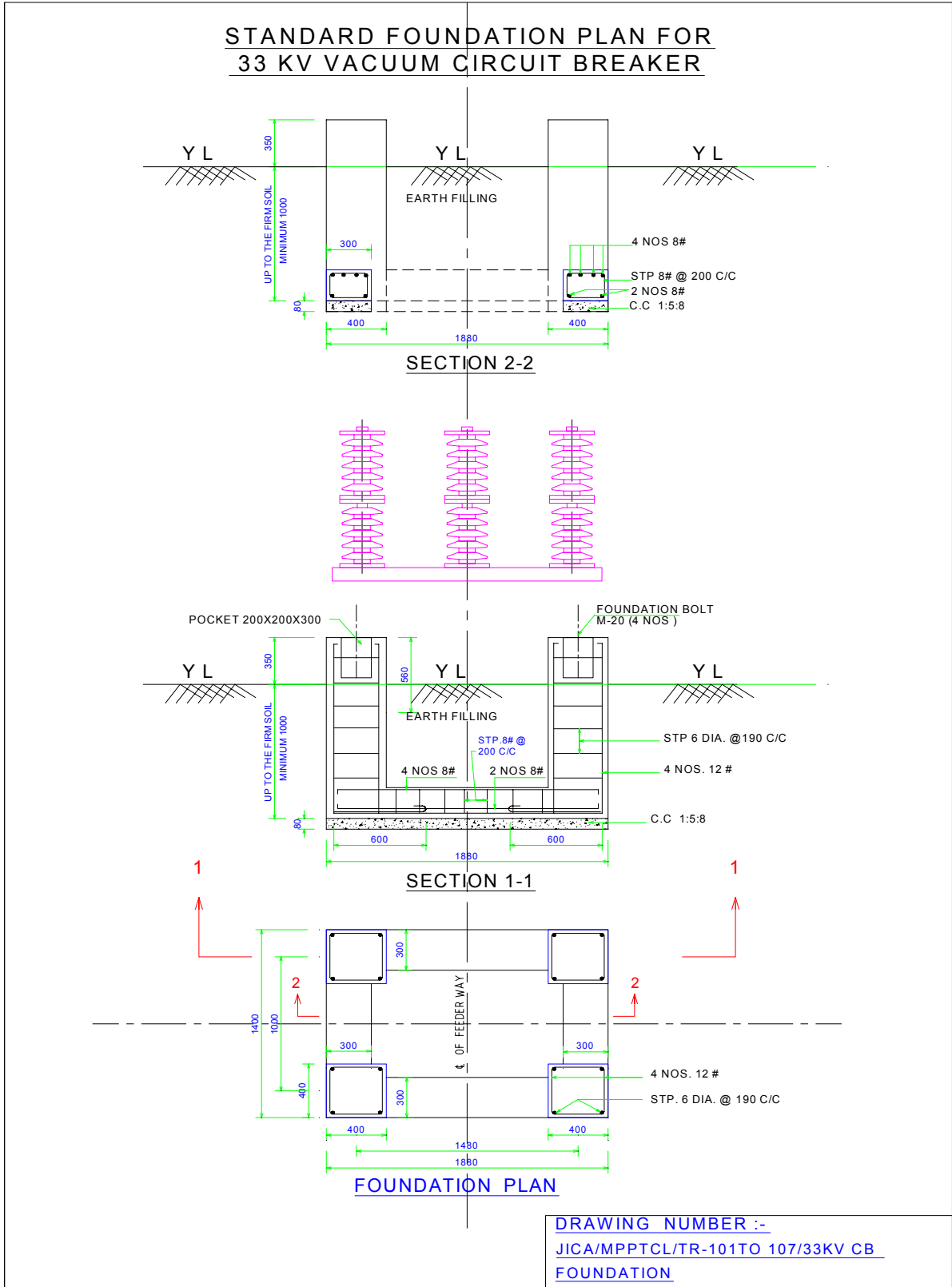
STANDARD CIVIL FOUNDATION PLAN FOR 220 KV SF6 CIRCUIT BREAKER (SPR) DUTY

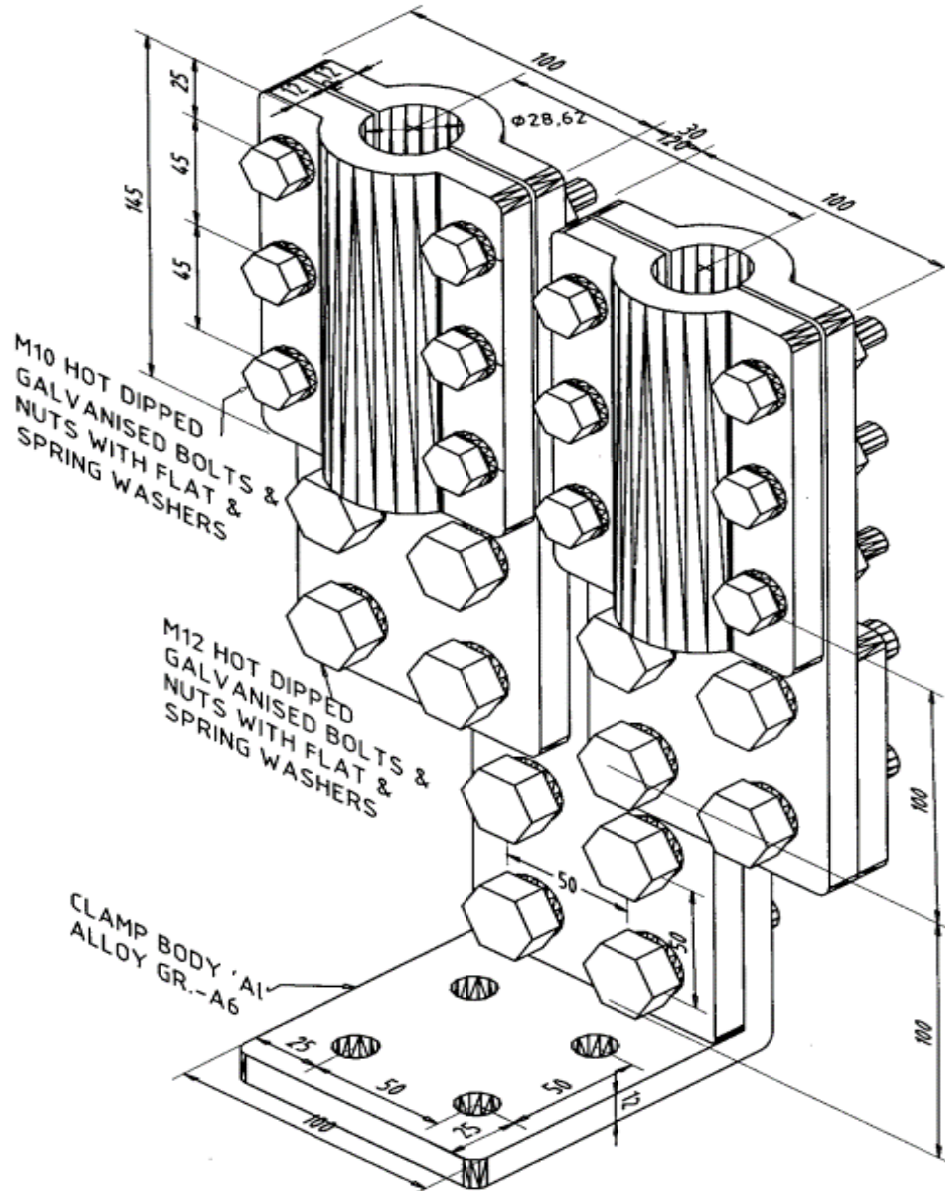


DRAWING NUMBER :-
JICA/MPPTCL/TR-101 TO 107/220KV CB FOUNDATION

**STANDARD CIVIL FOUNDATION PLAN
FOR 132 KV SF6 CIRCUIT BREAKER (NORMAL DUTY) TYPE**







S. No.	DESCRIPTION	MATERIAL	QTY.
1	CLAMP	ALLUMINIUM ALLOY GR.-A6	1
2	KEEPER	ALLUMINIUM ALLOY GR.-A6	2
3	BOLT & NUT M-10	HOT DIP GALVANISED M.S.	12
4	BOLT & NUT M-12	HOT DIP GALVANISED M.S.	12
5	FLAT WASHER (M-10 BOLT)	HOT DIP GALVANISED M.S.	12
6	FLAT WASHER (M-12 BOLT)	HOT DIP GALVANISED M.S.	12
7	SPRING WASHER (M-10 BOLT)	HOT DIP GALVANISED M.S.	12
8	SPRING WASHER (M-12 BOLT)	HOT DIP GALVANISED M.S.	12

TERMINAL CONNECTOR SUITABLE FOR TWIN/SINGLE ZEBRA CONDUCTOR

DRG. No. JICA/MPPTCL/TR-101-107/TERMINAL CONNECTOR

SCHEDULE-I (A)**DESCRIPTION OF EQUIPMENT FOR SCHEDULE FOR RATES & PRICES
TO BE FURNISHED IN VOLUME-VI**

S.No.	Particulars of equipment/ Item	Qty.
A	400kV SF6 Circuit Breaker	As per Price schedule
1	Supply of 400KV SF6 Circuit breakers complete with pre- insertion resistors and all accessories is including mounting structures, terminal connectors, gas leak detector and adapter for gas Filling etc. conforming to all technical requirements as described in the Bid document including foundation bolt.	
2(a)	Supply of 400KV SF6 Circuit breakers complete without pre-insertion resistors and all accessories including mounting structures, terminal connectors, gas leak detector and adapter for gas Filling etc. conforming to all technical requirements as described in the Bid document including foundation bolt	
B	220kV SF6 Circuit Breaker	
1(a)	Supply of 220KV SF6 Circuit breakers complete with all accessories including mounting structures, terminal connectors, gas leak detector and adapter for gas filling etc. conforming to all technical requirements as described in the bid document including foundation bolt	
C	132kV SF6 Circuit Breaker	
1(a)	Supply of 132 KV SF6 Circuit breakers complete with all accessories including mounting structures, terminal connectors, gas leak detector and adapter for gas filling etc. conforming to all technical requirements as described in the bid document including foundation bolt	
D	33KV Vacuum Circuit Breaker	
1(a)	Supply of 33KV Vacuum Circuit Breaker complete with all accessories including mounting structures, terminal connectors, etc. conforming to all technical requirements as described in the bid document but including foundation bolts	
1(b)	Supply of 33KV Vacuum Circuit Breaker (for 2500 Amps) complete with all accessories including mounting structures, terminal connectors, etc. conforming to all technical requirements as described in the bid document but including foundation bolts	

NOTE:

1. **The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.**
2. **The quantity of above equipments has been mentioned in Volume VI**

SECTION-II (A)**TECHNICAL SPECIFICATION FOR 400KV AND
220KV INDOOR CONTROL AND RELAY PANELS****1.0 SCOPE:**

The scope of this specification covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Specification means "Original Equipment Manufacturer (OEM)". The purchaser means the 'MPPTCL'.

In case bidder is not OEM, sole responsibility of offering equipments/material of manufacturer as per this specification requirement shall rest on the bidder.

i. 400KV CONTROL & RELAY PANELS:

400KV control, protection and relay Simplex design panels are required for 400KV substations. Offered protection and control schemes for 400 KV "SIMPLEX" panels shall be suitable for "TWO MAIN AND ONE TRANSFER BUS SWITCHING SCHEMES". Bidders are required to offer following five categories of "SIMPLEX" type panels:

i.	Simplex type Control and Relay panels for 400 KV lines.
ii.	Simplex type Control and Relay panel for 400kV side of 315 MVA, 400 / 220 / 33 KV Interconnecting transformer / 100 MVA 400/132/33 KV transformer
iii.	Simplex type Control and Relay panel for Transfer Bus Coupler application
iv.	Simplex type Control and Relay panel for Bus-tie/tie breaker application
v.	Simplex type Control and Relay panel for bus reactor application

ii. 220KV CONTROL & RELAY PANELS:

220 KV control, protection and relay Simplex design panels are also required for 400KV substations for 220kV system. Offered protection and control schemes for 220 KV "SIMPLEX" panels shall be suitable for "TWO MAIN AND ONE TRANSFER BUS SWITCHING SCHEMES". Bidders are required to offer following five categories of "SIMPLEX" type panels:

i.	"SIMPLEX" design Control & Relay panels for 220 KV transmission lines.
ii.	"SIMPLEX" design Control & Relay panels for 220KV Transfer Bus coupler application.
iii.	"SIMPLEX" design Control & Relay panels for 220 KV Bus tie application.
iv.	"SIMPLEX" design Control & Relay panels for 220 KV Side of 400/220 KV 315 MVA transformer
v.	"SIMPLEX" design Control & Relay panels for 220/132/33KV, 160MVA transformer / 220/33 KV 100 MVA Transformer
vi.	"SIMPLEX" type Control and Relay panel for bus reactor application

iii. The bidder may please note that both 400kV & 220kV C&R panels for feeder and bus coupler protection shall have main I & main II protection. The

main I shall be line current differential protection relay and main II shall be distance protection relay. However the supply of line current differential protection relay shall not be in the scope of bidder. As such, both panels shall be supplied with one DPR relay along with installation arrangement for line current differential protection relay with complete wiring provision in the panel so that both the relay could be put into circuit as per our requirement. However final protection scheme for 220 kV Feeder & Bus Coupler Panel shall be finalized during detailed engineering in consultation with PGCIL.

2.0 LIMITS OF CONTRACT:

2.1 It is not the intent to specify completely here all the details of design and construction of the control and relay panels. However, the C&R panels shall conform in all respects to the high standard of engineering design and workmanship. Various control and relay panels and other requirements specified under this section shall be complete in themselves in all respect with all main and auxiliary relays, fuses, links & switches duly wired, labels terminal panels, earthing terminals, indicating lamps, mimic diagram, annunciator, name plate, foundation bolts, interior illumination, cable termination arrangement with cable glands fitted on base mounting plate etc. including all other accessories which are essentially required for satisfactory operation . Such components shall be deemed to be within the scope of supply of the Bidder irrespective of whether these are specifically brought out in this specification or not.

2.2 Supply and laying of control and power cables for interconnecting various equipments is not covered under the specification. Cable terminating arrangements, viz. the cable hold support boxes, multi-core cable glands, sealing ends for other types of cables that may be specified, shall however be included in the offered price. These shall be subject to approval of purchaser. It is the responsibility of Bidder to ensure that the equipment specified and complimentary equipment required for completeness of the protection/control scheme be properly accommodated in the panels without congestion and if necessary Bidder may provide panels with larger dimensions in width only.

3.0 SYSTEM CONDITIONS:

Applicable climatic conditions shall be as per Section-I Volume-II.

4.0 STANDARD SPECIFICATIONS:

400KV and 220KV Simplex design C&R panels shall match with MPPTCL standard drawing copies of which are enclosed.

4.1.1 PANEL FINISH AND COLOUR: 400KV & 220KV SIMPLEX DESIGN PANELS:

400 KV & 220 KV C&R panels for all applications shall be of Simplex design and each panel shall be constructed of stretched – level selected sheet steel. Simplex type panels shall be made in suitable sections so that while mounting the panels can be located side by side with a view to form a compact unit. The major difference between 400 KV & 220KV Simplex design panels is that while the 400KV panels have doors at the rear, the 220KV Simplex design panels have swing type doors on the front with rear blocked.

4.1.2 400 KV C&R panels of Simplex design shall consist of a vertical front panel with all equipment mounted thereon including protective relay, indicating / recording instruments and energy meters etc. and having wiring access from the bottom. Double leaf door with lift off hinges shall be provided at the back. Doors shall have handles with built in locking facility. Bidders may please note that 400 KV Simplex panels shall be

fabricated of not less than 2.5mm thick steel sheet free from all surface defects. The panels have sufficient structural reinforcement to ensure a plain surface and rigidity to limit vibration during dispatch, installation and service.

4.1.3 220 KV C&R panels shall also be of SIMPLEX design having front swing door with relays flush mounted and rear blocked. These panels will be of free standing unitized construction with members folded and bolted.

- Load bearing members (front panel, base frame, door frame) will be 3mm thick.
- Non load bearing members (side panel, cubicle roof, door) will be 2mm thick.
- Cubicle bottom will be closed and shall have slots for cable entry. These will be covered by detachable plates.
- Weight of one Control and Relay panel shall be 600 to 650 Kg approx.
- Panels will comply with ingress protection degree IP54 as per IS2147.
- All doors and metal joints will be provided with foam type gaskets as per IS 13847.
- 15mm thick anti vibration pad will be provided loose (to be fixed below the base frame of the panel).
- Width of the panel shall be strictly maintained as 1000mm.
- Swing front panel shall be rigid with suitable guided bolt at bottom.

A drawing is appended herewith which shows the elevation, end view and 3D view of Simplex design 220KV Control and Relay panels.

4.1.4 Common Features applicable for both types of panels –

- 400KV & 220KV SIMPLEX panels shall be dust, moisture and vermin proof.
- All unfinished surface of steel panels and frame work shall be thoroughly cleaned by sand blasting, pickling and rinsing or by combination of processes or by other latest and improved techniques to remove dust, scales, foreign adhering matter and grease. Cleaning process shall be followed immediately by the application of rust inhibiting wash process. All control panels surfaces shall then be given suitable rust resisting primary coat and then one or more coats of opaline green quick drying enamel to serve as a base and binder for finishing coat.
- As mentioned earlier, purchaser has 61hosphat61ed colour schemes for SIMPLEX design 400 KV & 220 KV C&R panels which shall be **smoke gray** as per the colour shade No. 692 of IS :5 for 400 KV panels and **opaline green** as per colour shade No. 275 of IS : 5 for 220KV panels.
- Purchaser will accept respective matching colour and shade equivalent to BS-381 or any matching colour and shade of other authoritative equivalent standard. Colour finish shall be applied as per above colour scheme on the exterior steel works of the panels. Exterior painted surface shall not be fully glossy. Interior of all panels shall be painted with "Egg Shell White". Pretreatment & painting process is described in Clause 14.0. All steel works shall be 61hosphat61e in accordance with IS-6005. Panels shall be provided a degree of protection not less than IP-54 as per IS-2147.

COMPLIANCE OF PANELS, RELAYS, INSTRUMENTS AND OTHER GADGETS WITH STANDARD SPECIFICATIONS:

4.2.1 STANDARDS:

Applicable Standards for the offered equipments/items shall be as per Section-I Volume-II.

4.2.2 ACCEPTANCE OF OTHER AUTHORITATIVE STANDARDS:

In Annexure-A relevant Indian standard specification/IEC standards have been mentioned. Equipments meeting any other authoritative standard, which ensures equal or better quality than the standards, mentioned shall also be acceptable. Equipment for which Indian Standards are not available, the relevant British standards and IEC recommendations will be applicable. Please attach photocopy of all such standards according to which the equipment has been offered.

4.2.3 TYPE TESTS:

All offered numerical distance and differential protection relays as well as other static/electromechanical relays and meters on C&R Panels offered by the Bidders and as indicated below shall be fully type tested as per relevant standards. In case the equipment of the type and design offered, has already been type tested, the Bidder shall invariably furnish type test reports from the reputed and approved national/international laboratory/Government approved test houses to prove that indicated accuracy and other specifications of the relays offered conform to the relevant standards. Test certificates shall clearly indicate the type and model number etc., so that relevant details of offered relays could be verified. While submitting offers the model and type etc., shall be clearly indicated. Type test reports so furnished should not pertain to the period earlier than five years from the date of opening of Bid. It may be very specifically noted by Bidders that non-submission of type test reports about numerical and conventional relays and also about static meters along with the Bid shall be treated as a disqualification.

i.	Numerical distance protection relays
ii.	Numerical differential protection relay for X-mer & reactor
iii.	Numerical backup impedance relay for reactor
iv.	Numerical, Non directional and communicable 3 O/C + 1 E/F Relays as backup protection on 220 KV panels
v.	Static trivector energy meter of accuracy Class 0.2S
vi.	Multifunction meter of accuracy Class 0.5

4.2.4 DISCREPANCIES IN TECHNICAL PARTICULARS:

Regarding discrepancy in technical particulars stipulation under Section-I Volume-II shall be applicable.

4.3.0 PANEL CUT OUT AND DIMENSIONS:

4.3.1 As mentioned earlier, the C&R panels for both voltage classes, i.e. 400 KV & 220 KV shall be of Simplex design and while the Simplex design panel for 400 KV C&R panels shall have opening at the rear, the Simplex design 220 KV panels shall have a swing type front door and rear blocked.

4.3.2. Bidders may please note that the scheme / arrangement of panels envisaged for 400 KV transmission line protection is such that the control gadgets shall be housed in one panel and there shall be a provision for one relay panel to accommodate Main – I and Main – II schemes alongwith their associated periphernia. Thus, there shall be two nos. panels in all. As regards the 315MVA, 400 / 220 / 33KV transformers, there shall be two panels in all: one of which shall be control panel and the other shall be exclusively a relay panel. The quantities of panels required for each application for 400 KV as well as 220KV systems is summarized below –

S. No.	Description/ application	400KV system		220KV system	
		Simplex design Control panel	Simplex design Relay panel	Simplex design Control panel	Simplex design /Relay Panel/ Control & Relay panel
1.	Transmission line protection	01	01 (one for Main-I & Main-II protection schemes both)	01	01 (Relay Panel one for Main-I & Main-II protection schemes both)
2.	HV side of 315 MVA/100 MVA transformer	01	01	Nil	Nil
3.	MV side of 315 MVA/100 MVA transformer	Nil	Nil	Nil	01 Both Control and Relay Panel in one Panel
4.	HV side of 160 MVA/ 100 MVA transformer	Nil	Nil	Nil	01 Both Control and Relay Panel in one Panel
5.	TBC application	01	01 (one for Main-I & Main-II protection schemes both)	01	01 (Relay Panel one for Main-I & Main-II protection schemes both)
6.	Bus-tie application	01	Nil	Nil	01 Both Control and Relay Panel in one Panel
7.	400KV bus & line Reactor application	01	01	Nil	Nil
8.	For Bus-tie breaker protection	01	01	Nil	Nil

Bidders may please note that although GA drawings for individual applications mentioned above are not being furnished with the Bid document, all the same, the aforementioned table need be strictly followed in so far as number of panels for each application is concerned. Control panel for tie breaker in case of 400kV substations where one and half breaker switching scheme is applicable need also be supplied as a part of scheme for protection.

4.3.3 Constructional details & dimensions for 400 KV and 220 KV SIMPLEX type panels shall be as under:-

S. No.	Title	400 KV PANELS	220 KV PANELS
1	Type	Simplex (Control panel and relay panel) Please refer no. SK273 for dimensional details	Simplex design Control & Relay panel as shown in MPPTCL's standard drawing.
2	Height (mm)	2312 (Panel 2210 + base frame of 102 mm)	2312 (Panel 2210 + Base frame 102)
3	Depth (mm)	762 mm	750 mm
4	Width (mm)	i. Control panel – 700 mm ii. Relay panel – 700 -1000 mm (Subject to variation as per scheme requirement)	1000 mm (Subject to variation as per scheme requirement)
5	Base frame	Anticorrosive Black painted	Anticorrosive Black painted
6	Panel Exterior	Smoke grey	Opaline Green
7	Panel Interior	Egg Shell white	Egg Shell white
8	Mimic strips over laid type	Dark violet	Dark Brown
9	Variation in dimension of panels.	Bidder may please note that the height and depth of control panels will have to be maintained as mentioned against Sl.No. 2&3 above. As far as width of the control panels is concerned the same may be offered based on Bidder's optimum design to accommodate various relays and accessories, which are to be mounted on the panels.	Bidder may please note that the height and depth of control panels will have to be maintained as mentioned against Sl. No. 2&3 above. As far as width of the control panels is concerned, this shall also be maintained as 1000 mm as per S.No.4 above.
10	MPPTCL's Standard Drawing	Bidders shall ensure to match panels offered by them with MPPTCL's standard drawing enclosed herewith.	Bidders shall ensure to match panels offered by them with MPPTCL's standard drawing enclosed herewith.

4.3.4 The purchaser has standardized dimensions of panels for various applications and therefore no deviation in height / depth of panels in particular shall be permitted. The width of the panels is however subject to change. Bidders may please note that preferred cut out dimensions for mounting of control gadgets and relays shall be strictly inline with IS-4483 (Part I & II).

4.3.5 It is hereby clarified that standard drawing showing C&R panels for 400 & 220KV voltage classes have been developed considering that the Numerical Distance Protection relays offered by the Bidders have the protection, recording and metering functions listed elsewhere in the document, built in them. For

example, relays type LBB, NDR, DTOC have been considered built in the DPR or Differential and therefore has not been shown as discrete relays. Accordingly, Bidders will have to offer discrete relays for trip circuit supervision, DC supply supervision even these relays are also built-in feature of the numerical relays. This has to be noted specifically.

4.3.6 Control and Relay panels shall be floor mounting dead front sheet steel assemblies of unitised design. Panels shall be made in suitable sections as described else where in the specification so that while mounting, panels can be located side by side bolted together to form a compact and composite unit. Design, material selection, workmanship, and width of panels shall be such as to present a neat appearance, outside and inside with no works of welds, rivets, screw or bolts head apparently visible from the exterior surface of the control panels.

4.4.0 LIGHTING:

4.4.1 In each SIMPLEX panel, one 20 W, 230V AC tube light guarded with protected cage shall be provided inside the central roofed access for adequate illumination & the same shall be controlled by a door switch. Two incandescent 40 Watt (or 15W CFL) 230 Volt lamps with switch housed in protective cage, one each on the front & rear side of the panels shall be provided under the central roofed access.

One number 15A, 3 pin receptacle universal socket with switch shall be provided in each simplex control panels. Third pin of the socket shall be effectively grounded through the metallic structure. Socket shall be industrial grade control panels type complete with protective metallic cover.

4.5.0. AUXILIARY SUPPLY:

4.5.1 The auxiliary AC / DC supply shall be as per clause No. 6 Section-I Volume –II Part I of the specification

There shall be two independent DC supply sources suitable for 220V DC at 400 KV sub-stations.

4.5.2 Two dedicated separate DC supervision relays for each transformer or feeder circuit at 400 KV sub-stations shall be provided in control panels in the 400 KV sub-stations to monitor healthiness of each of the two main and duplicate DC supply. Main DC supply shall be connected to main protection relay, control, and indication circuit. Other (duplicate) DC supply shall be used exclusively for second trip coil and associated relays and related application. For each trip coil separate trip circuit supervision relay and healthy indication shall be provided including facility for pre and post close supervision. Main DC supply in manual and auto trip circuit and control for the second trip coil in the breaker control switch shall not be mixed up or paralleled with the main DC supply, to ensure tripping through second trip coil even though the first trip coil is burnt or becomes defective. Similarly auto trip through main protection relay should energize trip coil-I using main DC supply and backup protection relay should energize trip coil-II using duplicate DC supply. It is desired that at no point the main and duplicate DC supply should be paralleled.

4.5.3 Bidders shall take due care to indicate two separate DC supply sources in the schematic drawing showing the DC supply arrangement for panels.

4.5.4 Isolating devices with H.R.C. fuses shall be provided in each panels for both A.C. and D.C. power supplies. Distribution and wiring of the same shall be unitized through fuses and links in such a way so that isolation of respective system unit is possible without affecting the rest of the system or unit.

4.5.5 All H.R.C. fuses and links shall be with holder, and the same shall be mounted on slant support with identification labels.

4.5.6 H.R.C. fuses shall be provided as per following details;

S. No.	Circuit	Fuse Rating
1.	Circuit breaker-closing circuit	16A
2.	Trip circuit –I	16A
3.	Trip circuit –II	16A
4.	Main Protection	10A
5.	Back up protection	10A
6.	Indication	6A
7.	Annunciation	2A
8.	P.T. Circuit main	2A
9.	P.T. supply for Metering circuit	2A
10.	A.C. supply	5A

NOTE: Additional HRC fuses and links for individual circuit shall also be provided as per the requirement for completing the offered protection scheme.

4.6.0 CONTROL WIRING:

4.6.1 Successful Bidders shall furnish and install complete wiring up to the terminal block for the equipment, instrument devices mounted in the control panels strictly in accordance with the approved wiring diagram prepared by the Bidder based on the purchaser's information and schematic diagram.

4.6.2 Wiring shall be completed in all respects so as to ensure proper functioning of control, protection and metering schemes.

4.6.3 All spare relay contacts and spare contacts of switches shall be wired up to the terminal blocks.

4.6.4 Wiring shall be done with flexible heat resistant control panels wires, PVC insulated with stranded copper conductor. Minimum number of strand in the wire shall be three. The conductor size shall be equivalent to 2.5 mm square minimum for Current, potential & DC Control circuit and 1.5mm sq minimum for other indications and annunciation circuits.

4.6.5 Coloured cores shall be used for wiring as per latest revision of IS-375 viz; red yellow blue and black for R Y B phases and neutral respectively. Colour code for earthing shall be Green, and for annunciation circuits gray colour code shall be used. For DC circuits the colour code will be grey.

4.6.6 Each wire shall be identified at its both ends with wire designation number by plastic ferrule as per wiring diagram based on latest revision of IS-375 to denote the different circuit functions. Bidders shall take approval for the system of wire numbering and colour coding schemes. For identifying each wire bidders should provide wire schedule for each wire with drawing.

4.6.7 All wire terminations shall be made with compression type connectors. Wires shall not be tapped or spliced between terminal points. All wire shall have crimp type termination and direct Tee connection at any place is not at all required.

4.6.8 All series connected devices and equipment shall be wired up in sequence. Loop-in Loop out system of wiring shall be avoided as far as possible and the common buses shall normally be made through the terminal block for better reliability of testing and maintenance.

4.6.9 Fuses and links shall be provided for isolation of individual circuit from bus bars without disturbing other circuits and equipment.

4.6.10 DC trip and DC voltage supplies and wiring to main protective gear shall be segregated from those for special purposes. Each such group shall be fed through separate fuses, either direct from main supply fuses or the bus bars.

4.6.11 Since a number of wires will run from one point to another, it is desired that the support arrangement should be adequate and neat. Conventional method of bunching of wires should not be adopted since the same creates problems in case any wire is to be removed. Wires should be accommodated in suitable plastic channels with sliding plastic cover, which may be suitably mounted inside the panels neatly. Inspection/removal of wires laid in the plastic channels should be possible by sliding the covers.

4.6.12 Blank plastic channels should be provided by the sides of the panels to accommodate incoming cables from switchyard through cable glands with suitable holding arrangement rigidly fixed so that while handling other nearby cables no jerks are transferred to the terminals inside the cubicle.

4.6.13 Wherever practicable wiring shall be accommodated in the sidewall of the cubicles. Sharp bends shall be avoided.

4.7.0 TERMINAL BLOCKS:

4.7.1 Multi-way terminal blocks complete with necessary binding screws and washers for wire connection and marking strip for circuit identification shall be furnished for terminating the panel wiring and outgoing cables. Terminals shall be suitable for receiving atleast 2x7/0.737mm stranded copper conductor or equivalent aluminum conductor wires per terminal. It may please be noted that the current rating shall be double the current rating of 2x7/0.737 non stranded copper wire and terminal shall be suitable to receive 2x2.5sq mm/or 2x4sq mm copper conductor of control cable.

4.7.2 Terminal blocks shall have shorting and disconnection facilities ,so that the Board side and outgoing wires could be disconnected just by opening the disconnecting links which slides up or down without dislodging the wires from their position. The technical specification for these blocks shall conform to latest IEC 60947-7-1 as mentioned hereunder -

'The screw terminal block shall be manufactured as per IEC-60947-7-1. The insulating material of Terminal Block shall be of polyamide 6.6 meeting VO / V2 inflammability class as per UL 94. All metal parts including screws shall be copper alloy. The terminal shall be suitable for mounting on both 'DIN' as well as 'G' type rail. All the metal parts shall be captive and touch proof. The terminal block shall have screw locking design so that it can be stand vibration level upto 5g and also prevent accidental loosening of conductors.'

Non-disconnecting and disconnecting type terminal connectors shall be made of polyamide and shall be preferably of 'ELMEX' make having type designations KBTM4 and KL TDM4 respectively.

4.7.3 Highly reliable Test terminal blocks with facilities of shorting and easy removal of connection shall be provided for CT & PT circuits. Instrument transformer wires shall be terminated through suitably mounted test terminal blocks to facilitate site testing of all main and backup protection relays.

4.7.4 Test terminal blocks shall be grouped according to the circuit functions and each terminal block group shall have at least 20% spare terminals for accommodating additional input wires.

4.7.5 Not more than two wires shall be connected to any terminal or either side of the terminal block. If necessary, a number of terminals shall be connected by jumpers to provide additional wiring points.

4.7.6 Each terminal point shall be marked with designation obtained from the purchaser's schematic drawings.

4.7.7 Adjacent rows of terminal blocks shall be spaced not less than 100mm apart. These shall be mounted vertically at the sides of the cubicle and set obliquely towards the rear doors to give easy access to terminating end to enable ferrule number to be read without difficulty.

4.7.8 Bottom of terminal blocks shall be spaced at least 200mm above the cable gland of incoming multicore cables.

4.8 CABLE ENTRY:

4.8.1 All panels shall have provision of multiple cable entries from the bottom. Necessary cable glands should also be provided in the rear & front side of panels on a 4 mm thick mild steel gland plate to be bolted firmly with nut and bolts on base plate. Base plate shall be bolted further on the base frame with adequate number of nuts & bolts as may be necessary to allow free working space for cable connections and to facilitate its opening. Base plate shall be in 3 pieces for Simplex panels and one piece for simplex panels with proper opening for fixing gland plates. Thickness of these base plates shall not be less than 4 mm. Base plate provided on the base frame is to facilitate free working space and also to serve as a cover for control cables laid in the trenches from front to rear side of the Simplex panels. Purchaser will arrange for necessary floor opening below the panels to suit the cable trench design of purchaser's requirement.

4.8.2 Wiring through the terminal blocks shall be located in a manner that it becomes convenient to provide termination of control cable for floor openings.

4.8.3 Gland plate shall be supplied duly drilled and fitted with cable glands. Gland plate and doors shall be provided with gasket properly. Necessary glands as per clause- 4.8.5 below shall be fitted on the gland plate.

4.8.4 Rigid supports shall be provided along with terminal block for holding plastic channel. Suitable clamps may also be provided in plastic channel for holding cables.

4.8.5 Following quantities of cable glands with suitable blanking arrangement shall be fitted on the gland plate that shall be fastened suitably at the bottom of each of the 400 & 220 kV Simplex design panels quantities shown below shall be provided at the rear and front both panels:-

i	For 4 core x 2.5sq.mm 1.1KV Copper control cable	8 nos.
ii	For 8 core x 2.5sq.mm 1.1KV Copper control cable	4 nos.
iii	For 12 core x 2.5sq.mm 1.1KV Copper control cable	2 nos.

iv	For 19 core x 2.5sq.mm 1.1KV Copper control cable	2 nos.
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Bidders may please note that for control, protection and relay panels for use in 400 & 220KV substations, armoured / unarmoured copper control cables respectively shall be used by the purchaser. Offered cable glands shall be suitable for armoured and unarmoured copper control cables accordingly.

4.9.0 GROUNDING:

4.9.1 12.5mm x 6mm copper grounding bus shall be provided for each control panels extending along with entire length of the panels for the purpose of effectively grounding all metal structures.

4.9.2 Each continuous length of ground bus shall have provision of two terminals at two extreme points for connection to main ground grid of the substation.

4.9.3 Common star /neutral point of Potential and current transformer shall be connected with the grounding bus through a disconnecting type connector so as to adopt single point grounding of common star point either at the terminal block in the control panels or in the marshalling box of the instrument transformer.

4.9.4 Whenever any circuit is shown grounded on the drawing a single wire for that circuit shall be run independently up to the ground bus and connected to it.

5.0 CONTROL & RELAY PANELS:

As stated earlier, Control & Relay panels for 400 & 220KV voltage classes shall be of Simplex design. Full constructional details in respect of these panels, their colour scheme, details about the sheet steel utilized for construction and about other constructional aspects, have been elaborated in para nos. 4.0 and 4.3.

6.0 CONTROL AND INDICATION CIRCUITS:

6.1 Control and Indication circuits for each circuit breaker controlling feeder, shall generally comprise of the following:

- a. Mimic diagram
- b. A composite meter to indicate current, voltage, watts, VARS and Power factor.
- c. Circuit Breaker Control switch.
- d. "Trip coil / closing coil Healthy" lamps.
- e. Alarm cancellation arrangement.
- f. Breaker ON/OFF indication lamps.
- g. Energy meter with display facility of various electrical quantities viz., MW, MVA, MVAR, power factor etc.
- h. Facia annunciating windows
- i. Test terminal block and Relay Test Block on the front panels for testing of meters and relays as per specified scheme in Simplex panels.
- j. Relay Test Block on rear side of Simplex panels as per scheme.
- k. Any other devices which may be necessary for completing scheme based on improvement in design and adoption of new technology by the Bidder.
- l. In case of 400KV C&R panels provision of synchronizing plug and for 220KV C&R panels in out switch.

6.2 MIMIC DIAGRAM:

6.2.1 Mimic diagrams for 400 as well as 220KV Systems shall be made to represent TWO MAIN & ONE TRANSFER BUS Scheme and shall be placed at the eye level to

indicate position of each breaker. Power transformer, voltage transformer shall be fixed on mimic by suitable symbols having dark Black colour. Position indicator of isolating devices shall have matching colour in accordance with the voltage class of the mimic. Arrangement shall be of overlaid design using anodized aluminum section. Bidders may please note that Painted type mimic diagrams are not acceptable.

6.2.3 Offered mimic diagram shall have colour scheme for representing 400 KV voltage levels as Dark Violet and for 220KV the colour scheme shall be dark brown / violet.

6.3 CIRCUIT BREAKER & ISOLATING DEVICE POSITION INDICATORS (SEMAPHORES):

6.3.1 Position indicators of 'SEMAPHORE' TYPE shall be provided as part of the mimic diagrams on panels for indicating the position of circuit breakers and isolating devices, as mentioned earlier. Indicator shall be suitable for semi-flush mounting with only front disc projecting out and with terminal connection from the rear. Colour of position indicator strips shall be matching with the colour of associated mimic. Position indicators shall be suitable for DC operation. When the supervised object is in the closed position, the pointer of the indicator shall take up a position in line with the mimic bus bars, and at right angles to them, when the object is in the open position. When supply failure to the indicator occurs, the pointer shall take up an intermediate position to indicate the supply failure. Position indicators shall withstand 120% of rated voltage on continuous basis.

6.3.2 All 400 and 220 kV isolating devices and earth switches are required to be operated directly from the control room. Isolator operation shall be interlocked with the breaker operation and the earth switch operation shall be interlocked with the operation of both isolating device and breaker. For above purpose 3- position (close-open & return to neutral) pistol grip control switch shall be provided near to the respective semaphore for closing and opening operation of these devices by extending close and open command with desired interlocks specified above.

7.0 ANNUNCIATION SYSTEM:

7.1 Alarm annunciation system shall be provided for each panels by means of visual and audible alarm in order to draw the attention of the operating staff to the abnormal operating conditions or the operation of some protective device. Annunciation equipment shall be suitable for operation under the tolerance limit of voltages specified in this specification.

7.2 Annunciation shall be of visual and audible type. Facia annunciator, flush mounted on the front of the control panels, shall provide the visual annunciation. DC hooter or DC bell shall provide the audible alarm. Apart from requirement of facia windows for annunciating status of various relays, the Bidder shall also provide spare facia annunciator windows (two nos. each) for trip and non-trip functions.

7.3 Each facia annunciator shall have a minimum size of 35 mm X 50 mm-translucent plastic window for each Trip and alarm point. Translucent plastic plates of facia window shall be engraved in black letters with respective inscriptions. All inscriptions shall be engraved on each window in not more than three lines and size of letters shall not be less than 5 mm.

7.4 Each annunciation window shall be provided with two white lamps in parallel to provide safety against lamp failure. Long life lamps shall be used. Lamp circuit shall include series resistor of adequate rating. Cover plate of the facia windows shall be

flush with the panels and shall be capable of easy removal to facilitate replacement of lamps. Transparency of cover plates and wattage of the lamps provided in the fascia windows shall be adequate to ensure clear visibility of the inscriptions in the control room having high illumination intensity (500 Lux) from the location of the operating staff desk.

7.5 TRIP and NON TRIP fascia shall be differentiated. All trip windows shall have red colour translucent plastic window and all non-trip fascia windows shall have white colour translucent plastic window. Sequence of operation of the annunciator shall be as follows:

Alarm condition	Fault contact	Visual Annunciation	Audible Annunciation
Normal	Open	OFF	OFF
Abnormal	Close	Flashing	ON
Acknowledge push button is pressed/	a. Close	Steady on	OFF
	b. Open	Steady on	OFF
Reset push button is pressed.	a. Close	ON	OFF
	b. Open	OFF	OFF
Lamp test push button pressed.	Open	Steady on	OFF

7.6 Any new annunciation appearing after the operation of audible annunciation cancel, shall provide a fresh additional annunciation accompanied with visual alarm even if acknowledging or resetting of previous alarm is in process or yet to be carried out.

7.7 Annunciation system described above shall meet the following additional requirements:

- a. Annunciation system shall be capable of catering to at least 80% simultaneous signals (of windows provided) at a time.
- b. One self resetting push button shall be provided on each panels for testing the fascia window lamps. Push buttons for testing flasher and audible alarm circuit of annunciation system and for testing the annunciation supply failure monitoring circuit shall also be provided. These testing circuits shall also be so connected that while test is being done it shall not prevent the registering of any new annunciation that may land up during the test.
- c. One set each of the following push buttons shall be provided on each panels as shown in the front view drawing:
 - i Reset push button for annunciation system.
 - ii Accept push button for annunciation system.
 - iii Test push button for testing healthiness of annunciator. The operation of this button should not cause inadvertent operation of any equipment.
- d. Annunciation shall be repetitive type and shall be capable of registering the fleeting signal. Minimum duration of fleeting signal registered by the system shall be 15milli seconds.
- e. Annunciation shall be suitable for operation with normally open potential free contacts which close on a fault. It shall be possible at site to change operation of annunciator from potential free contact from "close to fault" to "open to fault" and vice versa.
- f. In case of static annunciator scheme, special precaution shall be taken by Bidder to ensure that spurious alarm condition does not appear due to

influence of external electromagnetic/electrostatic interference on the annunciator wiring and switching disturbances from the neighboring circuits within the panels.

- g. Offered annunciation scheme shall be complete in all respects including annunciator relay, flasher relay, test, accept and reset push buttons.
- h. Additional four spare windows two each for non trip and trip signals supported by trip relay for future application by the purchaser shall be provided duly wired up and terminated to the row of connectors.
- i. For each signal receiving through yard a separate Aux relay should be provided. No Signal from yard should be directly connected on window facia.

8.0 PROTECTION SCHEMES:

8.1 Protection schemes for 400kV and 220 kV systems included in this Bid are required for the following applications:

400 KV SYSTEM	
1	Control & Relay panels for 400 KV lines.
2	Control & Relay panel for 315MVA /100MVA , 400/220/33KV Transformer.
3	Control & Relay panel for Transfer Bus coupler application.
4	Control & Relay panel for bus tie application
5.	Control and Relay panel for bus reactor application
6.	Control and relay panel for protection of Tie Breaker application

220 KV SYSTEM	
1	Control & Relay panels for 220 KV lines.
2	Control & Relay panels for Transfer Bus coupler bays.
3	Control & Relay panels for bus tie bays.
4	Control & Relay panel for 220KV side of 400/220 KV, 315MVA, Transformer at 400 KV S/S
5	Control & Relay panel for 160MVA/100 MVA power transformer
6	Control and Relay panel for bus reactor application

8.2 PROTECTION SCHEMES FOR 400KV & 220KV LINES:

8.2.1 General philosophy is to have two main protections having equal performance requirement specifically about the “time of operation” hereinafter referred to as Main I & Main II Schemes for 400 KV & 220 KV Transmission lines. These schemes shall be in the form of Numerical relays / One Distance Relay and One differential Relay having built in back up protection, based on different fault detection algorithms and of different make. However, as mentioned differential relay is not required to be supplied by the bidder, where all wiring arrangement and provision for installation of differential relay is required to be made in the panels for 400& 220kV line protection panel.- Main I and Main II schemes for 400 KV & 220 lines shall be suitable for use with CVTs having transient response as per IEC. Besides Main I & Main II, the 400 KV lines shall be provided with two stage OVERVOLTAGE PROTECITON which can form integral part of the Numerical relays. For both 400 & 220 KV lines the maximum fault current could be as high as 40 KA and the minimum fault current could be 20% of rated CT secondary i.e. 1 A. As such, the starting and measuring units should suit to these requirements. Finally, protection schemes for both 400 & 220 KV lines shall be “Non-Switched Schemes” having separate measurements for phase to phase to phase to ground faults for each zone. **Please note that Supply of Line Differential relay is not in scope of bidder. Required Line Differential Relay for Feeder/TBC panels will be provided by**

purchaser however necessary wiring and fixing arrangement of numerical differential relays are to be provided by bidder. It is obligatory for bidder any other auxiliary relays required for fruitful operation of panel shall invariably be provide by the supplier. However, supply of distance relay for main II protection of feeder & bus coupler panel and differential relay for transformer panel is in the scope of the bidder. Bidder should note that no tripping command / closing command shall be directly connected through numerical relay. For Tripping / auto re closing of circuit breaker high speed tripping relay should be provided.

8.2.2 SALIENT FEATURES OF MAIN-I & MAIN-II DISTANCE PROTECTION SCHEMES

- i. Offered scheme shall have continuous self monitoring and diagnostic feature.
- ii. Offered scheme shall have stepped time-distance characteristics and three independent zones (zone 1, zone 2 and zone 3) and Zone 4 for reverse reach.
- iii. Offered scheme shall have mho or quadrilateral or other suitably shaped characteristics for zone-1, zone-2 and zone-3.
- iv. Offered scheme shall have following maximum operating time (including trip relay time, if any) of 30 milli seconds for all types of faults and source to line impedance ratio of 4.0.
- v. Offered relays shall have characteristics angle between 30 and 85 degrees.
- vi. Offered relays shall have resetting time of less than 50 milli seconds including the resetting time of tripping relays.

Other important requirements about Numerical relays pertaining to their protection, metering and recording functions have been elaborated in the subsequent clauses which may be carefully noted.

8.2.3 ~~For 220 KV lines, main protection shall be in the form of numerical distance relay along with all standard supporting relays.~~ It may be noted that, 400 as well as 220 KV circuit breakers will have two trip coils which will receive simultaneous trip command. As such schematic shall be made to select main DC supply or duplicate DC supply for each trip coil as stated in the previous section. For this purpose, contact multiplication will not be acceptable but the rating of the breaker control switch and each tripping relay contacts shall be adequate to handle the burden of two trip coils. Pistol grip type breaker control switches along with red and green indicating lamp for ON/OFF indication shall be provided.

- **Offered distance protection schemes for both 400 KV and 220 KV lines shall be suitable for single pole tripping and auto reclose duty and they shall have facility for check synchronising.**
- **Salient requirements about automatic reclosing scheme –**

Auto re-closing function shall be separate for Main-I & Main-II protection schemes and shall have following features –

- i. Single phase or / and three phase re-closing facilities
- ii. Have a continuously variable single phase dead time range of 0.1 to 2 secs in steps of 0.05 sec.
- ix. Have a continuously variable three phase dead time range of 0.1 to 2 secs in steps of 0.05 sec.

- x. Shall have a continuously variable reclaim time range of 5 – 300 secs in steps of 0.05 sec.
- xi. Shall have a two position selector switch from which auto-reclose IN /Out mode can be selected.
- xii. Shall have facilities for selecting check synchronizing or deadline charging facilities.
- xiii. Shall be of single shot type.
- xiv. Shall include check synchronizing relay which will have following features–
 - a. A time setting range continuously variable between 0.5 and 5 secs. with a facility of additional 10 secs.
 - b. Shall have a response time within 200 mili secs. with the timer disconnected.
 - c. Shall have phase angle setting not exceeding 35 degrees.
 - d. Shall have voltage difference setting not exceeding 10%.
 - e. Shall include deadline charging relay which shall have 2 sets of relays and each set shall be able to monitor the three phase voltage where 1 set shall be connected to the line CVT with a fixed setting of 20% of rated voltage and the other set shall be connected to Bus PT with a fixed setting of 80% of rated voltage.
 - f. Shall incorporate necessary auxiliary relays and timers to give a comprehensive scheme.
- xv. Shall have a two position selector switch from which Carrier IN/Out mode can be selected.

8.2.4 All 400KV and 220KV transmission lines are generally laid on double circuit transmission towers and each circuit is protected against lightning by ground wire joined at each tower. Maximum fault currents in both these voltage classes could be as high as 40KA but the minimum fault current could be as low as 20% of CT secondary rating (1A). Thus, starting and measuring relay characteristics should satisfy both extreme conditions. Numerical distance protection relay shall be suitable for use with CVTs also having non-electronic damping and transient response as per IEC. It shall be ensured that no additional delay to block tripping is involved in relay operating time created intentionally to have stable operation. Power supply unit if provided as an integral part of relay scheme shall be fully rated with liberal design in capacity. Insulation barriers shall be provided to ensure that transient present in CT and VT signals due to extraneous sources do not cause damage to static circuits. Circuits must comply with IEC recommendation for impulse withstands values. Adequate measures shall be taken to ensure that equipment is protected against voltage spikes occurring in auxiliary DC supply.

8.2.5 Numerical distance protection schemes offered by the Bidders for 400KV and 220KV lines shall have the following features -

- Numerical distance protection relay shall be capable of providing flexible, reliable integration of protection, control, and monitoring and measurement functions.
- Offered relay shall have 6 nos. of impedance measuring loops.
- Offered relay shall be suitable for protection of broken conductor following one out of three phases getting open circuited without any line or ground fault. Protection shall perform satisfactorily both for loaded and unloaded line condition.

- Offered relay shall preferably have independent polygonal characteristics with adjustable reactive and resistance reaches for maximum selectivity and maximum fault resistance coverage due to arc resistance.
- Offered relay shall provide selection and setting for mutual compensation of double circuit lines.
- Offered relay shall have minimum three directional zones and minimum one non-directional zone. Zone setting ranges shall be sufficient to cover line lengths appropriate to each zone. It shall have Carrier aided scheme options of Zone-I extension, permissive under reach or over reach and blocking.
- Offered relay shall have maximum operating time up to trip impulse generated from relay (complete protection time including applicable carrier time and tripping time)for the following source to line impedance ratios under all possible combination of line fault with CVT being used on the line at 50% of Zone-I reach:-

for Source Impedance Ratio 0.01 4 : 30ms at nearest end and 50ms at other end of line.

for Source Impedance Ratio 4 -15 : 35ms at nearest end and 55ms at other end of line.

- Offered relay shall have a secured directional response under all conditions, achieved by memory voltage polarizing or healthy phase voltage polarizing as may be appropriate.
- Offered relay shall have logic to detect VT fuse failure. Bidders shall clearly state if VT fuse failure for all the three phases can be detected individually.
- Offered relays shall be suitable to detect switch on to fault (SOTF) condition by appropriate means. Bidders may elaborate the SWITCH ON TO FAULT logic.
- Offered relay shall have LBB relay as a built in feature to take care of stuck breaker condition. If it is not so, then the Bidders may have to offer discrete relay to take care of stuck breaker condition.
- Offered relay shall have power swing blocking feature with suitable coverage to encircle distance relay characteristic with facilities for
 - (a) Fast detection of power swing
 - (b) Selective blocking of zones and
 - (c) Settable deblocking criteria for earth faults, phase faults and three phase faults.
- Offered relay shall have minimum three directional and one non-directional step time distance characteristics with independently variable time graded distance protection zones to cover two adjacent line sections.
- Offered scheme shall have minimum adjustable characteristics line angle setting range of 30 -85 degrees.
- Offered relay shall have load encroachment feature.
- Offered relay for 400 KV feeder shall have out of step protection.
- **Offered Distance schemes for 400KV & 220KV lines shall be suitable for single pole tripping and reclosing duty as stated in the previous para.**
- Offered relay shall be selective for internal and external faults.
- Offered relay shall have minimum two independent continuous variable time setting range of minimum 0-1 second for zone-2 and minimum 0-3 seconds for zone-3 in step of 0.01 secs. Variable time settings for non-directional zone shall also be provided to set minimum trip time of 0-5 seconds, over and above time settings for directional zones in step of 0.01 secs .
- It is desired that the total operating time of the offered relay need not exceed 30 ms.
- Offered relay shall have maximum resetting time of less than 35ms.

- Offered relay shall have built-in extensive self-supervision and diagnostic testing facility.
- Suitable number of potential free contacts if required (multiplied through reed relays only) may be provided on each distance scheme for carrier aided selection of permissive tripping and blocking and auto reclosing. Provision for event sequence recorder, stuck breaker, disturbance recorder, fault locator etc. shall be available.
- Offered relay shall be capable of performing basic metering functions. Voltages, Currents, Active and Reactive power registration shall be available on demand.
- Offered Numerical Distance relays shall be suitable for use on series compensated transmission lines. This is a desirable feature but it is not mandatory.
- Offered relay shall be capable of supporting IEC 61850 communication standard.
- Offered relay shall have two communication ports. Front port shall be for local communication for relay settings, modifications, extraction / analysis of fault / event / disturbance records from a lap top computer and there shall be rear port on 61850 standard for remote communication.
- Offered relay shall have following tools for fault diagnostics.
- Offered relay shall have minimum 12 digital inputs and 18 digital outputs.

i. FAULT RECORDS -

Relay shall have facility to store fault records with information on cause of tripping, date, time and trip values of electric parameters. It shall be capable of storing not less than 8 nos. of previous fault records.

ii. EVENT RECORDS -

Relay shall have facility to store 200 nos. time stamped event records with 1 ms resolution.

iii. DISTURBANCE RECORDS -

Number of available analogue channels and digital channels shall not be less than 8 and 32 respectively. Triggering for capturing / recording of disturbance should be possible from within the distance relay and / or from any other disturbance within the EHV sub-station. Offered relay shall necessarily have a storage capacity of atleast 8 disturbance records of 3 sec. duration each.

iv. Disturbance recorder, fault recorder and distance to fault locator functions shall be provided as integral part of the line protection relays.

- Offered relay shall have front panels display with keys to enter scroll through the settings and to view the measurements. It shall also be possible to take data from a pre-stored file in the PC and download the settings to the relay through the front port.
- Offered relay shall have directional phase over current and earth fault protection.
- Offered relay shall have non-directional phase over current and earth fault IDMT protection with high set element for instantaneous tripping.
- Offered relay shall have under / over voltage protection (Two stage).

- Offered relays shall conform to communication protocol no. IEC-61850 as stated earlier.
- Offered relay shall have self-monitoring and fault diagnostic feature with appropriate annunciation. User definable LEDs shall be provided for visual indication. Necessary serial ports and parallel ports with leads and termination shall be provided.
- Offered relay shall have facility for communication from remote sub-station (inline with IEC 61850 standard) so that these relays can be used for sub-station automation. Required hardware and software shall be included in the offered relay.
- Offered relays shall have port type IRIG – B for time synchronization.

Bidders shall elaborate following features of the numerical relays offered by them.

- i. Various programmable features of the relay
- ii. Application.
- iii. Relay functions.
- iv. Block diagram for hardware of the relay.
- v. Metering and recording.
- vi. Human machine interface.
- vii. Suitability of the relay for IEC communication protocol no. IEC-61850.

~~8.2.6 Besides the built in back-up protection in the Numerical Distance Relay, an additional Numerical, Directional, Non Communicable, 3 O/C + 1 E/F Relay is envisaged only on 220 KV feeder panels.~~

~~8.2.7 Bidder may please note that the feeder panel for 400 KV and 220 KV line shall have phase measurement units as per latest recommendation of CEA/WRPC. The phase measurement may be integral part of distance protection relay or separate unit shall have to be provided.~~

8.2.8 It may please note that for preclose supervision and post close supervision of trip coil six nos. Trip circuit supervision relay has to be provided Separately.

8.2.9 It may please be noted that for D.C. supervision of the panel two nos DC supervision relay has to be provided separately.

8.3. PROTECTION SCHEMES FOR 315MVA, 400/220/33KV, 100 MVA 400/132/33 KV, 220KV/ 33KV 100MVA & 160MVA, 220/132/33KV POWER TRANSFORMERS

8.3.1. Transformer protections required for 315 MVA, 400/220/33KV, 100 MVA 400/132/33 KV, shall be provided by two nos independent fully numerical transformer differential relay . Transformer protection required for 220KV / 33KV 100 MVA & 160MVA, 220/132/33KV Power Transformers shall be provided by one no fully numerical transformer differential protection relay. The offered numerical differential relay shall be suitable for protection of 3 winding transformer without external interposing CTs. In case protection requirement calls for providing interposing CTs, same shall be provided by the bidder in the control panel without additional cost. It should be ensured that differential Protection offered is stable under through fault condition, normal and over fluxing conditions and shall not operate with magnetizing inrush current. Bidders shall give all details of the protection offered. Differential relay shall have current rating of 1 Amp CT secondary and the total operating time shall not exceed 30 ms. from inception of fault up to contact status changing of output relay. Relay should have Bias setting adjustable from 15% to 50% with through fault current not less than 10 times the normal current. Operating characteristics should have dual

slope for enhanced sensitivity for internal faults and better stability during through faults. Fifth harmonic by-pass filters shall be provided to avoid possible mal-operation under over-fluxing conditions. Relay shall have three instantaneous high set over current unit and shall have continuous self monitoring and self diagnostic features. Visual indication and alarm shall be provided in this panel for over fluxing relay, and for standard Transformer protections. Alarm indication for SF6 gas pressure low, lockout, and air pressure low shall be provided along with, Inter trip and trip transfer indication. The offered differential relays shall also be suitable for IEC communication protocol 61850.

8.3.2 Numerical differential protection schemes offered by the Bidders for 400KV and 220KV Transformer shall have the following features :

- i. The scheme shall be based on numerical technology.
- ii. The scheme shall be suitable for three winding transformer with REF protection.
- iii. It should be ensured that differential Protection offered is stable under through fault condition, normal and over fluxing conditions.
- iv. Numerical differential relay shall not operate with magnetizing inrush current.
- v. Differential relay shall have current rating of 1 Amp CT secondary.
- vi. The total operating time shall not exceed 30 ms. from inception of fault up to contact status changing of output relay.
- vii. Relay should have Bias setting adjustable from 15% to 50% with through fault current not less than 10 times the normal current. Operating characteristics should have dual slope for enhanced sensitivity for internal faults and better stability during through faults.
- viii. In numerical differential protection fifth harmonic by-pass filters shall be provided to avoid possible mal-operation under over-fluxing conditions.
- ix. Relay shall have three instantaneous high set over current and IDMT unit and shall have continuous self monitoring and self diagnostic features.
- x. Relay have continuous self monitoring and self diagnostic features.
- xi. Offered relays shall have port type IRIG – B for time synchronization.
- xii. Offered relay shall be capable of supporting IEC 61850 communication standard.
- xiii. Offered relay shall have two communication ports. Front port shall be for local communication for relay settings, modifications, extraction / analysis of fault / event / disturbance records from a laptop computer and there shall be rear port on 61850 standard for remote communication.
- xiii. Offered relay shall have facility to trigger oscillograpy through master trip relay.
- xiv. Bidder may please note that the feeder panel for 400 KV and 220 KV line shall have phase measurement units as per latest recommendation of CEA/WRPC. The phase measurement may be integral part of distance protection relay or separate unit shall have to be provided

8.3.2 (A) Transformer differential protection relay shall have following built- in protections –

- i. Thermal imaging.
- ii. Restricted earthfault
- iii. Local breaker back-up (LBB)
- iv. Over excitation
- v. Back-up overcurrent and earthfault relay
- vi. Overload protection
- vii. Negative phase sequence imbalance detection
- viii. Trip circuit supervision
- ix. DC supply supervision
- x. NDR protection
- xi. Three Nos three stage definite time over current with three stage.

Note: Bidder may please note that If NDR protection and Definite time three stage overcurrent relay are not integral part of the relay bidder may provide separate relay for the same.

i. FAULT RECORDS -

Relay shall have facility to store fault records with information on cause of tripping, date, time and trip values of electric parameters. It shall be capable of storing not less than 8 nos. of previous fault records.

ii. EVENT RECORDS -

Relay shall have facility to store 200 nos. time stamped event records with 1 ms resolution.

iii. DISTURBANCE RECORDS -

Number of available analogue channels and digital channels shall not be less than 12 and 32 respectively. Triggering for capturing / recording of disturbance should be possible from within the distance relay and / or from any other disturbance within the EHV sub-station. Offered relay shall necessarily have a storage capacity of atleast 8 disturbance records of 3 sec. duration each.

iv. Disturbance recorder, fault recorder and distance to fault locator functions shall be provided as integral part of the line protection relays

8.3.2(B) AUXILIARY RELAYS FOR ALARM AND TRIP FUNCTIONS:

We have envisaged hand reset type auxiliary relays for alarm and trip functions as mentioned against Sl. No. 35 and 36 for 400 KV C&R panels of the BOM in clause no. 20. (A) & (B). Bidders may please note that these discrete relays are essentially required even though they form integral part of the Numerical Differential relay.

8.3.3 OVERFLUXING RELAY:

Power transformer should trip for over fluxing condition to isolate both from primary and secondary sides. Accordingly over fluxing relay should be provided in the control panel on the HV side for transformer protection, with provision of alarm and trip Contacts. Transformer has following over fluxing capacity and the offered relay shall be suitable to provide minimum settings as detailed hereunder:

Over fluxing factor	Duration.
1.40	5 sec
1.12	10 sec
1.15	15 sec.
1.25	60 sec.
1.10	continuous.

Relay shall have inverse characteristics and should be equipped with high set unit to operate in less than 5 seconds whenever over fluxing exceed than the set value by 1.1 above 1.4 times in step of 0.01. Over-fluxing relay shall have setting that may be continuously adjustable or in steps (0.01), for over-fluxing ranging from 1.0 and upward. Resetting value shall not be less than 0.95 of the operating value. Settings shall be available in two stages. First stage auxiliary element operation shall be around 1 sec.

This stage shall be complete with auxiliary relay so that alarm/facia etc. could be initiated. Thereafter in the second stage the auxiliary element shall operate after a further adjustable time delay say 10 to 100 sec in step of 0.1 second. This stage shall also be complete with auxiliary relay, which could be utilized for the tripping. Rating of auxiliary relay shall be selected accordingly. Relay shall be complete with independent operation indicator for the two stages. Bidders may please note that the basic setting on the relay shall be with over fluxing factor with 1.1 and shall have continuous duration. However, between the remaining two i.e. over fluxing factor of 1.25 or 1.40, anyone can be utilized.

8.3.4 Numerical differential protection relays offered by the Bidders for 315 MVA, 400/220/33KV, 100 MVA 400/132/33 KV, 100 MVA 220KV/ 33 KV and 160MVA, 220/132/33KV Xmers shall have “a definite time over current relay” as a built-in feature with variable setting range from 50 to 200 per cent of relay current alongwith a timer having a setting range of 2.5 to 25.0 sec. This relay shall be utilized to function as overload protection relay for 315 MVA,100 MVA 400/132/33 KV , 50 MVA 220KV/ 33 KV and 160MVA Xmers.

8.3.5. Other standard transformer protections such as gas operated Buchholz relay, winding temperature, oil temperature, low oil Level, Pressure release devices, Oil surge relay etc. will be provided by the purchaser with the transformer. Bidders have to make provision for alarm annunciation and tripping. These standard protections will be provided on the panels as stated above. There should be three number auxiliary relay for three number Pressure release device and Oil surge relay.

8.3.6 Besides the built in back-up protection in the Numerical Differential Relay, an additional Numerical, Non Directional, Communicable, 3 O/C + 1 E/F Relay is envisaged on 315 MVA 400/220/33KV, 100 MVA 400/132/33 KV , 100 MVA 220KV/ 33 KV and 160MVA, 220/132/33KV X-mer panels. *Bidders may please note this very carefully.*

~~**8.3.7** Bidder may please note that the Xmer panel for 400 KV and 220 KV power transformers shall have phase measurement units as per latest recommendation of CEA/WRPC. The phase measurement may be integral part of differential protection relay or separate unit shall have to be provided.~~

8.3.8 It may please be noted that for preclose supervision and post close supervision of trip coil six nos. Trip circuit supervision relay has to be provided Separately even this is inbuilt feature of the relay.

8.3.9 It may please be noted that for D.C. supervision of the panel two nos DC supervision relay has to be provided separately even this is inbuilt feature of the relay.

8.3.10 It may please be noted that in Numerical relay provision to trigger Oscillography through Master trip relay to be done by supplier.

8.3.11 It should be noted that Numerical differential relay, Aux. relay for Buchholz relay, PRV, OSR and Master trip relay should have one number spare contact for use in NIFPS system.

8.4 PROTECTION SCHEMES FOR 400KV & 220KV TRANSFER BUS COUPLER APPLICATION:

Protection scheme for 400 KV & 220 KV TRANSFER BUS COUPLER shall be identical to the LINE protection scheme specified above at 8.2.1 as such all standard features required for the scheme shall be provided. The mimic shall represent scheme for transfer bus instead of line. It may also may please note that Distance protection

provided in the Transformer bus coupler feeder may have five groups of setting for different feeders and there should be arrangement for group selection by providing five bay switch through digital inputs. Bus coupler panel shall have one number 6 way switch for selection of setting of group in numerical relay through digital input.

8.5 (a) PROTECTION SCHEME FOR 400KV & 220KV BUS TIE APPLICATION:

400kV & 220kV Bus Tie control and relay panel shall have two digital voltmeters with selector switch to display voltage of BUS-I and BUS-II. Four-element auxiliary relay shall be provided for monitoring circuit breaker parameters. The mimic shall be provided with semaphore for automatic display of breaker and isolator status. A Numerical, Non directional, Non communicable, 3O/C + 1E/F relay is envisaged on the 400 & 220kV Bus Tie Panels for isolation of Buses (I) & (II).

8.5 (b) CONTROL PANEL FOR 400 KV TIE BREAKER FOR CONNECTING 400 kV TRANSFORMER WITH 400 KV FEEDER IN ONE DIAMETER (TYPE-C):

8.5.1 The simplex design control panel for Tie Breaker shall have 3-position control switches for operation of breaker, isolators, and earth switches. The scheme shall have separate trip circuit supervision relays with pre and post close supervision for two trip coils provided in each breaker pole. Separate Main and duplicate DC supply healthy supervision relays shall be provided with AC bell and visual indication along with schematic for Test, Accept and Reset facilities. Semaphore indicator for breaker, isolating devices and earth switch shall be provided along with pistol grip 3-position control switch for remote operation. Digital Voltmeter, digital frequency meter separately for each Main-I and Main-II 400 kV BUS. One dual channel voltage and frequency recorder shall be provided for recording selected Bus Voltage and Frequency on real time basis. The Tie circuit breaker closing scheme shall be interlocked with check synchronizing from any of the selected 400 kV Bus in the diameter having Transformer and Feeder on either side, with selected 220 kV bus supply. One Auto recloser relay complete with reclosing scheme duly interlocked with 400 kV feeder in this diameter shall also be provided.

8.5.2 The offered scheme for Control Panel for 400kV Tie Breaker shall have the following equipments and other accessories:

S. No.	Particulars	Qty. for control panel type-c
1	Box type white PVC circuit label size 10 x 5 cm	2
2	Manufacturer's label mounted internally showing details of purchaser's order no. Serial no. For identification.	1
3	Digital volt meter with selector switch for bus -I	1
4	Digital volt meter with selector switch for bus -II	1
5	Digital frequency meter for bus-I	1
6	Digital frequency meter for bus-II	1
7	3-position breaker control switch	1
8	3-position isolator control switch	2
9	3-position earth switch control switch	2
10	Dual channel recorder complete with voltage & frequency modem to record selected bus voltage and frequency on real time basis.	1
11	Circuit breaker semaphore indicator	1
12	Isolator semaphore indicator	2
13	Earth switch semaphore indicator	2
14	Set of red and green indication lamp with holder for breaker	3
15	Pre and post close supervision lamp for trip coil-I	3

16	Pre and post close supervision lamp for trip coil-II	3
17	Main dc supply fail facia annunciation with ac bell and push button for accept, reset and lamp test	1
18	Duplicate dc supply fail facia annunciation with ac bell and push button for accept, reset and lamp test	1
19	Synchronising socket -12 pin	2
20	Synchronising selector switch	2
21	20W tubelight with protective cage and door switch for cubical illumination	1
22	15/5 amp universal power socket with switch and protective cover	1
23	Space heater 60W 230 volt with switch	1
24	4-elements aux. Relay for monitoring circuit breaker parameters	1
25	18-way twin lamp facia annunciator with push button with accept, reset and lamp test facility.	1
26	Additional relays and accessories offered by bidder, which are essentially required for completing protection scheme.	As per scheme requirement.

For the purpose of confirmation to supply all items mentioned above the bidder shall bring out all details in a tabular form in the manner indicated above Schedule VIII.

8.5.3 RELAY PANEL FOR 400 KV TIE BREAKERS (TYPE-D):

8.5.3.1 The offered scheme for Relay Panel for 400kV Tie Breaker shall have the following equipments and other accessories:

S. No.	Particulars	Quantity for Control panel Type-D
1	Box type white pvc circuit label size 10 x 5 cm	2
2	Manufacturer's label mounted internally showing details of purchaser's order no. Serial no. For identification.	1
3	Auto recloser relay complete with reclosing scheme interlocked with 400 kv feeder in the diameter.	1
4	Local breaker back up relay complete with scheme	1
5	Main dc supply fail facia annunciation with ac bell and push button for accept, reset and lamp test	1
6	Duplicate dc supply fail facia annunciation with ac bell and push button for accept, reset and lamp test	1
7	Trip circuit supervision relay for trip coil-1 and 2	6
8	Two stage over voltage relay for selection of definite and time graded tripping for bus-i and bus-ii	2
9	Pole discrepancy relay complete with protection scheme	1
10	Additional relays and accessories offered by bidder, which are essentially required for completing protection scheme.	As per scheme requirement.

For the purpose of confirmation to supply all items mentioned above the bidder shall bring out all details in a tabular form in the manner indicated above alongwith Bill of Material of Panels.

8.6 PROTECTION SCHEME FOR 220KV C&R PANEL FOR MV WINDING 220KV SIDE OF 315 MVA, 400/220/33KV TRANSFORMERS:

Transformer protection for 220 KV side of 315 MVA, 400/220/33KV transformers shall have back up protection comprising of a Numerical, Non directional three over

current plus one Earth fault relay. This relay shall have IDMT characteristics. Purchaser has provided one CT in one phase of 33 KV winding before delta formation, thus a single element induction over current relay shall be provided to safe guard against excessive flow of circulating current in the tertiary winding. One digital Ampere meter for monitoring circulating current in the tertiary winding shall be provided. It may be noted that the 220 kV as well as 33 kV circuit breakers will have two trip coils which will receive simultaneous trip command as such, offered schematic shall be suitable to select main DC supply or duplicate DC supply for each trip coil. For this purpose, contact multiplication will not be acceptable but the rating of the breaker control switch and each tripping relay contacts shall be adequate to handle the burden of two trip coils. Pistol grip type breaker control switches along with red and green indicating lamp for ON/OFF indication shall be provided. Bidders shall provide protection for 25 MVAR, 33 KV Shunt reactor in this panel which shall be in the form of differential protection and a two element O/C + one element E/F relay. These relays shall be connected for protection of reactor through the Bushing CTs to be provided on Shunt reactor.

8.7 PROTECTION SCHEME FOR 400/220 KV BUS REACTORS:

At our 400KV & 220KV substations we have to install bus reactors. The Bidders may offer the scheme for protection of these bus reactors considering one and half breaker switching scheme in case of 400KV substations and two main & one transformer scheme at our 220KV substation. The protection scheme of the bus reactor for 400 & 220KV shall consist of Numerical differential protection, restricted earth fault protection relay, back up impedance protection relay and back up over current and earth fault (non directional) & external LBB protection relay if the same is not the integral part of differential relay (if required).

8.7.1. Numerical Differential Protection: The specification shall be as under;

- (i) The scheme shall be based on numerical technology
- (ii) The scheme shall be suitable for protection, control and monitoring of shunt/line reactors. Therefore in addition to usual protections, it shall be suitable for handling the situations like CT saturation, switching transients and harmonics.
- (iii) The scheme shall have continuous self-monitoring and analogue / digital conversion with appropriate filtering techniques for accurate measurement of all input quantities.
- (iv) The scheme shall be designed to operate correctly for system frequency variations.
- (v) The differential protection function of scheme shall be provided with 2nd harmonic restraint to avoid tripping at magnetizing inrush current and shall also have a 5th harmonic restraint to avoid tripping at over-excitation.
- (vi) The recovery inrush and CT saturation shall not influence the differential function of the scheme.
- (vii) The differential protection shall have a settable restraint characteristic. The differential protection shall be stable in case of high through-faults.
- (viii) There shall be two numbers of three-phase non-directional time over current protection with low-set and high –set stages, connected to bushing CTs and star side CTs. The low set shall have IDMT characteristics and the high set shall have definite time settings.
- (ix) Two stages each of three phase under and overvoltage protections shall be included to perform automatic (if purchaser requires so, alternatively arrangement for generating alarm on over voltage/under voltage for attracting the attention of operator is required to be configured for taking

- operation decision) shunt/line reactors in and out switching. The over/under voltage protection shall be provided with reset ratio of 1% .
- (x) A thermal overload protection shall be included.
 - (xi) The scheme shall be provided with a programmable logic for trip and indications and configuration of the included protection control and monitoring functions.
 - (xii) The basic structure of scheme shall be modular for binary inputs and binary outputs to facilitate user adaptation.
 - (xiii) The numerical protection scheme shall be suitable to accept 1A current inputs.
 - (xiv) The scheme shall be provided with a front mounted menu driven human-machine-interface and / or local front panel for local parameterization with suitable security provisions for unauthorized access to settings.
 - (xv) The display of values for voltage, currents, frequency shall be available on Human machine interface.
 - (xvi) The scheme shall have built-in event recorder, which can record at least 100 events with the time resolution of 1ms.
 - (xvii) The scheme shall have built in disturbance recorder which shall record and store up to 5 disturbances. The disturbance records must be stored in a non-volatile memory. The sampling frequency of disturbance recorder shall be 64 samples/cycle or better. In order to effectively capture all relevant data in the fault record of the bay, the adequate numbers of analog channels, digital channels and storage time (in seconds) shall be provided.
 - (xviii) The scheme shall have adequate serial and fibre optic communication ports for communication. The ports shall used for configuration of the relay and disturbance data monitoring from local/remote and for the purpose of communicating to substation SCADA. All the necessary software and hardware required for remote configuration and for disturbance analysis shall be in the scope of the supplier.
 - (xix) The local and remote communications shall be as per internationally acceptable open/ IEC protocols. The numerical relays shall be IEC 61850 compliant, suitable and operational for communication with local substation SCADA.
 - (xx) The scheme shall have a minimum of 10 user programmable LED's for configuring internal protection function operation or abnormal operating status of the protected equipments.
 - (xxi) The scheme shall have capability to time synchronize with the external GPS signal.

8.7.2 NUMERICAL BACK UP IMPEDANCE PROTECTION RELAY:

The numerical impedance back up protection relay shall

- (i) be triple pole type, with faulty phase identification /indication
- (ii) be single step polarized 'mho' distance/ impedance relay suitable for measuring phase to ground and phase to phase faults.
- (iii) Have adequate ohmic setting range to cover at least 60% of the impedance of the reactor and shall be continuously variable.
- (iv) Have an adjustable characteristic angle of 30-80 degree
- (v) Have a definite time delay relay with a continuously adjustable setting range of 0.2 2.0 seconds.
- (vi) Include VT failure relay which shall block the tripping during VT fuse failure condition.

8.7.3 RESTRICTED EARTH FAULT PROTECTION RELAY:

The restricted earth fault protection relay shall;

- (i) be single pole and numerical type
- (ii) be of current/voltage operated high impedance type
- (iii) have a current setting of 10-40% of 1Amp./have a suitable voltage setting range
- (iv) be tuned to system frequency
- (v) have a suitable non-linear resistor to limit the peak voltage to 1000 Volts
- (vi) shall be a restricted earth-fault protection shall have directional element to detect internal earth-faults. Restricted earth-fault protection shall be provided with 2nd harmonic restraining feature to avoid mal-operations during shunt reactor switching-in. The restricted earth-fault shall cover both shunt reactor and neutral grounding reactor.

8.7.4 BACK UP OVER-CURRENT & E/F (NON DIRECTIONAL) PROTECTION:

- i. The scheme shall have three over current and one earth fault element(s) which shall be either independent or composite unit(s).
- ii. Shall be numerical type.
- iii. The local and remote communications shall be as per internationally acceptable open/IEC protocols. The numerical relays shall be IEC 61850 compliant, suitable and operational for communication with local substation SCADA.

8.7.5 EXTERNAL LBB PROTECTION RELAY: In case if LBB protection relay is not the integral part of numerical differential protection then Bidder may provide separate LBB relay

This relay shall

- i. be triple pole type
- ii. be of numerical type
- iii. have an operating time of less than 15 milli seconds
- iv. have a resetting time of less than 15 milli seconds
- v. have three over current elements
- vi. be arranged to get individual initiation from the corresponding phase of main protection of line for each over current element. However, common three phase initiation is acceptable for other protections and transformer / reactor equipment protections.
- vii. Have a setting range of 50-200% of rated current
- viii. Have a continuous thermal withstand two times rated current irrespective of the setting
- ix. have a timer with continuously adjustable setting range of 0.1-1 seconds
- x. have necessary auxiliary relays to make a comprehensive scheme.

9.0 CONFIGURATION OF 400KV / 220KV BUS REACTORS RELAY PANELS:

9.1 The general details in respect of the relay panels as mentioned at clause 8.7 above is mentioned below. However the purchaser reserves the right to change the positioning of items. If required during the detailed engineering/ drawing approvals.

9.2 SHUNT/ LINE REACTOR RELAY PANELS

S.No.	Item description	Qty.
1	Numerical differential relay	1 No.
2	Numerical impedance back up protection	1 No.
3	Restricted earth fault protection relay	1 No.
4	Numerical backup Over-current & E/F (non-directional) relay	1 No.
5	LBB relay (if required)	1 No.
6	CVT selection relay as per scheme requirement	LOT
7	Trip supervision Relay	6 Nos
8	DC supervision relay	2 Nos

9.3 OTHER IMPORTANT PROTECTIONS FOR FEEDER, TRANSFORMER, TBC, BUS TIE PANELS AND REACTOR PANELS:

9.3.1 LOCAL BREAKER BACK UP:

Local breaker back up relay shall be provided to take care of stuck breaker condition. In case, it is a built-in feature of distance / differential protection relays, then no separate LBB relay is required. This relay shall have following features –

- i. It will be a triple pole type relay
- ii. It shall have an operating time of less than 15 milli seconds
- iii. It shall have a resetting time of less than 15 milli seconds
- iv. It shall have three over current elements having setting range of 20 to 80% of rated current
- v. It shall have a continuous thermal withstand of 2 times the rated current irrespective of setting
- vi. It shall have a timer with continuously adjustable setting range of 0.1 to 1.0 seconds.

In case of panels for bus tie applications however a separate LBB relay need be provided. Necessary auxiliary relays for initiating tripping command to the 8 nos. circuit breakers shall also be included as a part of the scheme. Tripping relays shall be capable of handling burden of circuit breakers with two trip coils. **Bidders shall provide a separate panel to house two nos. tripping relays having 8 Nos. contacts per circuit for total 8 circuits in 400 KV & 220 KV systems where the switching arrangement is two main and one transfer bus. This is further clarified in Clause no. 20 about the Schedule of requirement also.**

9.3.2 TRIP CIRCUIT SUPERVISION:

9.3.2.1 Trip circuit supervision: Separate trip circuit supervision relay shall be provided for each of the two trip coils in each panel, for continuous monitoring of trip circuit i.e. for both pre and post close conditions. These relays shall have following characteristics –

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

Trip healthy lamp for each trip coil shall be provided separately for pre and post close monitoring. During unhealthy condition of trip circuit the relay shall initiate an audible alarm and visual indication on facia window. All 400 and 220 KV circuit breakers

are provided with two trip coils and hence separate trip circuit pre and post supervision for each trip coil is to be provided by Tender. Each trip circuit supervision relay shall be provided with operation indicator. Also for each trip coil circuit, separate DC circuit with fuses will be used.

9.3.3 DC SUPPLY SUPERVISION:

Separate DC supply supervision relay one each for the main and duplicate DC supply system shall be provided for 400 KV class C&R panels and 2 DC supply source for 220 KV panels. Out of the two DC supply systems, namely, protection and annunciation / indication, the offered relay shall be capable of monitoring failure of DC supply of the protection circuits. It shall have adequate potential free contacts to meet out the requirement of the scheme and also to meet the requirement for providing alarm and facia indication. Relay shall have a "time delay on drop off" of not less than 100 milli second and be provided with operation indicator/flag. This relay shall sound AC 230 V heavy-duty bell with provision for accept/reset and test facilities.

9.3.4 ALARM SCHEME:

Automatic tripping of the circuit breaker due to operation of protective relays shall be indicated by a common audible alarm. Offered alarm scheme shall be complete in all respects including one DC bell for non-trip alarm and one DC hooter for trip alarm with relays and other accessories if any. With each panels one alarm scheme will be required.

10.0 a) MULTI-FUNCTION METER:

We envisage a Multi-function meter on the panel to provide digital display of current, voltage, Watts, VARS and Power Factor. This meter shall have scrolling facility to facilitate reading any of these parameters and it will have a size of 144 sq mm/96 sq mm. Bidders may please note that the meter shall be capable of reading voltages upto a maximum value of 450 in case of 400 KV panels and 250KV in case of 220 KV panels. This meter shall have an accuracy class of 0.5. The multifunction meter shall have four and a half digit display, for example 210.8KV, with minimum display height of 25mm. This meter shall conform to IS 722 and shall be provided with non-reflecting glass fronts. Bidders may please note that the Multi function meter shall be suitable for DC Supply voltage of 110Volts or 220Volts as the case may be. AC Supply operated meters are not acceptable to us. The offered Multi function meter shall be of reputed make. **Bidders may please note very carefully that multifunction meter shall have communication facility through serial port RS-485 with Mod bus protocol complete with down loading software and RS 232 port.**

b) Bidder may please note that in addition to multifunction meter, 1 No. analogue type center zero MVAR meter is also required to be provided in each category of C&R panel covered under the bid.

11.0 ACCESSORIES:

11.1 Four Element Hand Reset Auxiliary Relay For Monitoring Circuit Breaker Parameters:

Four-element hand reset auxiliary Relay for each 400, 220,132 and 33 kV breakers is required to provide flag indication and display shall be provided in facia window annunciator for monitoring circuit breaker parameters of each breaker control provided in the panels as under ;

SF6 gas pressure low alarm

Air pressure low alarm
Spring discharge alarm
Pole discrepancy relay of CB operated.

11.2.0 ENERGY METERS:

The energy meter for each circuit shall be 3 phase 4 wire, 0.2S accuracy class with availability based tariff. One meter shall be provided for each circuit, as a self-contained device for measurement of power transmittals, in each successive 15 minute block, and certain other functions. The meters provided in C&R panels shall be utilized for measurement of active energy and average frequency in a programmable time clock initially set at 15 minute blocks. Meters shall measure and display reactive energy under voltage low (97%) and voltage high (103%) condition as per tariff requirement. Meters shall measure cumulative active energy import and export on daily basis and monthly basis. The Base Computer software (BCS) shall be configurable to cater to tariff applications like Time of Day (TOD) metering. In case of change of threshold values of voltages, the supplier shall undertake to set new threshold values of voltage. It shall be possible to select parameters of Meters as per requirement of Purchaser. Meter shall be fully static having non volatile memory and fully programmable. Meter shall have four quadrant registering facility with provision for recording/display various parameters like KWh, KVAh, KVARh, Line current and voltages including power factor. Load survey capability for 35 days shall be available to forecast load growth. Meter shall have 0.2S accuracy class. **The tenderer may please note that the energy meter of 0.2S accuracy class shall have ABT features and shall have suitable for RS232 and RS485 communication protocol for remote and local communication.**

11.2.1 MEASUREMENT ACCURACY: Measurement accuracy of meters shall be as per IEC 62052-11-2003, IEC 62053-22-2003 as under:

0.2s for Active Energy
0.5s for Reactive Energy or better

11.2.2 APPLICABLE STANDARDS FOR METERS: The meters shall fully comply with all stipulations in IEC standards 62052-11:2003 and 62053-22:2003. The reference ambient temperature shall be 23°C as per IEC. Errors shall be reasonable for all power factor angles from 0° to 360°. For reactive power (VAR) and reactive energy (VARh) measurement, IEC 62053-23:2003 shall be complied with. The meters shall conform to following Indian standards with latest amendments.

CBIP Technical Report No.88 (with latest amendments issued – June 2000) – specifications for AC Static Electricity Energy Meters.

IS 14697(1999) – AC static transformer operated Watt-hour and VAR-hour meters for class 0.2s and 0.5s.

IS 12063 –Degree for Protection.

IS 3202 – Climatic Proofing of Electrical Equipment.

The meter shall also comply with specifications & requirement as stipulated in “Part V: Transmission Metering Code” as published in Gazette of

Madhya Pradesh dated 20-08-04 by Madhya Pradesh Electricity Regulatory Commission (MPERC) as "Grid Code".

11.2.2 PRINCIPAL PARAMETERS: The energy meters shall indoor type connected with the secondary side of out door current and voltage transformers.

	Item	Details
(i)	Type of installation	Indoor Flush
(ii)	CT secondary	1 A
(iii)	VT secondary	110 V/ $\sqrt{3}$ Volts
(iv)	System frequency	50 HZ \pm 5%
(v)	Earthing System	Solidly Grounded
(vi)	Auxiliary DC supply if required	110V/220V \pm 20%

Multiplying factor to arrive at actual primary values wherever applicable shall be calculated from the CT and PT ratio of the installed CT and PT using the base computer software (BCS).

11.3.0 SWITCHES:

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

11.3.2 Selection of operating handles for different type of switches shall be as follows:

- a. Breaker control switches : Pistol grip, black
- b. Selector switches : Oval or knob black.
- c. Instrument switches : Round, Knurled, black
- d. Protection transfer switch : Pistol grip lockable and black.

11.3.3 Breaker control switch shall be of spring return to neutral 3-position type. Control springs shall be strong and robust enough to prevent inadvertent operation due to light touch. The spring return type switch shall have spring return from close and trip positions to 'after close' and 'after trip' position respectively.

11.3.4 Lockable switches which can be locked in selected position shall be provided for trip transfer scheme. Key locks shall be fitted on the operation handle. **The trip transfer switch will have three position Normal / Intermediate /Transfer.**

11.3.5 In 400 KV and 220 KV SIMPLEX type panels, selector switch for manual selection of semaphore position indicator strip position shall be provided for displaying matching position of isolating devices in the switchyard. These selection switches shall have two way selections and shall be mounted near to respective semaphore device.

11.4 INDICATING LAMPS:

11.4.1 All indicating lamps on the 400 KV as well as 220 KV C&R panels shall be LED Display type. This is a mandatory requirement.

11.4.2 Indicating lamps shall be panels mounting type with rear terminal connections. Lamps shall be provided with series connected resistors preferably built in the lamp assembly. Lamps shall have translucent lamp covers to diffuse different colours e.g.

red, green, amber, clear white or blue to differentiate system function. Lamp cover shall be preferably of screwed type, unbreakable and moulded from heat resistant material.

11.4.3 Wattage of the neon lamp shall be 0.25 to 0.5W if provided. Bulbs and lenses shall be interchangeable and easily replaceable from the front of the panels. Indicating lamp with resistor shall withstand 120% of rated voltage on continuous basis.

11.5 PUSH BUTTONS:

Push buttons shall be momentary contact type with rear terminal connections. Where ever required the push buttons shall be suitably surrounded to prevent inadvertent operation. These shall be provided with integral inscription plates engraved with their functions. All push buttons shall have minimum two normally open and two normally closed contacts. Contact faces shall be silver plated. Contacts shall be suitable to make/break and carry appropriate currents for the functions desired.

12.0 RELAYS:

All electromechanical relays shall have compliance to the following requirements.

12.1 All relays shall be contained in dust proof cases. All cases shall be mounted on the control and relay panels and the details of mounting shall be to purchaser's approval. Relays shall be of the projecting pattern or flush pattern as specified.

12.2 Indicators shall also be provided on such additional equipment to identify faulty phase and type of fault. Each indicator whether electrically or mechanically operated shall be reset by hand without opening the relay case. Each indicator shall be so designed that it should not be moved before the relay has completed its operation. It shall not be possible to test and operate any relay by hand without opening case.

12.3 All elements of relays shall be arranged such that on opening the case dust particles collected in or upon the case should not fall on the relay mechanism.

12.4 All relays shall conform to the requirement of IS-3231 or other applicable approved standards. Relays shall be suitable for flush or semi flush mounting on the front with connections from the rear. Relays shall be rectangular in shape and shall have dust proof, dull black or egg shell black enamel painted cases with transparent cover removable from the front.

12.5 All relays shall be draw out pattern or plug in type/modular construction with proper testing facilities. Testing facilities provided on the relays shall be specifically stated in the Tender. Necessary test plugs shall be supplied loose and shall be included in scope of supply. Test block and switches shall be located immediately below each relay for testing. As an alternative to "test block" and "test plug arrangements" the Bidder may supply alternative testing facility for protective relays.

12.6 All induction relays shall be designed to operate at system frequency of 50 Hz. Voltage operated relays shall be designed for star connected 110 Volt VT secondary supply and current operated relays of 1 amp CT secondary as specified in the specification. DC auxiliary relays and timers shall be designed for specified DC voltage and shall operate satisfactorily at 70% to 110% rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.

12.7 Relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. Necessary auxiliary relays and timers should be provided for interlocking scheme, multiplying main contacts, switching contact of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. and also as may be required for complete Protection schemes described in specification. All protective relays shall be provided with minimum two pair of potential free contacts. Auxiliary relays and timers shall have pairs of contacts as may be required to complete the scheme. All contacts shall be silver faced with spring action. Relay case sizes should not pose limitations in using available contacts on the relay due to inadequacy of terminals. Paralleling of contacts, shall be done at the external terminals of relay if required.

12.8 All auxiliary relays except the lock out relays and interlocking relays shall be provided with self reset type contacts. All protective relays shall be provided with externally hand reset positive action operation indicators with proper inscription. All protective relays which do not have built-in-hand reset operation indicators shall be provided with additional auxiliary relay having operating indicators (Flag relays) for this purpose. Similar separate operating indicator (auxiliary relays) shall be provided in all relays associated with protection tripping such as Buchholz relays, oil and winding temperature protection, pressure relief devices, fire protection etc.

12.9 Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance

12.10 Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type. If series relays are used the following shall be strictly ensured:

- a. Operating time of the series seal-in-unit shall be sufficiently shorter than that of the trip coil or trip relay in series with which it operates to ensure definite operation of the flag indicator of the relay.
- b. Seal-in-unit shall obtain adequate current for operation when one or more relays operate simultaneously.
- c. Impedance of the seal-in-unit shall be small enough to permit satisfactory operation of the trip coil on trip relays when the DC supply voltage is minimum.

12.11 All numerical, solid state and electronic relays shall have compliance to the following requirements:

- a. Printed circuit panels/cards shall be fin type and its contact shall be gold plated. All connections with the connector pegs shall be through wire wrapping. All solder joints on the printed circuit panels shall be encapsulated or covered with varnish.
- b. Components used in these relays shall be loaded under normal condition by less than half of their rated values. Resistors shall be of carbon composition or metal oxide type and the capacitors shall be plastic film or tantalum type. Stringent measures including shielding of long internal wiring should be taken to make relays immune to voltage spikes as per IEC. Relays must meet the requirements of IEC-255-4 appendix 'E' class III regarding BF, disturbance tests IEC-255-4 regarding impulse test at 5KV and transients present in CT & VT connections due to extraneous sources, do not cause damage to any of associated static circuits.

- c. All relays shall be designed for satisfactory performance under tropical and humid conditions. Special mention shall be made in the technical deviations schedule of the Bid for those relays, if any that Bidder proposes to use which differ from specified requirements.
- d. All devices required for correct operation of each relay shall be provided by contractor without any extra cost.
- e. It will be ensured that the terminals of the contacts of the relays are readily brought out for connections as required in the final approved scheme. Type of relay case size offered shall not create any restriction on availability of the contact terminals for wiring connections.
- f. DC/DC converter or power supply unit shall be provided for the solid state protective relay wherever necessary in order to provide a stable auxiliary supply for relay operation.
- g. Solid state relays shall be stable and suitably protected against transient/induced over voltages and noise signals. Bidders shall state clearly in their Tenders, special requirements if any for DC input arrangement or cabling considered necessary for satisfactory operation of solid state relays quoted by him.
- h. Timers shall be of the solid state type. Short time delay in term of milliseconds may be obtained by using copper lugs on auxiliary relays. In such case it shall be ensured that the continuous rating of the relay is not affected. Time delay in terms of milliseconds obtained using external capacitor resistor combination is not preferred and shall be avoided to the extent possible.

12.12 In order to minimize effect of galvanic actions associated with electro chemical effect, flag coils and DC relay operating coils shall be so placed in the circuit that these are not connected to the positive pole of the battery except through contacts which are normally open.

13.0 TESTS:

Manufacturer shall carry out type and routine tests on the relays and complete panels as per relevant Indian Standards or any equivalent International Standards and as specified hereunder.

13.1 ROUTINE AND ACCEPTANCE TESTS:

All modules and sub-assemblies shall be energized and tested for routine and acceptance tests jointly carried out in presence of purchaser's representative as per relevant IEC Specifications or any other international standards individually as well as in assembled form at the factory.

13.2 Relay and control panels shall be subjected to the following tests:

- o Mechanical operation test.
- o Verification of Degree of protection as per IS:2147
- o High voltage test as per IS or IEC as may be applicable.
- o Electrical control, Interlock and sequential operation tests.
- o Verification of wiring as per approved schematic.
- o Other routine tests on all associated equipment and relays as per relevant Indian Standards or IEC.

13.3 After all tests have been carried out, 4 (four) copies of each test report/inspection report shall be furnished. Each report shall supply the following information

- i. Complete identification data including serial number of all relays and their routine test reports.
- ii. Routine test reports for all the panels.

13.4 Supply of equipment shall be subject to the approval of Test Certificates by purchaser.

14.0 CONTROL CONNECTIONS AND INSTRUMENT WIRING:

14.1 Connections for switchgear operation and indications between the control and relay panels where ever separate termination for instrument and relay wiring on these control & relay panels and multicore cable terminal boxes are involved, these shall form a portion of the scheme for panels and the cost shall be included in the price of the control panels as stated by the Bidder.

14.2 Panels connection shall be insulated and securely fixed neatly to the back of the panels. All instrument and panels wiring shall be fire retardant. All panels wiring shall be taken to terminal panels which shall comply with requirements of multicore cable boxes where applicable. Control panels wiring shall be PVC impregnated with flame proof compound. Rubber insulation is not acceptable.

14.3 All wiring diagrams shall be clearly marked with the numbers which are shown on the ferrules of the individual cores. 20% spare and blank ferrule shall be supplied with each panel.

14.4 Flat washers shall not be used but both end of each instrument or control wire shall be properly crimped and terminated with a Rose Courtney or other sophisticated washer.

14.5 Each set of current & voltage transformer secondary connections shall be complete in all respect and shall be connected to form common star point. Star point shall be earthed at one point only. Each such earthing connection to the earth bar shall be made in accordance with the requirement of the earthing system and shall be made through a disconnecting link of approved design which can be removed when insulation tests are required without breaking any circuit normally carrying current.

14.6 For each circuit on the panels, the control indication and trip wiring shall be suitably segregated so that these could be isolated to permit testing or other work. Semaphore and other indication circuits shall be connected to the DC bus by a set of fuses. Similarly, the trip and close circuits shall also be connected by a separate set of fuses. Fuses shall be labeled clearly showing the circuits connected.

All secondary fuses shall be of an approved type. HRC fuses of standard make shall only be used. Where ever specified test blocks shall be provided for testing of meters and relays. These shall be of the switchboard type with connection at the back, mounted on front of panels. Test blocks shall provide complete isolation of meters, instruments and relays and the arrangements shall be such that power supply for testing could be connected at the test block from the external source or may be taken from the instrument transformer. Provision shall be made for short circuiting current transformer secondary and disconnection of potential transformer, by sliding and disconnecting type connectors.

15.0 PRETREATMENT AND PAINTING PROCESS:

Sheet steel fabricated members shall be subjected to pretreatment process before painting and process can be broadly divided as `Metal treatment and painting.

15.1 METAL TREATMENT:

Degreasing: This can be achieved either immersing in hot alkaline degreasing bath or in hot di-chloroethelene solution. After degreasing operation the surface shall be cleaned thoroughly with cold water.

Pickling : This is to remove rust and metal scales by immersing metal sheets in dilute sulphuric acid (approximately 20%) at nearly 60 deg. centigrade so as to totally remove scale and rust.

- o Rinse in cold water in two tanks to remove traces of acids.
- o Treat with phosphoric acid base neutralizer for removal of chlorine from the above acid pickling and again wash with running water.
- o Phosphating Immerse in grenadine zinc phosphate solution for about 20 minutes at 80 to 90 degree centigrade . Uniform phosphate coating of 4 to 5 gm per sq. meter shall be achieved.
- o Swill in cold water.
- o Rinse in Deorylyte bath at 70 to 80 degree centigrade to neutralize any traces of salts.
- o Seal the above phosphate coating with hot/dilute chromate solution.
- o Dry with compressed air

15.2 PAINTING:

Primer spray: One coat on wet surface by specially developed `High luster' zinc chromate primer and to stove at 150-160 deg. Centigrade for 25 to 30 minutes. Alternatively red-oxide primer with zinc chromate contents may be used. However former process shall be preferred.

Rubbing and putting : Apply putty to fill up the scars if any to present smooth surface and stove 15 to 20 minutes. Apply putty several times to get the perfect smooth finish.

Surfacing:	Sand down with mechanical abrasive and stove for 20 minutes.
Primer:	Spray second coat of primer as per (i) above or grey primer surface on wet and stove for 20 to 40 minutes at 150 deg. centigrade.
Finish paint:	Rubbing down dry and spray first coat of synthetic enamel finish paint on wet and stove for 30 minutes.
Surfacing:	Sand down or rub dry to prepare for final finish spray. Coats of synthetic enamel finish paint on wet and stove it at 150 deg. centigrade for 30 minutes.

- NOTE :**
- i Necessary stiffeners may be welded between large cut ducts to provide rigidity before painting process.
 - ii Painting process shall be done within 24 hrs. of completion of treatment.
 - iii Small coating paint shall be supplied along with equipment for touching up at site.

16.0 DRAWING AND LITERATURE:

16.1 G.A. drawings for each type of panels shall be submitted with the Bid.

16.2 As soon as possible after the award of contract the manufacture shall submit GA and Schematic drawings of each panel for the approval of purchaser.

16.3 Successful Bidders shall have to supply four sets each containing of approved GA, Schematic and wiring drawings illustrative pamphlets, literature, operation and maintenance instructions of the relay/panels under his scope of supply.

17.0 GUARANTEED TECHNICAL PARTICULARS & TECHNICAL QUESTIONNAIRE:

17.1 Guaranteed technical particulars for all relays, instruments, meters and all other accessories shall be furnished along with the Bid. While submitting technical particulars, please ensure to stipulate very clearly the class of accuracy, (wherever necessary), current and voltage rating, physical dimensions, weight, make, model No., type etc. in order to give a clear picture of device offered, along with literature/write-up. All 400 KV C&R panels shall be suitable for 220V DC supply and unless otherwise specified, the 220KV C&R panels shall be suitable for 110 V DC or 220V DC as per our requirement.

17.2 At the end of this specification we have attached technical questionnaire. Bidders are requested to reply various questions detailed out in the questionnaire although similar information is available elsewhere in the Bid. Please note in case Bidders do not furnish clear replies to our technical questionnaire, their offers may run the risk of rejection.

18.0 OTHER IMPORTANT REQUIREMENT:

18.1 QUALITY ASSURANCE PROGRAMME:

The Quality Assurance Programme of this specification shall be as per Section-I Volume-II.

18.2.0 INSPECTION:

18.2.1 Bidders shall chalk out a detailed inspection and testing program for manufacturing activities for the various components. Purchaser reserves the right to get carried out any tests by a third party. All Cost of inspection/tests shall be borne by the Bidder. No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

18.2.2 Acceptance of any quantity of panels/material shall in no way relieve the successful Bidder of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipments are later found to be defective.

18.2.3 At the time of inspection, Bidders shall identify each and every item/accessories. Unless all the items are identified, manufacture will not be treated as complete. Serial number of Relays & other accessories shall be entered into the test report. Various tests stipulated in IS shall be performed in the presence of purchaser's engineers or when the inspection waiver has been given, in such a case, the testing shall be done at the manufacturer's works as per IS stipulations and same should be confirmed by documentary evidence by way of Test Certificate which shall be got approved by the purchaser.

18.2.4 Whenever inspection call is given, the letter of inspection call will accompany the following:

- a. List of various panels and loose relays which are ready at the works and will be offered for inspection. Inspecting Officer will carry the list and check the items declared to have been offered for inspection.
- b. It is expected that before any equipment is offered for inspection, internal testing of the same for various important parameters are already done. Routine test report for such tests shall also accompany with the letter of inspection call.
- c. In case for any reasons inspection is not completed or equipment is not found complete with all accessories, the Purchaser will reserve the right to recover the complete cost of deputation of inspecting team to the works of the manufacturer.

19.0 COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS:

Responsibility for obtaining timely supplies of bought out items will rest on the Bidder and only on this basis, delivery period will be offered in the Bid. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and in case defective supply of any item is reported will rest on the Bidder. In case for attending to defect in any accessory or inspection/ replacement of the accessory, which may be bought out item for the Bidder; services of engineer of original manufacturer is required, the same will be organized on immediate basis by the Bidder at his cost.

Bidders may ensure that Bid document containing number of pages have been properly page numbered and signed by the Bidder. All Bid documents including schedules should be indexed properly and Index of the document should be enclosed/placed at the beginning of the Bid document.

20.0 SCHEDULE OF REQUIREMENT:

A. 400KV CONTROL & RELAY PANELS: (ALL SUITABLE FOR 220V DC SUPPLY)

400 KV Simplex type Control and relay panels shall have following instruments, relays and accessories to be provided per circuit on each feeder, transformer, TBC and Bus-tie panels as per the type of protection indicated above under clause-8.0 by the purchaser:

S. No.	Particulars	400KV Line	315MVA /100 MVA Xmer (400KV side)	400KV TBC Panel	400KV Bus Tie Panel	400KV Reactor Panel
I	CONTROL PANEL					
1	Type of panels	Simplex	Simplex	Simplex	Simplex	Simplex
2	Box type circuit label inscription (50x100mm) indicating Name of feeder/Transformer in side & out side of panels	Two	Two	Two	Two	Two
3	Purchaser's order no., Serial no.& Bidder's label	One	One	One	One	One
4	Over laid Mimic diagram with uniform 3mm	TWO MAIN AND ONE TRANSFER BUS				

S. No.	Particulars	400KV Line	315MVA /100 MVA Xmer (400KV side)	400KV TBC Panel	400KV Bus Tie Panel	400KV Reactor Panel
	thickness and 10mm width for horizontal strip and 6mm strip for droppers.					
5	Red and Green lamps(LED type) with holder for circuit breaker ON/OFF position indication for each Transformer / feeder circuit.	One Set	One Set	One Set	One Set	One Set
6	Pistol grip Circuit breaker control switch with three positions; ON, OFF & return to neutral.	One	One	One	One	One
7	Semaphore to indicate circuit breaker position automatically	One	One	One	One	One
8	Semaphore to indicate isolator position automatically.	Three	Three	Three	Two	Three
9 a	Multifunction meter to indicate phase and line currents, phase and line voltages, active power (MW), reactive power (MVAR) & Power factor. This meter shall have scrolling facility to facilitate reading any of these parameters. This meter shall be of size 144 sq. mm and it shall have a scale of 0 to 450KV for voltage reading (secondary rating 110V Phase to phase and 1 Amp). The meter shall have an accuracy of 0.5, the digit size shall be 25 mm and it will have LED display for the letters	One	One	One	One	One
9 b	Analogue of type center zero MVAR	One	One	One	One	One

S. No.	Particulars	400KV Line	315MVA /100 MVA Xmer (400KV side)	400KV TBC Panel	400KV Bus Tie Panel	400KV Reactor Panel
	meter					
10	Facia window annunciator complete with flasher and function relays	24 WAYS	36 WAYS	24 WAYS	18 WAYS	36 WAYS
11	Test plug/port for testing of Main protection Relay complete with connecting leads	One	One	One	One	One Set
12	Test terminal block for static trivector meter	One	One	One	-	One
13	Static trivector energy meter 3 phase 4 wire, having accuracy class as 0.2s.	One	One	One	-	One
14	Push button for facia annunciator testing of all lamps/accept/ reset arrangement.	Three	Three	Three	Three	Three
15	Four-element hand reset auxiliary relay to monitor circuit breaker Parameters to display in facia annunciator.	One	One	One	One	One
16	Push button for main and duplicate DC Supply fail test/ accept/ reset	Two	Two	Two	Two	Six
17	Trip circuit supervision healthy indication lamp with push button to select pre & post close supervision	Six	Six	Six	Six	Six
18	Protection transfer switch with lock as per clause no.11.3.4 for continuous display in Facia annunciator	One	One	One	-	One
19	DC supply fail indication AC lamp (For two dedicated DC supply sources)	Two	Two	Two	Two	Two
20	Additional accessories such as	One Set	One Set	One Set	One Set	As Reqd.

S. No.	Particulars	400KV Line	315MVA /100 MVA Xmer (400KV side)	400KV TBC Panel	400KV Bus Tie Panel	400KV Reactor Panel
	pistol grip for carrier IN/OUT & other devices required for completing the offered schemes.					
21	Synchronising Socket	One	One	One	One	One
II RELAY PANEL						
22	Box type circuit label inscription(50x100mm) indicating Name of feeder/ transformer in side & out side of panels	Two	Two	Two	Two	
23	Numerical Distance protection scheme complete with all modules & auxiliary relays etc. as per clause 8.2.	Main I Differential & Main II DPR	-	Main I differential & Main II DPR	-	
24	Numerical backup impedance Protection scheme complete with all modules & auxiliary relays etc. as per clause 8.7.2.	-	-	-	-	ONE
25	Numerical transformer/ reactor differential protection relay complete with all modules & auxiliary relays as per clause 8.3 & 8.7.1 respectively	-	Two	-	-	ONE
26	Numerical, non-directional & communicable 3O/C and 1 E/F relay on protection panel for 315 MVA X-mer and 400KV reactor panel as per cl.No.8.3.6 & 8.7.4	-	ONE	-	ONE	ONE
27	Restricted earth fault relay for 400KV reactors as per clause 8.7.3.	-	-	-	-	ONE
28	Pre & post close Trip circuit supervision relay	Six	Six	Six	Six	Six
29	DC supply healthy monitoring relay. (Two relays for two dedicated DC supply sources)	Two	Two	Two	Two	Two
30	PT supply selection	One	-	One	-	One Set

S. No.	Particulars	400KV Line	315MVA /100 MVA Xmer (400KV side)	400KV TBC Panel	400KV Bus Tie Panel	400KV Reactor Panel
	switch with aux. relay					
31	Two stage over voltage relay or selection of definite and time graded tripping for Bus I & II.	One	Nil	One	One	-
32(a)	LBB relay (Bidders may clarify if this is a built-in feature of numerical distance / differential relay). *	One	One	One	One	One
(b)	Restricted earth fault relay	-	One	-	-	-
33	Separate LBB relay for Bus tie panels as per Cl.No. 9.3.1	-	-	-	One LBB with 2 Nos. tripping relays	-
34	Over fluxing relay complete with timer etc.**	-	One	-	-	One
35	Hand reset auxiliary <u>trip relay</u> with flag indication for : i. Oil temp high trip ii. Winding temp high trip iii. Main buchholz trip iv. OLTC oil surge relay trip-3 Nos (for X-mer only). v. Pressure relief device trip- 3 Nos. vi. Spare	-	Total 10 Nos.	-	-	Total 8 Nos.
36.	Hand reset <u>alarm relay</u> with flag indication for: i. Oil temp high alarm ii. Winding temp high alarm iii. Main buchholz alarm iv. OLTC oil surge relay alarm- 3 v. Pressure relief device alarm vi. Spare	-	Total 8 Nos.	-	-	Total 6 Nos.

S. No.	Particulars	400KV Line	315MVA /100 MVA Xmer (400KV side)	400KV TBC Panel	400KV Bus Tie Panel	400KV Reactor Panel
37	Overload relay, inform of a definite time over current relay with variable setting range from 50 to 200 % of relay current & with a timer having setting range of 2.5 to 25.0 sec. ***	-	One	-	-	One
38	High speed tripping relay for master trip/inter-trip duty.	One	One	One	One	One
39	Additional auxiliary relays required for completing offered protection schemes	As required	As required	As required	As required	As required
40	Aux. relay for Auto reclosing	one		one		
41	High Speed Single phase Tripping Relay	Six	-	Six	-	-
42	Phase measurement unit if it is not integral part of Numeric distance protection or Numeric differential protection	One	One			
43	Six bay switch for selection of setting group in Numerical relay	-	-	One	-	-
III	EQUIPMENT MOUNTED INSIDE					
44	Space heaters with switch in each panel.	One	One	One	One	One
45	15/5A, 250Volts power socket with protective metallic cover & switch.	One	One	One	One	One
46	20Watt Tube light with door switch.	One	One	One	One	One
47	40Watt incandescent or 15Watt CFL lamp with switch.	Two	Two	Two	Two	Two
48	DC bell for NON TRIP alarm complete with accept, reset and test facilities.	One	One	One	One	One
49	DC hooter for trip alarm complete with accept, reset & test facility	One	One	One	One	One

S. No.	Particulars	400KV Line	315MVA /100 MVA Xmer (400KV side)	400KV TBC Panel	400KV Bus Tie Panel	400KV Reactor Panel
50	AC Bell for Main DC supply failure.	One	One	One	One	One
51	AC Bell for Duplicate DC supply failure.	One	One	One	One	One
52	Gland plate fitted with Cable glands	One Set	One Set	One Set	One Set	One Set
53	Foundation bolts	One Set	One Set	One Set	One Set	One Set
54	Additional relays or accessories offered by Bidder, which are essentially required for completing protection scheme.	One Set	One Set	One Set	One Set	One Set

B. 220 KV CONTROL & RELAY PANELS:

220KV Simplex type Control and relay panels shall have following instruments, relays and accessories to be provided per circuit on each feeder, transformer, TBC and Bus-tie panels as per the type of protection indicated above under clause-8.1 by the purchaser:

S. No.	PARTICULARS	TYPE-A 220KV Line	TYPE-B 160MVA /100 MVA Xmer (220KV Side)	TYPE-C 220KV TBC Panel	TYPE-D 220KV Bus Tie	TYPE-E 220KV Side of 315 MVA X mer	220KV Bus Reactor Panel
I	CONTROL PANEL					SUITABLE FOR 220V DC Supply	
1	Type of panels	Simplex	Simplex	Simplex	Simplex	Simplex	Simplex
2	Box type circuit label inscription (50x100mm) indicating Name of feeder/Transformer in side & out side of panels	Two	Two	Two	Two	Two	Two
3	Purchaser's order no., Serial no.& Tenderer's label	One	One	One	One	One	One
4	Over laid Mimic diagram with uniform 3mm thickness &10mm width for horizontal strip & 6mm strip for droppers.	Two Main And One Transfer Bus					
5	Red and Green lamps(LED type) with holder for circuit breaker ON/OFF position	One Set	One Set	One Set	One Set	One Set	One Set

S. No.	PARTICULARS	TYPE-A 220KV Line	TYPE-B 160MVA /100 MVA Xmer (220KV Side)	TYPE-C 220KV TBC Panel	TYPE-D 220KV Bus Tie	TYPE-E 220KV Side of 315 MVA X mer	220KV Bus Reactor Panel
	indication for each Transformer/feeder circuit.						
6	Pistol grip Circuit breaker control switch with three positions; ON, OFF & return to neutral.	One	One	One	One	Two (One For 220 & Other For 33kv Breakers)	One
7	Semaphore to indicate circuit breaker position automatically	One	One	One	One	Two (One For 220 & Other For 33kv Breakers)	One
8	Semaphore to indicate isolator position automatically.	Three	Three	Three	Two	Three	Three
9(a)	Multifunction meter to indicate phase and line currents, phase & line voltages, active power (MW), reactive power (MVAR) & Power factor. This meter shall have scrolling facility to facilitate reading any of these parameters. This meter shall be of size 144 sq. mm and it shall have a scale of 0 to 250KV for voltage reading (secondary rating 110V Phase to phase and 1 Amp). The meter shall have an accuracy of 0.5, the digit size shall be 25 mm and it will have LED display for the letters	One	One	One	One	One	One
9(b)	Analog type center zero MVAR meter	One	One	One	One	One	One
10	Facia window annunciator complete with flasher and	18/24 WAYS	36 WAYS	18WAYS	12 WAYS	18 WAYS	18 WAYS

S. No.	PARTICULARS	TYPE-A 220KV Line	TYPE-B 160MVA /100 MVA Xmer (220KV Side)	TYPE-C 220KV TBC Panel	TYPE-D 220KV Bus Tie	TYPE-E 220KV Side of 315 MVA X mer	220KV Bus Reactor Panel
	function relays						
11	Test plug/port for testing of Main protection Relay complete with connecting leads	One	One	One	One	One	One
12	Test terminal block for static trivector meter	One	One	One	-	Two	One
13	Static trivector Energy meter 3 phase 4 wire, having accuracy class as 0.2s.	One	One	One	-	Two (One For Mv & One For Tertiary Winding)	One
14	Push button for facia annunciator testing of all lamps/accept/reset arrangement.	Three	Three	Three	Three	Three	Three
15	Four-element hand reset auxiliary relay to monitor circuit breaker Parameters to display in facia annunciator.	One	One	One	One	One	One
16	Push button for main and duplicate DC Supply fail test/accept/reset	Two	Two	Two	Two	Two	Two
17	Trip circuit supervision healthy indication lamp with push button to select pre & post close supervision	Six	Six	Six	Six	Six	Six
18	Protection transfer switch with lock as per clause no. 11.3.4 for continuous display in Facia annunciator	One	One	One	-	-	-
19	DC supply fail indication AC lamp.	Two	Two	Two	Two	Two	Two
20	Additional accessories such as pistol grip for carrier IN/OUT & other devices	One Set	One Set	One Set	One Set	One	One

S. No.	PARTICULARS	TYPE-A 220KV Line	TYPE-B 160MVA /100 MVA Xmer (220KV Side)	TYPE-C 220KV TBC Panel	TYPE-D 220KV Bus Tie	TYPE-E 220KV Side of 315 MVA X mer	220KV Bus Reactor Panel
	required for completing the offered schemes.						
21	Synchronising Socket	One	One	One	One	One	One
II	RELAY PANEL						
22	Box type circuit label inscription (50x100mm) indicating Name of feeder/ transformer in side & out side of panels	Two	Two	Two	Two	Two	Two
23	Numerical Distance protection scheme complete with all modules & auxiliary relays etc. as per clause 8.2.	Main I Differential & Main II DPR	-	Main I Differential & Main II DPR	-	-	-
24(a)	Numerical transformer / reactor differential protection relay complete with all modules & auxiliary relays as per clause 8.3	-	ONE	-	-	-	ONE
24(b)	Numerical backup impedance protection scheme complete with all modules and auxiliary relays as per cl.no.8.7.2	-	-	-	-	-	One
25	Pre & post close Trip circuit supervision relay	Six	Six	Six	Six	Eight (Six For Mv & Two For Tertiary Breakers)	Six
26	DC supply healthy monitoring relay	Two	Two	Two	Two	Two	Two
27	PT supply selection switch with aux. relay	One	One	One	-	One	One
28	Numerical, Non directional, Communicable 3 O/C + 1 E/F	One (Directional)/ Nil	one	One/ Nil	One	Two	One

S. No.	PARTICULARS	TYPE-A 220KV Line	TYPE-B 160MVA /100 MVA Xmer (220KV Side)	TYPE-C 220KV TBC Panel	TYPE-D 220KV Bus Tie	TYPE-E 220KV Side of 315 MVA X mer	220KV Bus Reactor Panel
	Relay. For feeders relay shall be directional.						
29 (a)	LBB relay (Tenderers may clarify if this is a built-in feature of numerical distance/ differential relay). *	One	One	One	One	One	One
(b)	Restricted earth fault relay	-	One	-	-	-	One
30	Separate LBB relay for bus tie panel as per CI.No. 9.3.1	-	-	-	One LBB With 2 Nos. Tripping Relays	-	One
31	Over fluxing relay complete with timer etc.***	-	One	-	-	-	One
32	Hand reset auxiliary <u>trip relay</u> with flag indication for : i. Oil temp high trip ii. Winding temp high trip iii. Main buchholz trip iv. OLTC oil surge relay trip- 3 Nos. v. Pressure relief device trip - 3 Nos. vi. Spare	-	1 for each Total 10 Nos	-	-	-	1 for each, total 7 Nos.
33.	Hand reset <u>alarm relay</u> with flag indication for : i. Oil temp high alarm ii. Winding temp high alarm iii. Main buchholz alarm iv. OLTC oil surge relay alarm v. Pressure relief device alarm vi. Spare	-	1 for each, total 6 nos.	-	-	-	1 for each, total 6 nos.

S. No.	PARTICULARS	TYPE-A 220KV Line	TYPE-B 160MVA /100 MVA Xmer (220KV Side)	TYPE-C 220KV TBC Panel	TYPE-D 220KV Bus Tie	TYPE-E 220KV Side of 315 MVA X mer	220KV Bus Reactor Panel
34.	Overload relay, inform of a definite time over current relay with variable setting range from 50 to 200 % of relay current & with a timer having setting range of 2.5 to 25.0 sec. ***	-	One	-	-	-	One
35.	High speed tripping relay for master trip/inter-trip duty.	Two	One	Two	One	Two	One
36.	Non-directional three element over current relay for 33 KV tertiary winding	-	-	-	-	One	-
37.	Single element over current relay for circulating current protection of tertiary winding	-	-	-	-	One	-
38.	Differential protection for 25 MVAR reactor to be provided on tertiary winding	-	-	-	-	One	-
39.	Non-directional two element over current & one element earth fault relay for 33KV reactor	-	-	-	-	One	-
40.	Additional auxiliary relays required for completing offered protection schemes	As Required	As Required	As Required	As Required	As Required	As Required
41.	Aux Relay for auto reclosing	One		One			
42.	High Speed Single phase Tripping Relay	Three	-	Three	-	-	-
43.	Phase measurement unit if it is not integral part of Numeric distance	One	One	-	-	-	-

S. No.	PARTICULARS	TYPE-A 220KV Line	TYPE-B 160MVA /100 MVA Xmer (220KV Side)	TYPE-C 220KV TBC Panel	TYPE-D 220KV Bus Tie	TYPE-E 220KV Side of 315 MVA X mer	220KV Bus Reactor Panel
	protection or Numeric differential protection						
44	Six bay switch for selection of setting group in Numerical relay	-	-	One	-	-	-
III EQUIPMENT MOUNTED INSIDE							
45	Space heaters with switch in each panel.	One	One	One	One	One	One
46	15/5A, 250Volts power socket with protective metallic cover & switch.	One	One	One	One	One	One
47	20Watt Tube light with door switch.	One	One	One	One	One	One
48	40Watt incandescent or 15Watt CFL lamp with switch.	Two	Two	Two	Two	Two	Two
49	DC bell for NON TRIP alarm complete with accept, reset and test facilities.	One	One	One	One	One	One
50	DC hooter for trip alarm complete with accept, reset and test facility	One	One	One	One	One	One
51	AC Bell for DC supply supervision.	One	One	One	One	One	One
52	Gland plate fitted with Cable glands at the front & rear panel	One Set	One Set	One Set	One Set	One Set	One Set
53	Foundation bolts	One Set	One Set	One Set	One Set	One Set	One Set
54	Additional relays or accessories offered by Tenderer, which are essentially required for completing protection scheme.	One Set	One Set	One Set	One Set	One Set	One Set

For the purpose of confirmation to supply all items mentioned above the Bidders shall bring out all details in a tabular form in the manner indicated above in Schedule VIII.

IMPORTANT NOTE:

- i. Bidders shall indicate Unit prices for all the gadgets and relays offered by them for the 400 KV as well as 220 KV C&R panels. This has to be strictly complied. A Schedule for this purpose is enclosed and this shall form a part of Schedule-I about details of equipment and quantity for 400 KV as well as 220 KV C&R Panels.
- ii. Bidders may please refer Clause no. 9.3.1 and arrange to provide a separate two nos. tripping relays having 8 NO contacts per circuit with bus tie panel. They shall keep a provision for 8 such circuits to start with.

REMARKS: (i) * ~~In case the LBB relay forms an integral part of the numerical distance as well as differential relay then Bidders need not offer separate relays. Bidders may clarify accordingly.~~

(i) **In case over fluxing relay forms an integral part of the numerical differential relay, then Bidders need not offer a separate relay. This may be clarified.

(ii)*** In case 'Overload relay' forms integral part of X'mer diff. relay, then separate (discrete) relay need not be offered.

(iii)In case the restricted earth fault relay forms an integral part of the numerical differential relay for 315 Xmer then Bidders need not offer separate relays. Bidders may clarify accordingly.

(iv) Please note that both 400 & 220kV feeder & bus coupler panels shall be suitable for main I & main II protection, Main I shall be differential & main II shall be DPR relay. However as mentioned in the specification elsewhere that the supply of differential relay shall not be in the scope of bidder whereas DPR for main II shall be supplied by the bidder.

SECTION II (B)
2.1.2 TECHNICAL SPECIFICATION FOR 400KV & 220KV BUS BAR PROTECTION SCHEME

1.0 SCOPE:

The scope of this specification covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Specification means "Original Equipment Manufacturer (OEM)". The purchaser means the 'MPPTCL'.

In case bidder is not OEM, sole responsibility of offering equipments/material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 FEATURES OF BUS BAR DIFFERENTIAL SCHEME

2.1 The offered Numerical, LOW IMPEDENCE, Centralized configurations bus bar protection scheme shall be suitable for 1A secondary current, 110V secondary PT voltage, 50 Hz. Double bus bar with transfer bus and/or single bus bar with transfer bus arrangement of the proposed EHV substations. The bus bar protection scheme shall be suitable for following requirement:

1. The Numerical, Low Impedance, Centralized configuration type with biased differential characteristics, should have operative and restraint characteristics suitable for 220/110V DC Aux. Supply with variation of minus 20% and plus 10%. The automatic selection facility for DC voltage shall be provided in the scheme to make it suitable for selection of 110/220V DC voltage as per our requirement. Therefore provision of auto selection of DC auxiliary supply voltage need be made in C&R panels for Busbar protection.
2. The offered scheme shall be suitable to ensure the isolation of the faulty zone, stable during through fault and shall be backed up by check zone and end zone protection.
3. The scheme shall have maximum operating time up to trip impulse to trip relay for all types of faults not more than 20 milli seconds.
4. The scheme shall have operating selectivity for each bus bar, and shall also have dynamic zone selection through isolator replica without the use of external CT switching relays. It shall be possible to isolate any particular bay or zone of the busbar protection scheme during the maintenance activity without affecting the protection of the complete scheme. The scheme shall be highly stable for external fault.
5. It shall give hundred percent security up to 40KA fault level.
6. The scheme shall have continuous supervision for CT secondary against any possible open circuit and CT saturation and if it occurs, shall render the relevant zone of protection inoperative and initiate an alarm.
7. The scheme shall be of phase segregated and triple pole, not give false operation during normal load flow in bus bars and incorporate clear zone indication.
8. The scheme shall have independent zones of protection. The scheme shall announce all faults events and monitoring status on the 24 window annunciator. However, adequate number of windows shall be provided to fulfill scheme requirement.

9. The scheme shall include necessary CT switching through relay software or through isolator contact/replica directly without using external CT switching relays.
10. The scheme shall include individual high speed hand reset tripping relay for each feeder.
11. The scheme shall ensure that all configuration and logic are realized in the relay software. The dynamic replicas shall be provided to show bus bar linking as desired by the system.
12. The scheme shall include logic to monitor open/close operations of all the isolators of the substation. For bus bar protection scheme status of isolators through auxiliary contacts from yard upto C&R panels may not be available at no. of substations because of old installation. Hence to sort out this problem, replica of isolators of switchyard for each bay and for all zone of protection shall be required with offered scheme. Therefore, adequate no. of switches for isolators position may be provided in Bus bar protection panel itself.
13. The scheme shall have adequate number of independent settings groups
14. The scheme should be transient free in operation.
15. The scheme should include continuous DC supplies supervision for alarm and trip circuits.
16. The scheme shall include protection 'IN/OUT' switch for each zone with alarm and window on annunciation indication.
17. The scheme shall have disturbance recorder, event logger etc. i.e complete in all respect
18. The busbar protection scheme shall have atleast two communication port. It shall have one no. independent front Ethernet port RJ45/ RS-232/LAN port for local communication for relay setting, modifications, extraction and analysis of fault/event/disturbance records from laptop and a rear fiber optic port on IEC-61850 standard for remote communication to SCADA system. In addition the scheme shall have capability for accurate time synchronization with GPS clock through (IRIG-B port/PPM/SNTP). The scheme should conform to atleast following requirements of IEC-61850 and necessary certificates shall be furnished for the compliance.
 - a) Basic Data Exchange
 - b) Data Sets
 - c) Un buffered reporting
 - d) Generic Object Oriented substation events
 - e) Time synchronization
 - f) File transfer.
19. The scheme shall have continuous comprehensive self diagnostic feature to monitor the healthiness of the all hardware and software elements of the relay. Any failure detected shall be annunciated.
20. The scheme shall be a complete package in all respects including all software's, hardware's etc. all auxiliary relays, individual high speed hand reset tripping relays for each feeder, indication lamps, etc. if required.
21. The scheme shall ensure that No region within the bus bar zone should be left unprotected by the offered bus bar scheme. Fault between isolator and CT in bus coupler section should be detected by the bus bar scheme.
22. The scheme shall include necessary software for CT ratio correction No ICT etc. shall be allowed to be used.
23. There shall be provision of one No.24 point Annunciations to accommodate all annunciations related to the scheme. The scheme should have at least 8 nos. LEDs for fault indication.
24. Bidders may incorporate additional check zone with a view to obtain greater degree of stability.

25. It shall include continuous supervision of each DC supply separately.
26. Test Terminal Block shall be fully enclosed with removable covers and shall be made of moulded, non-inflammable good quality material with boxes barriers moulded integrally.
27. The offered control panel and protective scheme shall be expandable beyond the present scope of existing feeders, transformers and buses as per single line diagram enclosed with the Bid documents. Over and above this, provision of expanding minimum 6 nos. bays in future shall be available. **This requirement is very specific and shall be noted carefully.**
28. The existing CTs may be with 3 core, 4 core or 5 core. These CTs shall be used bus differential protection scheme. At some places independent core for bus differential protection scheme may not be available because existing core may be in use with other protection. For such cases, CT in and out connections for 3 phases and one neutral shall be required. Hence, the scheme should be suitable to receive three phase and neutral of CT for in & out connection for each CT. It means internal neutral formation shall not be acceptable. May please note that disconnecting type connector for CTs connections shall only be acceptable.
29. The scheme should not trip for the differential current below the load current of heaviest loaded feeder. This feature should be provided with enable/disable option.
30. The scheme shall provide on the unit and should be accessible for checking of the menu, setting and DR etc. at least in the following ways.
 - a) HMI on the front of the relay. The busbar protection scheme shall have a large HMI in the front capable of displaying bay currents and all calculated differential currents etc.
 - b) The relay should display the menu, setting, DR & ER etc. through the keyboard provided on the front of the relay.
 - c) The scheme should have RS 232/LAN port on the front of the panel for accessing by using personal computer to go through the Menu. Setting measurements and Disturbance records and dynamic busbar replica etc. This may be on the propriety Protocol. The associated softwares shall be supplied alongwith the relay.
 - d) It should be provided with suitable port so that all the relays in the system could be brought on the common bus and connected to a common computer available in the substation for communication for accessibility of menu, Disturbance records, event record and busbar replica etc.
31. The offered numerical relay should have in-built breaker failure for each CT input with the operating and resetting time not more than 20 m.secs. The relay shall have adjustable time delay of 100 to 500 ms with tripping time delay of relay not more than 20 milli secs.
32. The offered Numerical relay should have PT modules so that measurement of all three phases of Main Bus-I and Main bus-II can be recorded.
33. The relay should provide clear indication for CT open circuit / CT saturation.

In existing substations, all necessary co-ordination /inter-connections between existing schemes/feeder panels shall be fully covered in the scope of the Bidder. Auxiliary relays, trip relays, flag relays, switches etc. if required to facilitate the operation of the scheme detailed in this Bid shall be fully covered in the scope of the Bidder/offer.

The cables required for the scheme shall be supplied/laid by MPPTCL and commissioning of panels shall be done under the supervision of the service engineer of the supplier.

2.2 WEATHER PROOF RELAY PANELS:

- a) This panel shall include necessary number of electrically reset relays each with at least eight contacts for isolator auxiliary contracts multiplication and for changing the CT and DC circuits to relevant zones of bus bar protection.
- b) The panel shall be sheet steel enclosed and shall be dust, weather and vermin proof. Sheet steel used shall be at least 2.0 mm thick and properly braced to prevent wobbling
- c) The enclosures of the panel shall provide a degree of protection of not less than IP-55 (as per IS: 2147).
- d) The panel shall be free standing floor mounting type or pedestal mounting type as per requirement.
- e) The panel shall be provided with double hinged doors with padlocking arrangement.
- f) All doors, removable covers and panels shall be gasketed all around with synthetic rubber gaskets Neoprene/EPDM generally conforming with provision of IS 11149. However, XLPE gaskets can also be used for fixing protective glass doors. Ventilating louvers, if provided shall have screens and filters. The screens shall be made of either brass or GI wire mesh.
- g) Cable entries shall be from bottom. Suitable removable cable gland plate shall be provided on the cabinet for this purpose.
- h) All sheet steel work shall be digressed, pickled, phosphated and then applied with two coats of zinc chromates primer and two coats of finishing systematic enamel paint, both inside and outside. The colour of the finishing paint shall be light grey in accordance with shade no. 697 of IS.5.
- i) Suitable heaters shall be mounted in the panel to prevent condensation. Heaters shall be controlled by thermostats so that the cubicle temperature does not exceed 30°C. On-off switch and fuse shall be provided. Heater shall be suitable for 240V AC supply voltage.
- j) The test terminal blocks (TTB) to be provided shall be fully enclosed with removable covers and made of moulded, non-inflammable plastic material with boxes and barriers moulded integrally. All terminals shall be clearly marked with identification numbers or letters to facilitate connection to external wiring. Terminal block shall have shorting.

3.0 REQUIREMENT: The requirement of 220kV panel for bus bar protection scheme shall be strictly as per price schedule enclosed with the bid document. Bidders may please note that 220kV simplex design with front door opening and rear blocked panels shall be preferred. May please also note that although in some of the 220KV Substations at present there is provision of main -I and transfer bus. However all these substations will be augmented having provision of main bus - II also in near future. As such, Bidders are requested to offer the bus differential scheme suitable for main-I + main-II and transfer bus arrangement with in-dependent zone of protection.

4.0 LIMITS OF CONTRACT:

4.1 It is not the intent to specify completely here all the details of design and construction of the control and relay panels. However, the C&R panels shall conform in all respects to the high standard of engineering design and workmanship. Various control and relay panels and other requirements specified under this section shall be complete in themselves in all respect with all main and auxiliary relays, fuses, links & switches duly wired, labels terminal panels, earthing terminals, indicating lamps, mimic diagram, annunciator, name plate, foundation bolts, interior illumination, cable

termination arrangement with cable glands fitted on base mounting plate etc. including all other accessories which are essentially required for satisfactory operation . Such components shall be deemed to be within the scope of supply of the Bidder irrespective of whether these are specifically brought out in this specification or not.

4.2 Supply and laying of control and power cables for interconnecting various equipments is not covered under the specification. Cable terminating arrangements, viz. the cable hold support boxes, multi-core cable glands, sealing ends for other types of cables that may be specified, shall however be included in the offered price. These shall be subject to approval of purchaser. It is the responsibility of Bidder to ensure that the equipment specified and complimentary equipment required for completeness of the protection/control scheme be properly accommodated in the panels without congestion and if necessary Bidder may provide panels with larger dimensions in width only.

5.0 CLIMATIC CONDITIONS:

Applicable climatic conditions shall be as per Section-I Volume-II.

6.0 PANEL FINISH AND COLOUR:

- SIMPLEX panels shall be dust, moisture and vermin proof.
- All unfinished surface of steel panels and frame work shall be thoroughly cleaned by sand blasting, pickling and rinsing or by combination of processes or by other latest and improved techniques to remove dust, scales, foreign adhering matter and grease. Cleaning process shall be followed immediately by the application of rust inhibiting wash process. All control panels surfaces shall then be given suitable rust resisting primary coat and then one or more coats of opaline green quick drying enamel to serve as a base and binder for finishing coat.
- As mentioned earlier, purchaser has standardised colour schemes for SIMPLEX design 220 KV C&R panels which shall be **opaline green** as per colour shade No. 275 of IS : 5 for 220 KV panels.
- Purchaser will accept respective matching colour and shade equivalent to BS-381 or any matching colour and shade of other authoritative equivalent standard. Colour finish shall be applied as per above colour scheme on the exterior steel works of the panels. Exterior painted surface shall not be fully glossy. Interior of all panels shall be painted with "Egg Shell White". Pretreatment & painting process is described in Clause 14.0. All steel works shall be phosphated in accordance with IS-6005. Panels shall be provided a degree of protection not less than IP-54 as per IS-2147.

7.0 COMPLIANCE OF PANELS, RELAYS, INSTRUMENTS AND OTHER GADGETS WITH STANDARD SPECIFICATIONS:

7.1 Applicable Standards for the offered equipments/items shall be as per Section-I Volume-II.

7.2 ACCEPTANCE OF OTHER AUTHORITATIVE STANDARDS:

In above table relevant Indian standard specification/IEC standards have been mentioned. Equipments meeting any other authoritative standard, which ensures equal or better quality than the standards, mentioned shall also be acceptable. Equipment for which Indian Standards are not available, the relevant British standards and IEC

recommendations will be applicable. Please attach photocopy of all such standards according to which the equipment has been offered.

7.3 TYPE TESTS:

The offered numerical bus-bar protection scheme as well as other static/electromechanical relays and meters on C&R Panels offered by the Bidders shall be fully type tested as per relevant standards. In case the equipment of the type and design offered, has already been type tested, the Bidder shall invariably furnish type test reports from the reputed and approved national/international laboratory/Government approved test houses to prove that indicated accuracy and other specifications of the relays offered conform to the relevant standards. Test certificates shall clearly indicate the type and model number etc., so that relevant details of offered relays could be verified. While submitting offers the model and type etc., shall be clearly indicated. Type test reports so furnished should not pertain to the period earlier than five years from the date of opening of Bid.

It may be very specifically noted by Bidders that non-submission of type test reports about numerical and conventional relays and also about static meters along with the Bid shall be treated as a disqualification.

7.4. DISCREPANCIES IN TECHNICAL PARTICULARS:

Regarding discrepancy in technical particulars as stipulated in Section-I Volume-II shall be applicable.

7.5. PANEL CUT OUT AND DIMENSIONS:

Constructional details & dimensions for 220 KV SIMPLEX type panels shall be as under:-

S. No.	Title	220 kV PANELS
1	Type	Simplex design Control & Relay panel
2	Height (mm)	2312 (Panel 2210 + Base frame 102)
3	Depth (mm)	750 mm
4	Width (mm)	1000 mm
5	Base frame	Anticorrosive Black painted
6	Panel Exterior	Opaline Green
7	Panel Interior	Egg Shell white
8	Mimic strips over laid type	Dark Brown
9	Variation in dimension of panels.	Bidder may note that the height and depth of control panels will have to be maintained as mentioned against Sl. No. 2&3 above. As far as width of the control panels is concerned, this shall also be maintained as 1000 mm.

8.0 LIGHTING:

In each SIMPLEX panel, one 20 W, 230V AC tube light guarded with protected cage shall be provided inside the central roofed access for adequate illumination & the same shall be controlled by a door switch. Two incandescent 40 Watt (or 15W CFL) 230 Volt lamps with switch housed in protective cage, one each on the front & rear side of the panels shall be provided under the central roofed access.

One number 15A, 3 pin receptable universal socket with switch shall be provided in each simplex control panels. Third pin of the socket shall be effectively grounded through the metallic structure. Socket shall be industrial grade control panels type complete with protective metallic cover.

9.0. AUXILIARY SUPPLY:

The auxiliary AC and DC supply shall be as per clause No. 6 Section-I Volume –II Part I of the specification

10.0 CONTROL WIRING:

10.1 Successful Bidders shall furnish and install complete wiring up to the terminal block for the equipment, instrument devices mounted in the control panels strictly in accordance with the approved wiring diagram prepared by the Bidder based on the purchaser's information and schematic diagram.

10.2 Wiring shall be completed in all respects so as to ensure proper functioning of control, protection and metering schemes.

10.3 All spare relay contacts and spare contacts of switches shall be wired up to the terminal blocks.

10.4 Wiring shall be done with flexible heat resistant control panels wires, PVC insulated with stranded copper conductor. Minimum number of strand in the wire shall be three. The conductor size shall be equivalent to 2.5 mm square minimum for Current, potential & DC Control circuit and 1.5mm sq minimum for other indications and annunciation circuits.

10.5 Coloured cores shall be used for wiring as per latest revision of IS-375 viz; red yellow blue and black for R Y B phases and neutral respectively. Colour code for earthing shall be Green, and for annunciation circuits gray colour code shall be used. For DC circuits the colour code will be Red-positive & Black-negative.

10.6 Each wire shall be identified at its both ends with wire designation number by plastic ferrule as per wiring diagram based on latest revision of IS-375 to denote the different circuit functions. Bidders shall take approval for the system of wire numbering and colour coding schemes.

10.7 All wire terminations shall be made with compression type connectors. Wires shall not be tapped or spliced between terminal points. All wire shall have crimp type termination and direct Tee connection at any place is not at all required.

10.8 All series connected devices and equipment shall be wired up in sequence. Loop-in Loop out system of wiring shall be avoided as far as possible and the common buses shall normally be made through the terminal block for better reliability of testing and maintenance.

10.9 Fuses and links shall be provided for isolation of individual circuit from bus bars without disturbing other circuits and equipment.

10.10 DC trip and DC voltage supplies and wiring to main protective gear shall be segregated from those for special purposes. Each such group shall be fed through separate fuses, either direct from main supply fuses or the bus bars.

10.11 Since a number of wires will run from one point to another, it is desired that the support arrangement should be adequate and neat. Conventional method of bunching of wires should not be adopted since the same creates problems in case any wire is to

be removed. Wires should be accommodated in suitable plastic channels with sliding plastic cover, which may be suitably mounted inside the panels neatly. Inspection/removal of wires laid in the plastic channels should be possible by sliding the covers.

10.12 Blank plastic channels should be provided by the sides of the panels to accommodate incoming cables from switchyard through cable glands with suitable holding arrangement rigidly fixed so that while handling other nearby cables no jerks are transferred to the terminals inside the cubicle.

10.13 Wherever practicable wiring shall be accommodated in the sidewall of the cubicles. Sharp bends shall be avoided.

11.0 TERMINAL BLOCKS:

11.1 Multi-way terminal blocks complete with necessary binding screws and washers for wire connection and marking strip for circuit identification shall be furnished for terminating the panel wiring and outgoing cables. Terminals shall be suitable for receiving atleast 2x7/0.737mm stranded copper conductor or equivalent aluminum conductor wires per terminal. It may please be noted that the current rating shall be double the current rating of 2x7/0.737 non stranded copper wire and terminal shall be suitable to receive 2x2.5sq mm/or 2x4sq mm copper conductor of control cable.

11.2 Terminal blocks shall have shorting and disconnection facilities ,so that the Board side and outgoing wires could be disconnected just by opening the disconnecting links which slides up or down without dislodging the wires from their position. The technical specification for these blocks shall conform to latest IEC 60947-7-1 as mentioned hereunder -

'The screw terminal block shall be manufactured as per IEC-60947-7-1. The insulating material of Terminal Block shall be of polyamide 6.6 meeting VO / V2 inflammability class as per UL 94. All metal parts including screws shall be copper alloy. The terminal shall be suitable for mounting on both 'DIN' as well as 'G' type rail. All the metal parts shall be captive and touch proof. The terminal block shall have screw locking design so that it can be stand vibration level upto 5g and also prevent accidental loosening of conductors.'

Non-disconnecting and disconnecting type terminal connectors shall be made of polyamide and shall be preferably of 'ELMEX' make having type designations KBTM4 and KLTD4 respectively.

11.3 Highly reliable Test terminal blocks with facilities of shorting and easy removal of connection shall be provided for CT & PT circuits. Instrument transformer wires shall be terminated through suitably mounted test terminal blocks to facilitate site testing of all main and backup protection relays.

11.4 Test terminal blocks shall be grouped according to the circuit functions and each terminal block group shall have at least 20% spare terminals for accommodating additional input wires.

11.5 Not more than two wires shall be connected to any terminal or either side of the terminal block. If necessary, a number of terminals shall be connected by jumpers to provide additional wiring points.

11.6 Each terminal point shall be marked with designation obtained from the purchaser's schematic drawings.

11.7 Adjacent rows of terminal blocks shall be spaced not less than 100mm apart. These shall be mounted vertically at the sides of the cubicle and set obliquely towards

the rear doors to give easy access to terminating end to enable ferrule number to be read without difficulty.

11.8 Bottom of terminal blocks shall be spaced at least 200mm above the cable gland of incoming multicore cables.

12.0 CABLE ENTRY:

12.1 All panels shall have provision of multiple cable entries from the bottom. Necessary cable glands should also be provided in the rear & front side of panels on a 4 mm thick mild steel gland plate to be bolted firmly with nut and bolts on base plate. Base plate shall be bolted further on the base frame with adequate number of nuts & bolts as may be necessary to allow free working space for cable connections and to facilitate its opening. Base plate shall be in 3 pieces for Simplex panels and one piece for simplex panels with proper opening for fixing gland plates. Thickness of these base plates shall not be less than 4 mm. Base plate provided on the base frame is to facilitate free working space and also to serve as a cover for control cables laid in the trenches from front to rear side of the Simplex panels. Purchaser will arrange for necessary floor opening below the panels to suit the cable trench design of purchaser's requirement.

12.2 Wiring through the terminal blocks shall be located in a manner that it becomes convenient to provide termination of control cable for floor openings.

12.3 Gland plate shall be supplied duly drilled and fitted with cable glands. Gland plate and doors shall be provided with gasket properly. Necessary glands as per clause- 4.8.5 below shall be fitted on the gland plate.

12.4 Rigid supports shall be provided along with terminal block for holding plastic channel. Suitable clamps may also be provided in plastic channel for holding cables.

12.5 Following quantities of cable glands with suitable blanking arrangement shall be fitted on the gland plate that shall be fastened suitably at the bottom of each of the 400 & 220 kV Simplex panels respectively. Quantities of cable glands shall be provided at the bottom of each panel as per breakup given below:

S. No.	Cable gland suitable for	Qty. of glands for 220 KV S/s
1.	2 core 2.5 sq.mm	8 nos.
2.	4 core 2.5 sq. mm	8 nos.
3.	4 core 4 sq.mm (armoured cable)	--
4.	12 core 2.5 sq.mm	8 nos.

Bidders may please note that for control cables for 220 KV C&R shall be Unarmoured type. Offered cable glands shall be suitable for unarmoured copper control cables accordingly. Please note that above quantity of cable glands are tentative and if required same will be revised as per scheme requirement.

13.0 GROUNDING:

Bidders may please note that all existing panels at our 220 KV substations have been provided with 12.5 x 6mm copper grounding bus extending along the entire length of the panels for the purpose of effective grounding of all metal parts. Simplex design panel for bus bar scheme shall also be provided with a copper strip of size 12.5 x 6mm for the purpose of grounding for all the proposed 220 KV substations also, the copper grounding bus shall have a dimension of 12.5 x 6 mm.

14.0 ALARM SCHEME:

14.1 Automatic tripping of the circuit breaker due to operation of protective relays shall be indicated by a common audible alarm. Offered alarm scheme shall be complete in all respects including one DC bell for non-trip alarm and one DC hooter for trip alarm with relays and other accessories if any. With each panels one alarm scheme will be required.

14.2 DC SUPPLY SUPERVISION RELAY: Separate DC supply supervision relay, one each for the main and duplicate 220/110 V DC supply system shall be provided for 220 KV panels. Scheme shall be capable of monitoring failure of DC supply of the circuit to which it is connected. It shall have adequate potential free contacts to meet out the requirement of the scheme and also to meet the requirement for providing alarm and facia indication. The scheme shall have a "time delay on drop off" of not less than 100 m.secs and be provided with operation indicator/flag. This relay shall sound AC 230 V heavy-duty bell with provision for accept/reset and test facilities.

14.3 HIGH SPEED TRIPPING RELAYS:

Adequate number of High Speed Tripping Relays will be provided for extension of tripping command from busbar protection scheme to the circuit breakers in each circuit. This relay will have adequate no. of NO & NC contacts suitable for 110/220V DC voltage as per offered scheme requirement. If needed no. of NO & NC contact may be increased based on actual requirement as per scheme. This relay shall have following features:

- a) High speed operation
- b) High degree of mechanical stability
- c) Compact

15.0 ROUTINE AND ACCEPTANCE TESTS:

All modules and sub-assemblies shall be energized and tested for routine and acceptance tests jointly carried out in presence of purchaser's representative as per relevant IEC Specifications or any other international standards individually as well as in assembled form at the factory.

15.1 Relay and control panels shall be subjected to the following tests:

- o Mechanical operation test.
- o Verification of Degree of protection as per IS:2147
- o High voltage test as per IS or IEC as may be applicable.
- o Electrical control, Interlock and sequential operation tests.
- o Verification of wiring as per approved schematic.
- o Other routine tests on all associated equipment and relays as per relevant Indian Standards or IEC.

15.2 After all tests have been carried out, 4 (four) copies of each test report/inspection report shall be furnished. Each report shall supply the following information

- i. Complete identification data including serial number of all relays and their routine test reports.
- ii. Routine test reports for all the panels.

15.3 Supply of equipment shall be subject to the approval of Test Certificates by purchaser.

16.0 PRETREATMENT AND PAINTING PROCESS:

Sheet steel fabricated members shall be subjected to pretreatment process before painting and process can be broadly divided as `Metal treatment and painting.

16.1 METAL TREATMENT:

Degreasing: This can be achieved either immersing in hot alkaline degreasing bath or in hot di-chloroethelene solution. After degreasing operation the surface shall be cleaned thoroughly with cold water.

Pickling: This is to remove rust and metal scales by immersing metal sheets in dilute sulphuric acid (approximately 20%) at nearly 60 deg. centigrade so as to totally remove scale and rust.

Rinse in cold water in two tanks to remove traces of acids.

Treat with phosphoric acid base neutralizer for removal of chlorine from the above acid pickling and again wash with running water.

Phosphating Immerse in grenadine zinc phosphate solution for about 20 minutes at 80 to 90 degree centigrade . Uniform phosphate coating of 4 to 5 gm per sq. meter shall be achieved.

Swill in cold water.

Rinse in Deorylyte bath at 70 to 80 degree centigrade to neutralize any traces of salts.

Seal the above phosphate coating with hot/dilute chromate solution.

Dry with compressed air

16.2 PAINTING:

Primer spray: One coat on wet surface by specially developed `High luster' zinc chromate primer and to stove at 150-160 deg. Centigrade for 25 to 30 minutes. Alternatively red-oxide primer with zinc chromate contents may be used. However former process shall be preferred.

Rubbing and putting : Apply putty to fill up the scars if any to present smooth surface and stove 15 to 20 minutes. Apply putty several times to get the perfect smooth finish.

Surfacing: Sand down with mechanical abrasive and stove for 20 minutes.

Primer: Spray second coat of primer as per (i) above or grey primer surface on wet and stove for 20 to 40 minutes at 150 deg. centigrade.

Finish paint: Rubbing down dry and spray first coat of synthetic enamel finish paint on wet and stove for 30 minutes.

Surfacing: Sand down or rub dry to prepare for final finish spray. Coats of synthetic enamel finish paint on wet and stove it at 150 deg. centigrade for 30 minutes.

- NOTE :** i Necessary stiffeners may be welded between large cut ducts to provide rigidity before painting process.
ii Painting process shall be done within 24 hrs. of completion of treatment.

- iii Small coating paint shall be supplied along with equipment for touching up at site.

17.0 DRAWING AND LITERATURE:

17.1 G.A. drawings for each type of panels shall be submitted with the Bid.

17.2 As soon as possible after the award of contract the manufacture shall submit GA and Schematic drawings of each panel for the approval of purchaser.

17.3 Successful Bidders shall have to supply four sets each containing of approved GA, Schematic and wiring drawings illustrative pamphlets, literature, operation and maintenance instructions of the relay/panels under his scope of supply.

18.0 GUARANTEED TECHNICAL PARTICULARS & TECHNICAL QUESTIONNAIRE:

18.1 Guaranteed technical particulars for all relays, instruments, meters and all other accessories shall be furnished along with the Bid. While submitting technical particulars, please ensure to stipulate very clearly the class of accuracy, (wherever necessary), current and voltage rating, physical dimensions, weight, make, model No., type etc. in order to give a clear picture of device offered, along with literature/write-up. All 220KV C&R panels shall be suitable for 110 V DC or 220V DC as per our requirement.

18.2 At the end of this specification we have attached technical questionnaire. Bidders are requested to reply various questions detailed out in the questionnaire although similar information is available elsewhere in the Bid. Please note in case Bidders do not furnish clear replies to our technical questionnaire, their offers may run the risk of rejection.

19.0 OTHER IMPORTANT REQUIREMENT:

19.1 QUALITY ASSURANCE PROGRAMME:

The Quality Assurance Programme of this specification shall be as per Section-I Volume-II.

19.2 INSPECTION:

19.2.1 Bidders shall chalk out a detailed inspection and testing program for manufacturing activities for the various components. Purchaser reserves the right to get carried out any tests by a third party. All Cost of inspection/tests shall be borne by the Bidder. No material shall be despatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

19.2.2 Acceptance of any quantity of panels/material shall in no way relieve the successful Bidder of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipments are later found to be defective.

19.2.3 At the time of inspection, Bidders shall identify each and every item/accessories. Unless all the items are identified, manufacture will not be treated as complete. Serial number of Relays & other accessories shall be entered into the test report. Various tests stipulated in IS shall be performed in the presence of purchaser's engineers or when the inspection waiver has been given, in such a case,

the testing shall be done at the manufacturer's works as per IS stipulations and same should be confirmed by documentary evidence by way of Test Certificate which shall be got approved by the purchaser.

19.2.4 Whenever inspection call is given, the letter of inspection call will accompany the following:

- a. List of various panels and loose relays which are ready at the works and will be offered for inspection. Inspecting Officer will carry the list and check the items declared to have been offered for inspection.
- b. It is expected that before any equipment is offered for inspection, internal testing of the same for various important parameters are already done. Routine test report for such tests shall also accompany with the letter of inspection call.
- c. In case for any reasons inspection is not completed or equipment is not found complete with all accessories, the Purchaser will reserve the right to recover the complete cost of deputation of inspecting team to the works of the manufacturer.

20.0 COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS:

Responsibility for obtaining timely supplies of bought out items will rest on the Bidder and only on this basis, delivery period will be offered in the Bid. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and in case defective supply of any item is reported will rest on the Bidder. In case for attending to defect in any accessory or inspection/ replacement of the accessory, which may be bought out item for the Bidder; services of engineer of original manufacturer is required, the same will be organized on immediate basis by the Bidder at his cost.

Bidders may ensure that Bid document containing number of pages have been properly page numbered and signed by the Bidder. All Bid documents including schedules should be indexed properly and Index of the document should be enclosed/placed at the beginning of the Bid document.

21.0 MISCELLANEOUS ACCESSORIES:

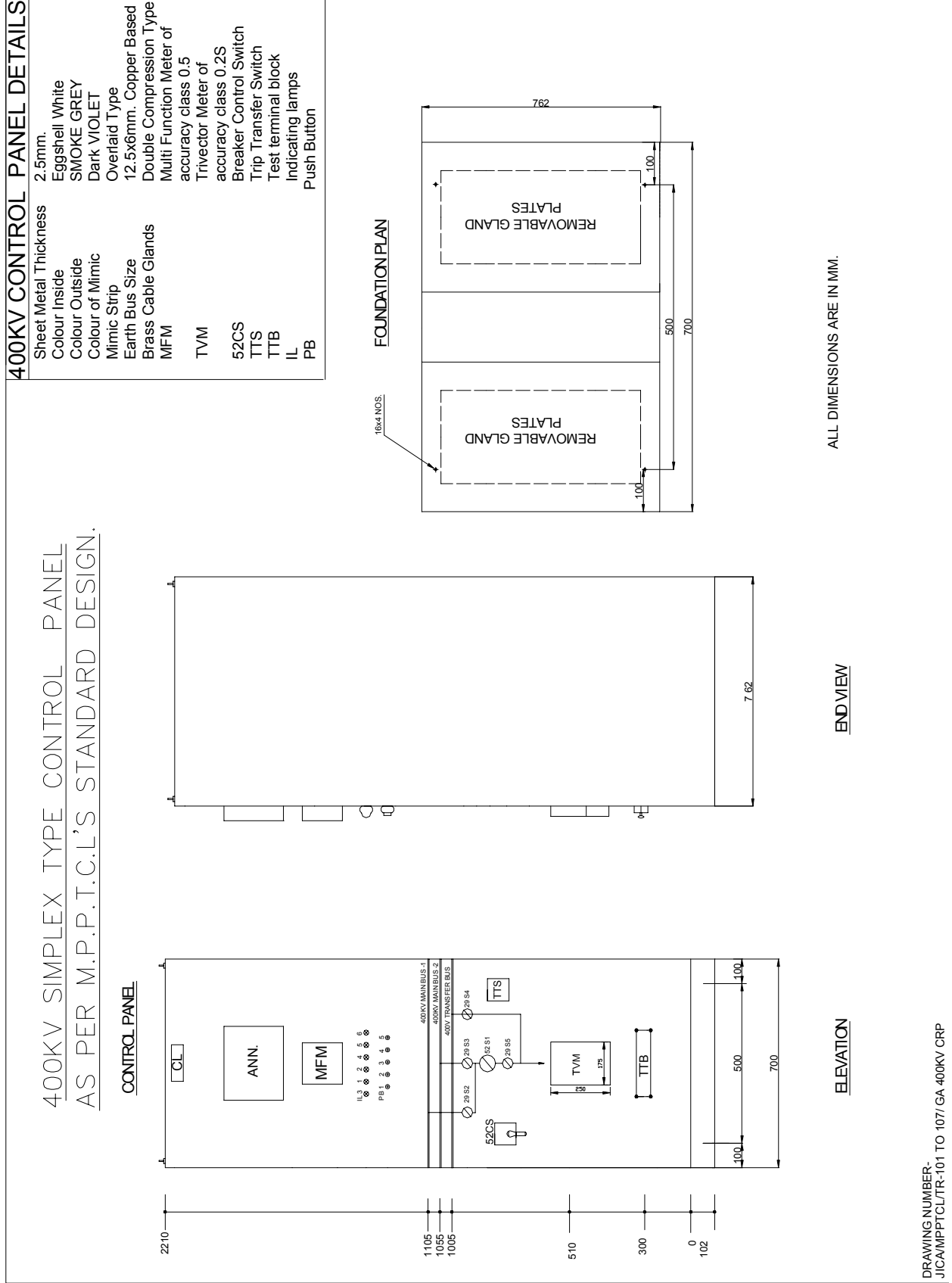
- i. **Plug point –**
240V, single phase, 50 Hz AC socket with switch cubicle to accept 5 Amps and 15 Amps pin round standard Indian plug shall be provided in the interior of the panel.
- ii. **Interior lighting -**
Panel shall be provided with a fluorescent lighting fixture suitable for 240V, single phase, 50 Hz AC supply.
- iii. **Switches and fuses –**
Busbar protection panel shall be provided with necessary arrangements for receiving, distributing and isolating DC and AC supplies.
- iv. **Space heater –**
Panel shall be provided with a space heater rated for 240V, single phase, 50 Hz supply for internal heating of the panel to prevent condensation of moisture.

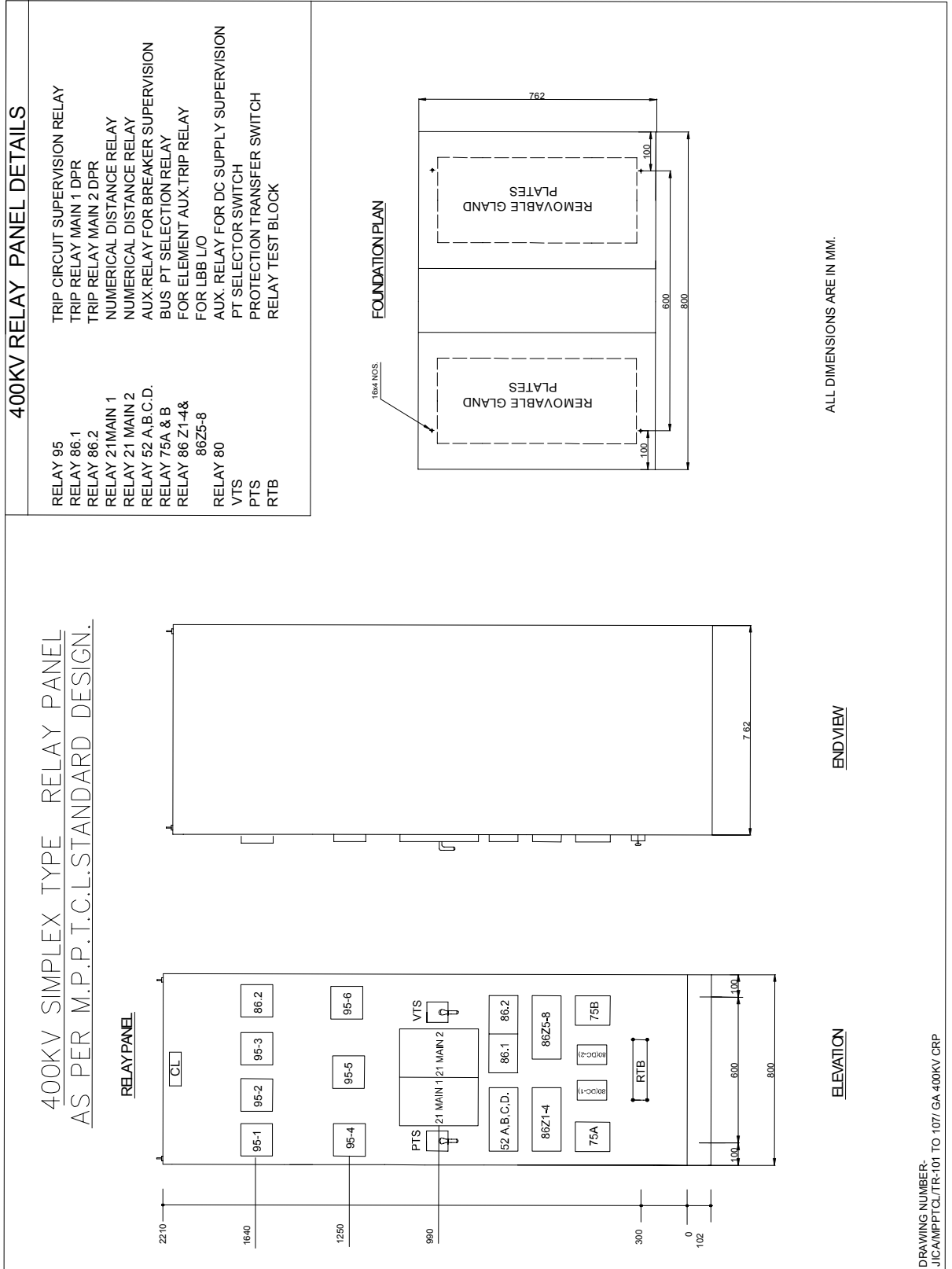
22.0 SCHEDULE OF REQUIREMENT OF RELAYS ETC:

It is obligatory on the part of Bidders to furnish Schedule of Requirement of Accessories provided with equipment in the Schedule VIII of Volume II of the Bid document. In case Schedule VIII duly filled in complete in all respects is not furnished, the Bid may be treated as non-responsive.

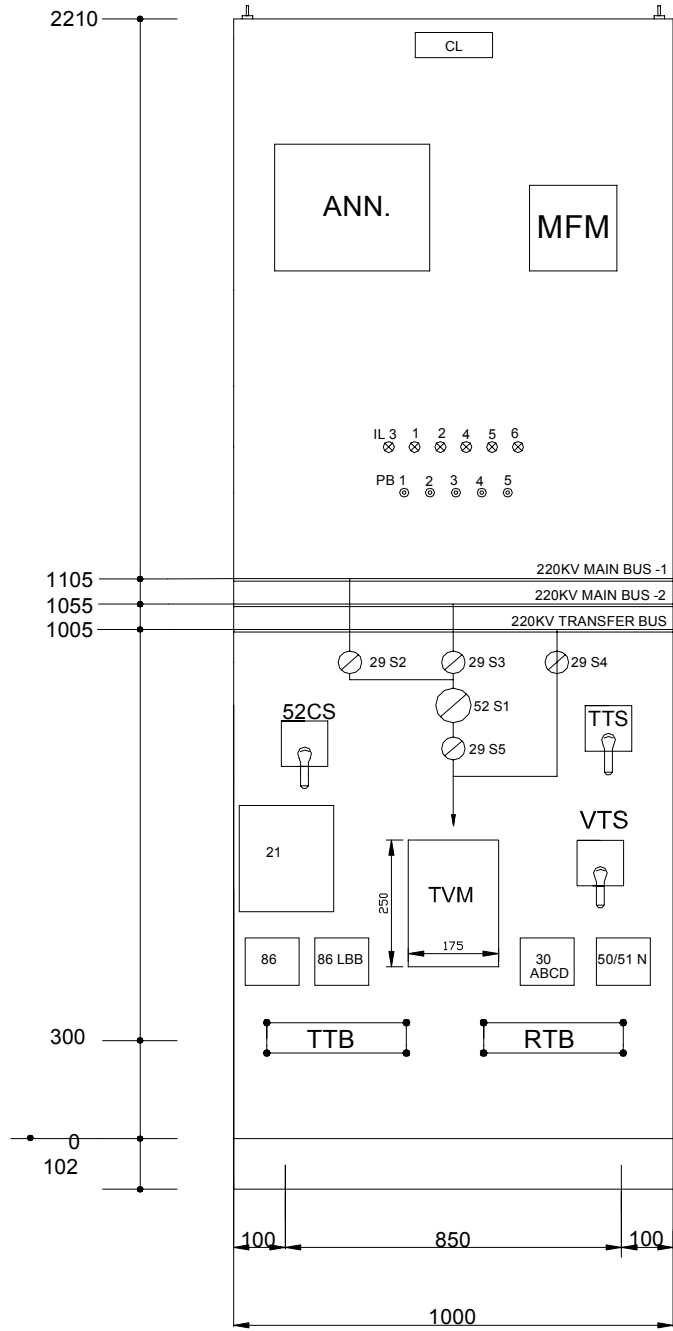
APPENDIX-B**DRAWINGS**

S.No.	Drawing No.	Description
1	JICA/MPPTCL/TR-101 TO 107/ GA 400KV CP	General Arrangement Drawing for 400KV Control Panel
2	JICA/MPPTCL/TR-101 TO 107/ GA 400KV RP	General Arrangement Drawing for 400KV Relay Panel
3	JICA/MPPTCL/TR-101 TO 107/ EL 220KV CRP	Elevation Drawing for 220KV Control & Relay Panel
4	JICA/MPPTCL/TR-101 TO 107/ GA 220KV CRP	General Arrangement Drawing for 220KV Control & Relay Panel





GENERAL ARRANGEMENT OF 220KV SIMPLEX TYPE CONTROL & RELAY PANEL

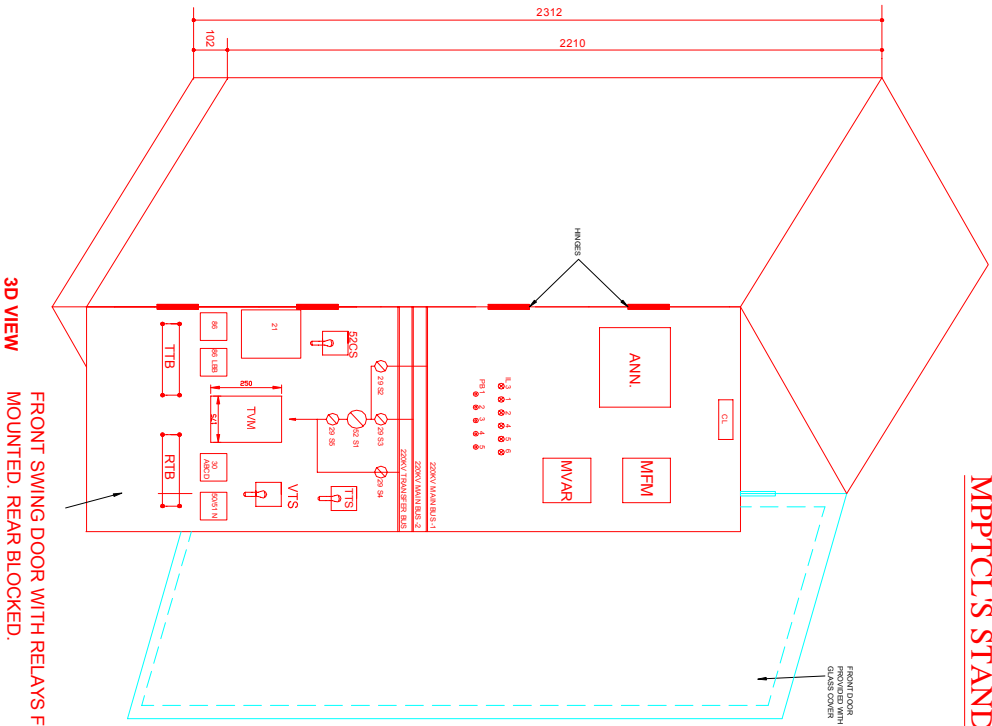


ELEVATION

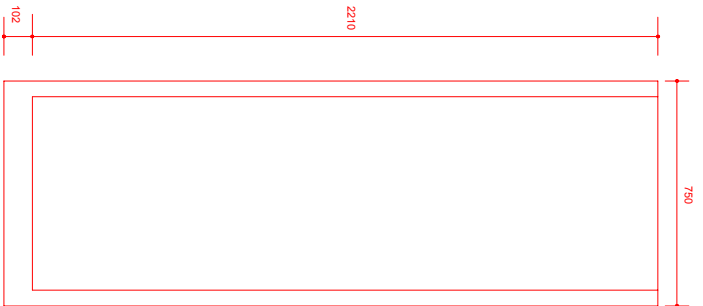
DRAWING NUMBER-
JICA/MPPTCL/TR-101 TO 107/ EL 220KV CRP

220KV SIMPLEX TYPE CONTROL & RELAY PANEL AS PER

MPPTCL'S STANDARD DESIGN



3D VIEW
FRONT SWING DOOR WITH RELAYS FLUSH MOUNTED. REAR BLOCKED.



END VIEW

220KV PANEL DETAILS

Sheet Metal Thickness	3.0/ 2.5mm.
Colour Inside	Eggshell White
Colour Outside	Opaline Green
Colour of Mimic	Subject to approval
Mimic Strip	Overlaid Type
Earth Bus Size	12.5x10mm, Copper Based
Brass Cable Glands	Double Compression
Type	Multi Function Meter of accuracy class 0.5
MFM	MVAR Meter
MVAR	Trivector Meter of accuracy class 0.25
TVM	Breaker Control Switch
TTS	Tip Transfer Switch
29 S1 TO S5	Semaphores
52CS	Indicating lamps
TTS	Push buttons
29 S1 TO S5	PT Selection switch
IL	Distance Protection Relay
PB	Back-up Relay
VTS	Tripping Relay
21	Tripping Relay for LBB
50/51N	TCS & DC Supervision Relays Considered
86	Built-in DPR (21).
86 LBB	Aux. Relay for Breaker
195, 295, 80 ABC	
30 ABCD	

CONSTRUCTION:
PANELS WILL BE OF FREE STANDING UNITS CONSTRUCTION WITH LIGHT GAUGE STEEL OR ALUMINIUM CHANNELS. FRONT PANEL, BASE FRAME, DOOR AND BEARING MEMBERS (DOOR FRAME) WILL BE 3MM THICK. NON-LOAD BEARING MEMBERS (SIDE PANEL, CUBICLE ROOF, DOOR) WILL BE 2MM THICK. CUBICLE BOTTOM WILL BE CLOSED AND HAVE CABLE SLOTS COVERED BY DETACHABLE PLATES. DOOR WILL BE PROVIDED AT THE BACK WITH FLUSH TYPE LOCK ARRANGEMENT. WEIGHT OF CONTROL & RELAY PANEL WILL BE 600 KG (SAFETY APPROX.) PANELS SHALL BE COMPLETELY WITH INGRESS PROTECTION DESPITE IP-54 AS PER IS 2147. ALL DOORS AND METAL JOINTS WILL BE PROVIDED WITH FOAM TYPE GASKETS AS PER IS 13847. 15mm THICK ANTI-VIBRATION PAD WILL BE PROVIDED AS LOOSE FIT BE FIXED BELOW PANEL BASE FRAME. RELAY PANELS WILL BE RACK MOUNTING (FRAME) TYPE WITH REVERSE DOOR IN THE FRONT. WIDTH OF THE PANEL SHALL BE RETAINED AS 1000MM (can be adjusted as per requirement of layout of relays).

ALL DIMENSIONS ARE IN MM. NOT TO SCALE.

M. P. POWER TRANSMISSION Co. LTD. JABALPUR

DRG. No:- JICAM/MPPTCL/TR-101- 107/ GA 220KV CRP

SCHEDULE-I(A)
DESCRIPTION OF EQUIPMENT INCLUDED IN THE PRICE
SCHEDULE FOR RATES AND PRICES TO BE FURNISHED IN
VOLUME-VI

S.No.	Particulars of Item	Qty.
A	Prices for 400 KV C&R Panels	As per price shedule
1(a)	400 KV Simplex type C&R Panels for protection of 400KV line complete with all relays & accessories as described in the specification	
2	400 KV Simplex type C&R Panels for 315MVA, 400/220/33KV X'mer and 100 MVA 400/132/33 KV X'mer complete with all relays & accessories as described in the specification.	
3	400 KV Simplex type C&R Panels for 400KV Transfer bus coupler applications complete with all relays & accessories as described in the specification.	
4	400 KV Simplex type C&R Panels for tie breaker application complete with all relays & accessories as described in the specification.	
5	400 KV Simplex type C&R Panels for bus reactor application complete with all relays & accessories as described in the specification.	
6	400 KV Simplex type C&R Panels for busbar protection complete with all relays & accessories as described under clause 2.0 of Section-II(B). The number bays for 400KV substations shall be (20+6 addl.) i.e total 26 nos. bays	
B	Prices for 220KV C&R Panels	
1(a)	220 KV Simplex type C&R Panels for protection of 220KV feeder circuit complete with all relays & accessories as described in the specification	
2	220 KV Simplex type C&R Panels for 220KV Transfer bus coupler applications complete with all relays & accessories as described in the specification	
3	220 KV Simplex type C&R Panels for bus tie application complete with all relays & accessories as described in the specification	
4	220 KV Simplex type C&R Panels for 220/132/33 KV 160 MVA and 220/33 KV 50 MVA transformer with all relays & accessories as described in the specification	
5	220 KV Simplex type C&R Panels for 220 KV side of 400/220/33 KV 315 MVA transformer with all relays & accessories as described in the specification	
6	220 KV Simplex type C&R Panels for busbar protection of 220 KV switchyards complete with all relays & accessories as described under clause 2.0 of Section-II(B). The number bays for 220KV substations shall be (14+6 addl.) i.e total 20 nos. bays	
7	220 KV Simplex type C&R Panels for bus reactor application complete with all relays & accessories as described in the specification.	

NOTE:

1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.
2. The quantity of above equipments has been mentioned in Volume VI
3. May please note that 220KV C&R panels for busbar protection scheme shall be suitable for total 20 nos. bays irrespective of the Single Line Diagram for 220kV substations enclosed with the bid document.

SECTION-II (C)
2.1.2 TECHNICAL SPECIFICATION FOR 132KV CONTROL AND RELAY PANELS

In case bidder is not OEM, sole responsibility of offering equipments/material of manufacturer as per this specification requirement shall rest on the bidder.

1.1 Protection schemes to be supplied under this Bid are required for following applications:

TYPE - A	SIMPLEX TYPE Control & Relay Panels for 132 KV transmission lines.
TYPE - B	SIMPLEX TYPE Control & & Relay Panels for 132KV side of 63 & 40 MVA 132/33KV Power Transformers
TYPE - C	SIMPLEX TYPE Control & Relay Panels for LV side 160MVA or 100 MVA X-mer
TYPE - D	SIMPLEX TYPE Control & Relay Panels for 132 kV transfer bus coupler bays.

2.0 LIMITS OF CONTRACT:

2.1 It is not the intent to specify completely here all the details of design and construction of the control and relay panels. However, the equipment shall conform in all respects to the high standard of engineering design and workmanship. Various control and relay panels and other requirements specified under this section shall be complete in themselves in all respect with all main and auxiliary relays, fuses, links & switches duly wired, labels terminal boards, earthing terminals, indicating lamps, mimic diagram, annunciator, name plate, foundation bolts, interior illumination, cable termination arrangement with cable glands fitted on base mounting plate etc. including all other accessories which are essentially required for satisfactory operation. Such components shall be deemed to be within the scope of supply of the Bidders irrespective of whether these are specifically brought out in this specification or not.

2.2 Supply and laying of control and power cables for interconnecting various equipment is not covered under the specification. Cable terminating arrangements, viz. the cable hold support boxes, multi-core cable glands, sealing ends for other types of cables that may be specified, shall however be included in the offered price. These shall be subject to approval of purchaser. It is the responsibility of Bidders to ensure that the equipment specified and complimentary equipment required for completeness of the protection/control scheme be properly accommodated in the panel without congestion and if necessary provide panels with larger dimensions in width only.

3.0 CLIMATIC CONDITIONS:

The climatic condition shall be as per Section-I, Volume-II of this bid.

4.0 STANDARD SPECIFICATIONS:

4.1 132KV C&R panels shall match with MPPTCL's standard drawing, a copy of which is enclosed.

4.2 PANEL FINISH AND COLOUR: 132KV SIMPLEX DESIGN PANELS:

132 KV C&R panels for all applications shall be of Simplex design and each panel shall be constructed of stretched – level selected sheet steel. Simplex type

panels shall be made in suitable sections so that while mounting the panels can be located side by side with a view to form a compact unit. The 132 KV Simplex design panels shall have front door of swing type and rear blocked with control gadgets and relays flush mounted.

4.2.1 132KV C&R panels of SIMPLEX design shall consist of a vertical front panel with all equipment mounted thereon including the control gadgets and relays as shown in MPPTCL's standard drawing. These panels shall have a front door of swing type as shown in the drawing with rear portion blocked. **The front swing type door shall have a Transparent Protective unbreakable front Door cover to prevent deposition of dust on the control gadgets and relays.**

4.2.2 132KV C&R panels having swing type of front door shall be free standing unitized construction with members folded and bolted. Other salient features shall be as follows -

- Load bearing members (front panel, base frame, door frame) will be 3mm thick.
- Non load bearing members (side panel, cubicle roof, door) will be 2mm thick.
- Cubicle bottom will be closed and shall have slots for cable entry. These will be covered by detachable plates.
- Weight of one Control and Relay panel shall be 600 to 650 Kg approx.
- Panels will comply with ingress protection degree IP54 as per IS2147.
- All doors and metal joints will be provided with foam type gaskets as per IS13847.
- 15mm thick anti vibration pad will be provided loose (to be fixed below the base frame of the panel).
- Dimensions of 132kV (C&R) panels shall be as stipulated in clause 4.4.2.

A drawing is appended herewith which shows the elevation, end view and 3D view of the Simplex design 132KV Control and Relay panels.

4.2.3 Other salient features applicable for 132 KV Simplex design panels -

- 132 KV SIMPLEX panels shall be dust, moisture and vermin proof.
- All unfinished surfaces of steel panels and frame work shall be thoroughly cleaned by sand blasting, pickling and rinsing or by combination of processes or by other latest and improved techniques to remove dust, scales, foreign adhering matter and grease. Cleaning process shall be followed immediately by the application of rust inhibiting wash process. All control panels surfaces shall then be given suitable rust resisting primary coat and then one or more coats of opaline green quick drying enamel to serve as a base and binder for finishing coat.
- As mentioned earlier, purchaser has standardised colour schemes for SIMPLEX design 132 KV C&R panels and these shall have **opaline green** colour as per shade No.275 of IS: 5.
- Exterior painted surface shall not be fully glossy. Interior of all panels shall be painted with "Egg Shell White". Pretreatment & painting process is described in Clause 14.0. All steel works shall be phosphated in accordance with IS-6005. Panels shall be provided a degree of protection not less than IP- 54 as per IS-2147.

4.3 COMPLIANCE OF PANELS, RELAYS, INSTRUMENTS AND OTHER GADGETS WITH STANDARD SPECIFICATION:

Applicable standards for the offered equipment/items shall be as per Section-I, Volume-II.

4.3.1 ACCEPTANCE OF OTHER AUTHORITATIVE STANDARDS:

In the paragraph 4.3.1 above relevant Indian standard /British standard / IEC standard specification have been mentioned. However, the equipment meeting any other authoritative international standard, which ensures equal or better quality than the standards, mentioned shall also be acceptable. Equipment for which Indian Standards are not available, the relevant British standards and IEC recommendations will be applicable. Please attach photocopy of all such standards according to which the equipment has been offered.

4.3.2 TYPE TEST:

All offered numerical distance and differential protection relays as well as other static/electromechanical relays and meters on C&R Panels offered by the bidders and as indicated below shall be fully type tested as per relevant standards. In case the equipment of the type and design offered, has already been type tested, the bidder shall invariably furnish type test reports from the reputed and approved national/international laboratory/Government approved test houses to prove that indicated accuracy and other specifications of the relays offered conform to the relevant standards. Test certificates shall clearly indicate the type and model number etc., so that relevant details of offered relays could be verified while submitting offers the model and type etc., shall be clearly indicated. Type test reports so furnished should not pertain to the period earlier than five years from the date of opening of bid.

It may be very specifically noted by Bidders that non-submission of type test reports about numerical and conventional relays and also about static meters along with the bid shall be treated as a disqualification.

i.	Numerical distance protection relays
ii.	Numerical differential protection relay
iii.	Numerical, Non-directional / directional 3 O/C + 1 E/F Relay
iv	Static trivector energy meter of accuracy Class 0.2S .
v.	Multi function meter of accuracy Class 0.5 .

4.3.4 DISCREPANCIES IN TECHNICAL PARTICULARS:

Regarding discrepancy in technical particular stipulation under Section-I, Volume-II shall be applicable.

4.4 PANEL CUT OUT AND DIMENSIONS:

4.4.1 As mentioned earlier, control and relay panels for 132 KV voltage class shall be of Simplex design and shall strictly conform to MPPTCL's standard drawing. Further, as clarified earlier, the 132KV C&R panel of Simplex design shall have a swing type front door with a transparent unbreakable cover and rear portion blocked.

4.4.2 The constructional details and size of panels for 132KV voltage class shall strictly comply to MPPTCL's standard drawing and as mentioned below-

S.No.	Description	132KV C&R panel
1.	Type	Simplex
2.	Height	2300 mm (panel height 2240 mm with base frame as 60 mm)

3.	Depth	750 mm
4.	Width	850 mm
5.	Base frame	Anti corrosive, black painted
6.	Panel exterior	Opaline green shade
7.	Panel interior	Egg shell white shade
8.	MIMIC strips (Over laid type)	Blue grey shade

4.4.3 The purchaser has standardized dimensions of panels for various applications and therefore no deviation in height / depth of panels in particular shall be permitted. The width of the panels is however subject to change. Bidders may please note that preferred cut out dimensions for mounting of control gadgets and relays shall be strictly inline with IS4483 (Part I & II).

4.4.4. It is hereby clarified that standard drawings showing C&R panels for 132 KV voltage class have been developed considering that the Numerical Distance / Differential Protection relays offered by the bidders shall have the protection, recording and metering functions listed elsewhere in the document, built in them. For example, relays type LBB have been considered built in the DPR and therefore has not been shown as discrete relays. Accordingly, bidders will have to offer discrete relays for those functions which are not built in. This has to be noted specifically.

4.4.5. Simplex control and Relay panels shall be floor mounting front swing type door with sheet steel assemblies of unitised design. Panels shall be made in suitable sections as described else where in the specification so that while mounting, panels can be located side by side bolted together to form a compact and composite unit. Design, material selection, workmanship, and width of panels shall be such as to present a neat appearance, outside and inside with no works of welds, rivets, screw or bolts head apparently visible from the exterior surface of the control panels.

4.5.0 PANEL LIGHTING:

4.5.1 In each SIMPLEX control panel one 20W, 230V AC tube light guarded with protected cage or alternatively CFL shall be provided inside the central roofed access for adequate illumination & the same shall be controlled by a door switch. Two incandescent 40 Watt 230 Volt lamps with protective cage with switch one each on the front & rear side of the panel shall be provided under the central roofed access.

4.5.2 One number Universal 15A/5A, 3 pin receptacle socket with plug and switch shall be provided in each control panel. The third pin of the socket shall be effectively grounded through the metallic structure. Socket shall be industrial grade control panel type complete with protective metallic cover.

4.6.0 AUXILIARY SUPPLY –

4.6.1 The auxiliary AC / DC supply shall be as per clause No. 6 Section-I Volume –II Part I of the specification

4.6.2 Bidders shall arrange to provide extension of these power supplies to different panels of the control board group.

4.6.3 Isolating devices with H.R.C. fuses shall be provided in each panel for both A.C. and D.C. power supplies. Distribution and wiring of the same shall be unitized through fuses and links in such a way so that isolation of respective system unit is possible without affecting the rest of the system or unit.

- 4.6.4** All H.R.C. fuses and links shall be with holder, and the same shall be mounted on slant support with identification labels.
- 4.6.5** H.R.C. fuses shall be provided as per following details;

S. NO.	CIRCUIT	FUSE RATING
1.	Circuit breaker-closing circuit	16A
2.	Trip circuit -I	16A
3.	Trip circuit -II	16A
4.	Main Protection	10A
5.	Back up protection	10A
6.	Indication	6A
7.	Annunciation	6A
8.	P.T. Circuit main	2A
9.	P.T. supply for Metering circuit	2A
10.	A.C. Supply fuses and links	5A

NOTE: Additional HRC fuses for individual circuit shall also be provided as per the requirement for completing the offered protection scheme.

4.7.0 CONTROL WIRING -

4.7.1 Successful Bidders shall furnish and install complete wiring up to the terminal block for the equipment, instrument devices mounted in the control panel strictly in accordance with the approved wiring diagram prepared by the Bidder based on the purchaser's information and schematic diagram.

4.7.2 Wiring shall be complete in all respects so as to ensure proper functioning of control, protection and metering schemes.

4.7.3 All spare relay contacts and spare contacts of switches shall be wired up to the terminal blocks.

4.7.4 Wiring shall be done with flexible heat resistant switch board wires, PVC insulated with stranded copper conductor. Conductor size shall be equivalent to 2.5 mm square minimum for Current, potential & DC Control circuit and 1.5mm sq minimum for other indications and annunciation circuits.

4.7.5 Coloured cores shall be used for wiring as per latest revision of IS-375 viz; red yellow blue and black for R Y B phases and neutral respectively. Colour code for earthing shall be Green, and for annunciation circuits gray colour code shall be used. For DC circuits the colour code will be gray.

4.7.6 Each wire shall be identified at its both ends with wire designation number by plastic ferrule as per wiring diagram based on latest revision of IS-375 to denote the different circuit functions. Bidders shall take approval for the system of wire numbering and colour coding schemes.

4.7.7 All wire terminations shall be made with compression type connectors. Wires shall not be tapped or spliced between terminal points. All wire shall have crimp type termination and direct Tee connection at any place is not at all required.

4.7.8 All series connected devices and equipment shall be wired up in sequence. Loop-in Loop out system of wiring shall be avoided as far as possible and the common buses shall normally be made through the terminal block for better reliability of testing and maintenance.

4.7.9 Fuses and links shall be provided for isolation of individual circuit from bus bars without disturbing other circuits and equipment.

4.7.10 The DC trip and DC voltage supplies and wiring to main protective gear shall be segregated from those for special purposes. Each such group shall be fed through separate fuses, either direct from main supply fuses or the bus bars.

4.7.11 Since a number of wires will run from one point to another, it is desired that the support arrangement should be adequate and neat. Conventional method of bunching of wires should not be adopted since the same creates problems in case any wire is to be removed. Wires should be accommodated in suitable plastic channels with sliding plastic cover, which may be suitably mounted inside the panels neatly. Inspection/removal of wires laid in the plastic channels should be possible by sliding the covers.

4.7.12 Blank plastic channels should be provided by the sides of the panels to accommodate incoming cables from switchyard through cable glands with suitable holding arrangement rigidly fixed so that while handling other nearby cables no jerks are transferred to the terminals inside the cubicle.

4.7.13 Wherever practicable wiring shall be accommodated in the side wall of the cubicles. Sharp bends shall be avoided.

4.7.14 Each wire shall be identified at its both ends with wire designation number by plastic ferrule as per wiring diagram based on latest revision of IS-375 to denote the different circuit functions. Bidders shall take approval for the system of wire numbering and colour coding schemes. For identifying each wire bidders should provide wire schedule for each wire with drawing so that tracing of wire will not consumed much time.

4.8.0 TERMINAL BLOCKS:

4.8.1 Multi-way terminal blocks complete with necessary binding screws and washers for wire connection and marking strip for circuit identification shall be furnished for terminating the panel wiring and outgoing cables. Terminals shall be suitable for receiving atleast 2x7/0.737mm stranded copper conductor or equivalent aluminium conductor wires per terminal. It may please be noted that the current rating shall be double the current rating of 2x7/0.737 non stranded copper wire and terminal shall be suitable to receive 2x2.5sq mm/or 2x4sq mm copper conductor of control cable.

4.8.2 Terminal blocks shall have shorting and disconnection facilities ,so that the Board side and outgoing wires could be disconnected just by opening the disconnecting links which slides up or down without dislodging the wires from their position.

4.8.3 Highly reliable Test terminal blocks with facilities of shorting and easy removal of connection shall be provided for CT & PT circuits. Instrument transformer wires shall be terminated through suitably mounted test terminal blocks to facilitate site testing of all main and backup protection relays.

4.8.4 Test terminal blocks shall be grouped according to the circuit functions and each terminal block group shall have at least 20% spare terminals for accommodating additional input wires.

4.8.5 Not more than two wires shall be connected to any terminal or either side of the terminal block If necessary, a number of terminals shall be connected by jumpers to provide additional wiring points.

4.8.6 Each terminal point shall be marked with designation obtained from the purchaser's schematic drawings.

4.8.7 Adjacent rows of terminal blocks shall be spaced not less than 100 mm apart. These shall be mounted vertically at the sides of the cubicle and set obliquely towards

the rear doors to give easy access to terminating end to enable ferrule number to be read without difficulty.

4.8.8 Bottom of terminal blocks shall be spaced at least 200mm above the cable gland of incoming multicore cables.

4.8.9 There should be a distance of 3 cm. between CT Terminal block and PT terminal block.

4.9.0 CABLE ENTRY:

4.9.1 Control Panel shall have provision of multiple cable entries from the bottom. Necessary cable glands should also be provided on a 4 mm thick mild steel gland plate to be bolted firmly with nut and bolts on base plate. Base plate shall be bolted further on the base frame with adequate number of nuts & bolts. Purchaser will arrange for necessary floor opening below the panels to suit the cable trench design of purchaser's requirement.

4.9.2 Wiring through the terminal blocks shall be located in a manner that it becomes convenient to provide termination of control cable for floor openings.

4.9.3 Gland plate shall be supplied duly drilled and fitted with cable glands. The gland plate and doors shall be provided with gasket properly. Necessary glands as per clause 4.9.5 below shall be fitted on the gland plate.

4.9.4 Rigid supports shall be provided along with terminal block for holding plastic channel. Suitable clamps may also be provided in plastic channel for holding cables.

4.9.5 Following quantities of cable glands with suitable blanking arrangement shall be fitted on the gland plate that shall be fastened suitably at the bottom of each panel :

S. No	Particulars	Core size	Cable glands for cable				
			19 core	12 core	8 core	4 core	2 core
1	132kV feeder	2.5 sq. mm	2	2	4	8	5
2	132kV transformer panel for 63/40 MVA		3	3	4	8	6
3	132KV C&R panels for 160MVA /100 MVA Xmer		2	2	4	8	5
4	132kV bus coupler		2	2	4	8	5

4.10.0 GROUNDING:

4.10.1 12.5mm x 6mm copper strip grounding bus shall be provided for each control board extending along with entire length of the board for the purpose of effectively grounding all metal structures.

4.10.2 Each continuous length of ground bus shall have provision of two terminals at two extreme points for connection to main ground grid of the substation.

4.10.3 Common star /neutral point of Potential and current transformer shall be connected with the grounding bus through a disconnecting type connector so as to adopt single point grounding of common star point either at the terminal block in the control panel or in the marshalling box of the instrument transformer.

4.10.4 Whenever any circuit is shown grounded on the drawing a single wire for that circuit shall be run independently up to the ground bus and connected to it.

5.0 CONTROL & RELAY PANELS:

As stated earlier, 132 KV Control & Relay panels shall be of Simplex design. Full constructional details in respect of these panels, their colour scheme, details about the sheet steel utilized for construction and about other constructional aspects, have been elaborated in para no. 4.4. Bidders may please note that the 132KV C&R panels shall be utilized at new as well as existing sub-stations, and in view of this, bidders will have to match these panels with those already existing. The successful bidders shall be furnished details in this regard.

5.1 Labelling for each circuit shall be provided on each control and relay panel.

5.2 Panels shall be of uniform thickness (minimum 2.5mm) and made of level sheet steel. Bottom of the cubicle shall be made in a manner to open it for the purpose of wiring and cable entry. Panels shall be designed to be of self-supporting type and wherever additional structural strength is required, inconspicuous bracing, gusset, welding etc., shall be used. All control panels and switchgear cubicles shall be made absolutely vermin proof design of the approval of the purchaser.

5.3 Panels shall be made in suitable sections to facilitate easy transport and handling and shall be later assembled at site. It may please be noted carefully that a single continuous sheet steel should not be used for a substation to make a single board for all the panels required. Panels should have unitised construction with facility to bolt together the panels where more than one panel is involved.

5.4 Some of the Simplex control panel required for existing installation will have to be matched with the existing panels in respect of colour shade, height, depth and width of corridor. Details in this regard shall be furnished to successful Bidders.

6.0 CONTROL & INDICATION CIRCUITS:

6.1 Control and indication circuits for each circuit breaker controlling feeder, bus coupler or transformer shall generally comprise of the following:

- a. Mimic diagram
- b. A composite meter to indicate current, voltage, Watts ,VARs and power factor.
- c. Circuit Breaker Control switch.
- d. "Trip Healthy" lamps.
- e. Alarm cancellation arrangement.
- f. Breaker ON/OFF indication lamps.
- g. Energy meter with display facility of various electrical quantities viz. voltages, MW, MVA, MVAR, Line current, power factor etc.
- h. Facia annunciating windows Semaphore indicators for CB & Isolators.
- i. Semaphore indicators for circuit breakers and isolators.
- j. Selector Switch for isolator Semaphores
- k. Test terminal block and Relay Test Block on the front panel for testing of meter and relays as per specified scheme
- l. Relay Test Block on rear side of Simplex panel as per scheme.

- m. Any other devices which may be necessary for completing scheme based on improvement in design and adoption of new technology by the Bidder.

6.2 MIMIC DIAGRAM -

6.2.1 Coloured mimic diagram and symbols shall represent the exact representation of system. Mimic diagram for 132KV and 33 KV systems shall be made to represent ONE MAIN & TRANSFER BUS Scheme. Mimic diagram shall be placed at the eye level to indicate the position of each breaker. Power transformer, voltage transformer shall be fixed on mimic by suitable symbols having dark Black colour. Position indicator of isolating devices shall have matching colour in accordance with the voltage class of the mimic. Arrangement shall be of over laid design using anodized aluminum section. Painted type mimic diagram is not acceptable.

6.2.2 Offered mimic diagram shall have colour scheme for representing various voltage levels as per the details indicated under:-

- i 132KV Blue gray shade 695 of IS 5
- ii 33 KV Azure blue shade 104 of IS 5

6.3. CIRCUIT BREAKER & ISOLATOR POSITION INDICATORS (EMAPHORES) –

6.3.1. Position indicators of 'SEMAPHORE' TYPE shall be provided as part of the mimic diagrams on panels for indicating the position of circuit breakers. Indicator shall be suitable for semi-flush mounting with only front disc projecting out and with terminal connection from the rear. Colour of position indicator strips shall be matching with the colour of associated mimic. Position indicators shall be suitable for DC operation. When the supervised object is in the closed position, the pointer of the indicator shall take up a position in line with the mimic busbars, and at right angles to them, when the object is in the open position. When the supply failure to the indicator occurs, the pointer shall take up an intermediate position to indicate the supply failure. Position indicators shall withstand 120% of rated voltage on continuous basis.

6.3.2. For 132KV isolators, selector switch for manual selection of semaphore position indicators shall be provided for displaying matching position of isolators in the switchyard. These selection switches shall have two way selections and shall be mounted near to respective semaphore for isolators.

7.0 ANNUNCIATION SYSTEM:

7.1 Alarm annunciation system shall be provided for each panel by means of visual and audible alarm in order to draw the attention of the operating staff to the abnormal operating conditions or the operation of some protective device. Annunciation equipment shall be suitable for operation under the tolerance limit of voltages specified in this specification.

7.2 Annunciation shall be of visual and audible type. Facia annunciator, flush mounted on the front of the control panel, shall provide the visual annunciation. DC hooter or DC bell shall provide the audible alarm. Apart from requirement of facia windows for annunciating status of various relays, Bidders shall also provide spare facia annunciator window two nos. each for trip and non-trip function.

7.3 Each facia annunciator shall have a minimum size of 35 mm X 50 mm-translucent plastic window for each Trip and alarm point. Translucent plastic plates of facia window shall be engraved in black letters with respective inscriptions. All inscriptions shall be

engraved on each window in not more than three lines and size of letters shall not be less than 5 mm.

7.4 Each annunciation window shall be provided with two white lamps in parallel to provide safety against lamp failure. Long life lamps shall be used. Lamp circuit shall include series resistor of adequate rating. Cover plate of the facia windows shall flush with the panel and shall be capable of easy removal to facilitate replacement of lamps. Transparency of cover plates and wattage of the lamps provided in the facia windows shall be adequate to ensure clear visibility of the inscriptions in the control room having high illumination intensity (500 Lux) from the location of the operating staff desk.

7.5 TRIP and NON TRIP facia shall be differentiated. All trip windows shall have red colour translucent plastic window and all non-trip facia windows shall have white colour translucent plastic window.

Sequence of operation of the annunciator shall be as follows:

Alarm condition	Fault contact	Visual Annunciation	Audible Annunciation
Normal	Open	OFF	OFF
Abnormal	Close	Flashing	ON
Acknowledge push button is pressed/	a Close	Steady on	OFF
	b Open	Steady on	OFF
Reset push button is pressed.	a Close	ON	OFF
	b Open	OFF	OFF
Lamp test push button pressed.	Open	Steady on	OFF

7.6 Any new annunciation appearing after the operation of audible annunciation cancel shall provide a fresh additional annunciation with accompanied visual alarm even if acknowledging or resetting of previous alarm is in process or yet to be carried out.

7.7 Annunciation system described above shall meet the following additional requirements:

- a) Annunciation system shall be capable of catering to at least 80% simultaneous signals(of windows provided) at a time.
- b) One self resetting push button shall be provided on each panel for testing the facia window lamps. Push buttons for testing flasher and audible alarm circuit of annunciation system and for testing the annunciation supply failure monitoring circuit shall also be provided. These testing circuits shall also be so connected that while test is being done it shall not prevent the registering of any new annunciation that may land up during the test.
- c) One set each of the following push buttons shall be provided on each panel as shown in the front view drawing:
 - i. Reset push button for annunciation system.
 - ii. Accept push button for annunciation system.
 - iii. Test push button for testing healthiness of annunciator. Operation of this button should not cause inadvertent operation of any equipment.

- d) Annunciation shall be repetitive type and shall be capable of registering the fleeting signal. Minimum duration of fleeting signal registered by the system shall be 15milli seconds.
- e) Annunciation shall be suitable for operation with normally open potential free contacts which close on a fault. It shall be possible at site to change operation of annunciator from potential free contact from "close to fault" to "open to fault" and vice versa.
- f) In case of static annunciator scheme, special precaution shall be taken by Bidder to ensure that spurious alarm condition does not appear due to influence of external electromagnetic/ electrostatic interference on the annunciator wiring and switching disturbances from the neighboring circuits within the panels.
- g) Offered annunciation scheme shall be complete in all respects including annunciator relay, flasher relay, test, accept and reset push buttons.
- h) Additional four spare windows two each for non trip and trip signals supported by trip relay for future application by the purchaser shall be provided duly wired up and terminated to the row of connectors.
- i) For each signal receiving through yard a separate Aux. Relay should be provided. No signal from yard should be directly terminated on window facia.

8.0 PROTECTION SCHEMES :

8.1. Protection schemes are required for following applications:

TYPE – A	For 132 KV Feeder protection
TYPE – B	For 132 KV side of 63 or 40 MVA , 132/33KV Transformers
TYPE – C	For 132KV Side of 160MVA,220/132/33kv Xmer/ 100 MVA 400/132/33 KV Transformer
TYPE – D	For 132 kV Transfer bus coupler bays.

Protection schemes meant for above applications are described hereunder: -

8.2 Protection Scheme For 132KV Transmission Lines (TYPE-A) :

8.2.1 General concept for protection of 132 KV transmission lines is to have one main and one discrete back up relay (3O/C + 1 E/F, IDMT relay having directional feature). Main protection for the lines shall be a three zone, three step distance scheme having MHO or quadrilateral characteristics. Maximum fault current could be as high as 40KA for 132KV System but minimum fault current could be as low as 20% of rated current. Thus, the starting and measuring relay characteristic should satisfy both extreme conditions. Numerical distance relays for 132 KV lines shall be suitable for use with Bus PTs.

8.2.2 BIDDERS MAY PLEASE NOTE THAT THE NUMERICAL DISTANCE RELAYS FOR 132 KV LINES SHALL BE SUITABLE FOR 110V DC SUPPLY UNLESS OTHERWISE SPECIFIED AND THAT AUTO-RECLOSE FEATURE IS NOT REQUIRED FOR THESE DISTANCE RELAYS.

8.2.3. All 132 kV transmission lines are generally laid on double circuit transmission towers. DC supply for numerical relay shall be from DC/DC converter and these shall be liberally designed and adequately rated for operation under extremely adverse operating conditions during service. Insulation barriers shall be provided to ensure that transient present in CT and VT signals due to extraneous sources do not cause damage to static circuits. Circuits must comply with IEC recommendation for impulse withstands values. Adequate measures shall be taken to ensure that equipment is protected against voltage spikes occurring in auxiliary DC supply.

8.2.4 Numerical distance protection relays shall have the following functions/features:

- Numerical distance protection relay shall be capable of providing flexible, reliable integration of protection, control, and monitoring and measurement functions.
- Offered relay for 132KV lines shall have 6 nos. of impedance measuring loops.
- Offered relay shall be suitable for protection of broken conductor following one out of three phases getting open circuited without any line or ground fault. Protection shall perform satisfactorily both for loaded and unloaded line condition.
- Offered relay shall preferably have independent polygonal characteristics with adjustable reactive and resistance reaches for maximum selectivity and maximum fault resistance coverage due to arc resistance.
- Offered relay shall provide selection and setting for mutual compensation of double circuit lines.
- Offered relay shall have minimum three directional zones and minimum one non-directional zone. Zone setting ranges shall be sufficient to cover line lengths appropriate to each zone. It shall be possible in future to add Carrier aided scheme options of Zone-I extension, permissive under reach or over reach and blocking.
- Offered relay shall have maximum operating time up to trip impulse generated from relay (complete protection time including applicable carrier time and tripping time)for the following source to line impedance ratios under all possible combination of line fault with CVT being used on the line at 50% of Zone-I reach :-

for Source Impedance Ratio 0.01 - 4 : 30ms at nearest end and 50ms at other end of line.

for Source Impedance Ratio 4 -15 : 35ms at nearest end and 55ms at other end of line.

- Offered relay shall have a secured directional response under all conditions, achieved by memory voltage polarizing or healthy phase voltage polarizing as may be appropriate.
- Offered relay shall have logic to detect VT fuse failure. Bidders shall clearly state if VT fuse failure for all the three phases can be detected individually.
- Offered relays shall be suitable to detect switch on to fault (SOTF) condition by appropriate means. Bidders may elaborate the SWITCH ON TO FAULT logic.
- Offered relay shall have LBB relay as a built in feature to take care of stuck breaker condition. If it is not so, then the bidders may have to offer discrete relay to take care of stuck breaker condition.
- Offered relay shall have power swing blocking feature with suitable coverage to encircle distance relay characteristic with facilities for
 - (a) Fast detection of power swing
 - (b) Selective blocking of zones and

(c) Settable deblocking criteria for earth faults, phase faults and three phase faults.

- Offered relay shall have minimum three directional and one non-directional step time distance characteristics with independently variable time graded distance protection zones to cover two adjacent line sections.
- Offered relay shall have minimum adjustable characteristics line angle setting range of 30 -85 degrees.
- **Offered distance relay need not be suitable for auto reclosing of 132KV lines**
- Offered relay shall be selective for internal and external faults.
- Offered relay shall have minimum two independent continuous variable time setting range of minimum 0-1 second for zone-2 in steps of 0.01 secs and minimum 0-3 seconds in steps of 0.01 secs for zone-Variable time settings for non-directional zone shall also be provided to set minimum trip time of 0-5 seconds, over and above time settings for directional zones.
- It is desired that total operating time of the offered relay need not exceed 30 ms.
- Offered relay shall have maximum resetting time of less than 35ms.
- Offered relay shall have built-in extensive self-supervision and diagnostic testing facility.
- Suitable number of potential free contacts if required (multiplied through reed relays only) may be provided on each distance scheme for carrier aided selection of permissive tripping and blocking and auto reclosing. Provision for event sequence recorder, stuck breaker, disturbance recorder, fault locator etc. shall be available.
- Offered relay shall be capable of performing basic metering functions. Voltages, Currents, Active and Reactive power registration shall be available on demand.
- Offered relay shall have protection against broken line conductor. (Snapping of conductor or jumper of one of the phases of the line but not involving earth).
- Offered Numerical Distance relays shall be suitable for use on series compensated transmission lines. This is a desirable feature although not mandatory.
- Offered relay shall be capable of supporting IEC 61850 communication standard.
- Relay shall have two communication ports. Front port shall be for local communication for relay settings, modifications, extraction / analysis of fault / event / disturbance records from a lap top computer and there shall be rear port on 61850 standard for remote communication.
- Offered relays shall have following fault diagnostic features :
- Offered relay shall have minimum 12 Digital inputs and 18 Digital outputs contacts.

i. FAULT RECORDS:

Relay shall have facility to store fault records with information on cause of tripping, date, time and trip values of electric parameters. It shall be capable of storing not less than 8 nos. of previous faults records.

ii. EVENT RECORDS:

Relay shall have facility to store 200 nos. time stamped event records with 1 ms resolution.

iii. DISTURBANCE RECORDS:

Number of available analogue channels and digital channels shall not be less than 8 and 32 respectively. Triggering for capturing / recording of disturbance should be possible from within the distance relay and / or from any other disturbance within the EHV sub-station. Offered relay shall necessarily have a storage capacity of atleast 8 disturbance records of 3 sec. duration each.

- iv. Disturbance recorder, fault recorder and distance to fault locator functions shall be provided as integral part of the line protection relays.
- Offered relay shall have front panels display with keys to enter scroll through the settings and to view the measurements. It shall also be possible to take data from a pre-stored file in the PC and download the settings to the relay through the front port.
 - Offered relay shall have directional phase over current and earthfault protection.
 - Offered relay shall have non-directional phase over current and earthfault IDMT protection with high set element for instantaneous tripping.
 - Offered relay shall conform to communication protocol no. IEC-61850 as stated earlier.
 - Offered relay shall have self-monitoring and fault diagnostic feature with appropriate annunciation. User definable LEDs shall be provided for visual indication. Necessary serial ports and parallel ports with leads and termination shall be provided.
 - Offered relay shall have facility for communication from remote sub-station (inline with IEC 61850 standard) so that these relays can be used for sub-station automation. Required hardware and software shall be included in the offered relay.
 - Offered relay shall have port type IRIG – B for time synchronisation.

Bidders shall elaborate following features of the numerical relays offered by them.

- i. Various programmable features of the relay
- ii. Application of the relays
- iii. Relay functions
- iv. Block diagram for hardware of the relay.
- v. Metering and recording.
- vi. Human machine interface.
- vii. Suitability of the relay for IEC communication protocol no. IEC-61850.

8.2.5 Besides the built in back-up protection in the Numerical Distance Relay, an additional Numerical, Directional, Communicable, 3 O/C + 1 E/F Relay is envisaged on 132 kV feeder panels as backup protection.

8.2.6 It may please be noted that for preclose supervision and post close supervision of trip coil two nos. Trip circuit supervision relay has to be provided Separately even this is inbuilt feature of the relay.

8.2.7 It may please be noted that for D.C. supervision of the panel one nos DC supervision relay has to be provided separately even this is inbuilt feature of the relay. .

8.3. PROTECTION SCHEME FOR 132/33 kV TWO WINDING POWER TRANSFORMERS OF RATING 63 / 40 MVA (Type- B) :

8.3.1. Transformer protection is required for 63/40 MVA, three phase, 132/33KV transformers shall be provided by fully numerical transformer differential protection relay. Offered numerical differential relay shall be suitable for protection of three winding transformer without external interposing CTs. In case protection requirement calls for providing interposing CTs, same shall be provided by the Bidders in the control panel without additional cost. It should be ensured that differential Protection offered is stable under through fault condition, normal and over fluxing conditions and shall not operate with magnetizing inrush current. Bidders shall give all details of the protection offered. Differential relay shall have current rating of 1 Amp CT secondary and the total operating time shall not exceed 30 ms. from inception of fault up to contact status changing of output relay. Relay should have Bias setting adjustable from 15% to 50% with through fault current not less than 10 times the normal current. Operating characteristics should have dual slope for enhanced sensitivity for internal faults and better stability during through faults. Fifth harmonic by-pass filters shall be provided to avoid possible mal-operation under over-fluxing conditions. Relay shall have three instantaneous high set over current unit and shall have continuous self monitoring and self diagnostic features. Visual indication and alarm shall be provided in this panel for over fluxing relay, and for standard Transformer protections. Alarm indication for SF6 gas pressure low, lockout, and air pressure low shall be provided along with, Inter trip and trip transfer indication.

8.3.2. Numerical differential protection schemes offered by the Bidders for 400KV and 220KV Transformer shall have the following features :

- i. The scheme shall be based on numerical technology.
- ii. The scheme shall be suitable for three winding transformer with REF protection.
- iii. It should be ensured that differential Protection offered is stable under through fault condition, normal and over fluxing conditions.
- iv. Numerical differential relay shall not operate with magnetizing inrush current.
- v. Differential relay shall have current rating of 1 Amp CT secondary.
- vi. The total operating time shall not exceed 30 ms. from inception of fault up to contact status changing of output relay.
- vii. Relay should have Bias setting adjustable from 15% to 50% with through fault current not less than 10 times the normal current. Operating characteristics should have dual slope for enhanced sensitivity for internal faults and better stability during through faults.
- viii. In numerical differential protection fifth harmonic by-pass filters shall be provided to avoid possible mal-operation under over-fluxing conditions.
- ix. Relay shall have three instantaneous high set over current and IDMT unit and shall have continuous self monitoring and self diagnostic features.
- x. Relay have continuous self monitoring and self diagnostic features.
- xi. Offered relays shall have port type IRIG – B for time synchronization.
- xii. Offered relay shall be capable of supporting IEC 61850 communication standard.
- xiii. Offered relay shall have two communication ports. Front port shall be for local communication for relay settings, modifications, extraction / analysis of fault / event / disturbance records from a laptop computer and there shall be rear port on 61850 standard for remote communication.
- xiii. Offered relay shall have facility to trigger oscillograpy through master trip relay.

8.3.2.A Differential protection relay shall have following built-in protections –

- i. Thermal overload
- ii. Restricted earthfault (Two nos One for HV and other for LV)
- iii. Local breaker back-up (LBB)
- iv. Over excitation
- v. Back-up overcurrent and earthfault relay
- vi. Overload protection

- vii. Negative phase sequence imbalance detection
- viii. Trip circuit supervision
- ix. DC supply supervision

i. FAULT RECORDS:

Relay shall have facility to store fault records with information on cause of tripping, date, time and trip values of electric parameters. It shall be capable of storing not less than 8 nos. of previous faults records.

ii. EVENT RECORDS:

Relay shall have facility to store 200 nos. time stamped event records with 1 ms resolution.

iii. DISTURBANCE RECORDS:

Number of available analogue channels and digital channels shall not be less than 12 and 32 respectively. Triggering for capturing / recording of disturbance should be possible from within the differential relay and / or from any other disturbance within the EHV sub-station. Offered relay shall necessarily have a storage capacity of atleast 8 disturbance records of 3 sec. duration each.

iv. Disturbance recorder and fault recorder shall be provided as integral part of the line protection relays.

8.3.3 AUXILIARY RELAYS FOR ALARM AND TRIP FUNCTIONS:

We have envisaged hand reset type auxiliary relay for alarm and trip functions as mentioned against Sl. No. 29 and 30 of the BOM in clause no. 19. Bidders may please note that these discrete relays are essentially required even though these may form integral part of the Numerical Differential relay.

8.3.4 OVERFLUXING PROTECTION Power transformer should trip for over fluxing condition to isolate both from primary and secondary sides. Accordingly over fluxing relay should be provided in the control panel for HV side. Offered relay shall be suitable to provide minimum settings as detailed hereunder:

Over fluxing factor	Duration.
1.40	5 sec
1.12	10 sec.
1.15	15 sec.
1.25	60 sec.
1.10	continuous.

Relay should have inverse characteristics and should be equipped with high set unit to operate in less than 5 seconds whenever over fluxing exceed than the set value by 1.1 above 1.4 times. Over-fluxing relay should have setting that may be continuously adjustable or in steps, for over-fluxing ranging from 1.0 and upward in step of 0.01. Resetting value shall not be less than 0.95 of the operating value. Settings shall be available in two stages. First stage auxiliary element operation shall be around 1 sec. This stage shall be complete with auxiliary relay so that alarm/facia etc. could be initiated. Thereafter in the second stage the auxiliary element shall operate after a further adjustable time delay say 10 to 100 sec. This stage shall also be complete with auxiliary relay, which could be utilized for the tripping. Rating of auxiliary relay shall be

selected accordingly. Relay shall be complete with independent operation indicator for the two stages. Bidders may please note that the basic setting on the relay shall be with over fluxing factor with 1.1 and shall have continuous duration. However, between the remaining two i.e. over fluxing factor of 1.25 or 1.40, any one can be utilized.

8.3.5 Numerical differential protection relay offered by the Bidders for 63 / 40 MVA, 132/33KV Xmers shall have "a definite time over current relay" as a built-in feature with variable setting range from 50 to 200 per cent of relay current alongwith a timer having a setting range of 2.5 to 25.0 sec. This relay shall be utilized to function as overload protection relay for 63 / 40 MVA Xmers.

8.3.6 Other standard transformer protections such as gas operated Buchhloz relay, oil surge relay, winding temperature, oil temperature, low oil Level, Pressure release devices etc. will be provided by the purchaser with the transformer. Bidders have to make provision for alarm annunciation and tripping. These standard protections will be provided on the control panels as stated above.

8.3.7 Besides the built in back-up protection in the Numerical Differential Relay, an additional Numerical, Non Directional, Communicable, 3 O/C + 1 E/F Relay is envisaged on 132 kV X-mer panels.

8.3.8 It may please be noted that for preclose supervision and post close supervision of trip coil two no nos. Trip circuit supervision relay has to be provided Separately even this is inbuilt feature of the relay. .

8.3.9 It may please be noted that for D.C. supervision of the panel two nos DC supervision relay has to be provided separately even this is inbuilt feature of the relay.

8.3.10 It may please be noted that in Numerical relay provision to trigger Oscillography through Master trip relay to be done by supplier.

8.3.11 It may please be noted that no Trip/ close command should be connected directly through neumerical relay.For tripping command separate high speed trip relay has to be provided.

8. 4 PROTECTION SCHEME FOR 132 KV AND 33 KV SIDES OF 160 MVA, 220/132/33 KV and 100 MVA 400/132/33 KV POWER TRANSFORMER (TYPE-C) :

Transformer protection for 132KV side of 160 MVA, 220/132/33KV transformer shall have back up protection comprising of a Numerical, Non directional three over current plus one Earth fault relay. The relay shall have IDMT characteristics. The purchaser has provided one CT in one phase of 33 KV winding before delta formation, thus a single element induction over current relay shall be provided to safe guard against excessive flow of circulating current in the tertiary winding. One digital Ampere meter for monitoring circulating current shall be provided. It may be noted that the 132 kV as well as 33 kV circuit breakers will have two trip coils which will receive simultaneous trip command as such offered schematic shall be suitable to select main DC supply or duplicate DC supply for each trip coil. For this purpose, contact multiplication will not be acceptable but the rating of the breaker control switch and each tripping relay contacts shall be adequate to handle the burden of two trip coils. Pistol grip type breaker control switches along with red and green indicating lamp for ON/OFF indication shall be provided.

8.5 PROTECTION SCHEME FOR 132 KV TRANSFER BUS COUPLER (TYPE-D)

Protection scheme for 132 KV TRANSFER BUS shall be identical to the LINE protection scheme specified above at **8.2.1** as such all standard features required for the scheme shall be provided. Mimic shall however represent scheme for transfer bus instead of line which may please be noted. It may also may please note that Distance protection provided in the Transformer bus coupler feeder may have five groups of setting for different feeders and there should be arrangement for group selection by providing five bay switch through digital inputs.

8.6 OTHER IMPORTANT PROTECTIONS FOR FEEDER, TRANSFORMER AND TBC PANELS:

8.6.1. LOCAL BREAKER BACK UP:

Local breaker back up relay shall be provided to take care of stuck breaker condition. This relay shall have three current operated elements with a time delay unit (delay of 0.1 to 2 sec) to ensure that the scheme operates only under the condition when there is a persisting fault and the breaker has failed to trip. Setting range of over current element shall be 50% to 200% and for earth fault element 20% to 80%. Necessary auxiliary relay for initiating tripping command to a total of eight number circuit breakers shall also be included as a part of the scheme. Tripping relay included shall be capable of handling burden of circuit breaker with two trip coils. Please note that all breakers shall be normal duty type having two trip coils receiving trip command in parallel.

8.6.2 TRIP CIRCUIT SUPERVISION:

Separate trip circuit supervision relay shall be provided for each of the two trip coils for each feeder/transformer circuit of 132 kV in all panels, for continuous monitoring of trip circuit i.e. for both pre and post close conditions. Trip healthy lamp for each trip coil shall be provided separately for pre and post close monitoring. During unhealthy condition of trip circuit the relay shall initiate an audible alarm and visual indication on facia window. All circuit breakers are provided with two trip coils and hence separate trip circuit pre and post supervision for each trip coil is to be provided by Bidders. Each trip circuit supervision relay shall be provided with operation indicator. Also for each trip coil circuit, separate DC circuit with fuses will be used.

8.6.3 DC SUPPLY SUPERVISION:

Separate DC supply supervision relay shall be provided for 132 KV class Simplex type C&R panels. Bidders may please note that the DC supply source shall be one only and out of the two DC supply systems, namely, protection and annunciation / indication, the offered relay shall be capable of monitoring failure of DC supply of the protection circuits effectively. It shall have adequate potential free contacts to meet out the requirement of the scheme and also to meet the requirement for providing alarm and facia indication. Relay shall have a "time delay on drop off" of not less than 100 milli second and be provided with operation indicator/flag. This relay shall sound AC 230 V heavy-duty bell with provision for accept/reset and test facilities.

8.6.4. ALARM SCHEME:

Automatic tripping of the circuit breaker due to operation of protective relays shall be indicated by a common audible alarm. Offered alarm scheme shall be complete in all respects including one DC bell for non-trip alarm and one DC hooter for trip alarm with relays and other accessories if any. With each panel one alarm scheme will be required.

9.0 a) MULTI-FUNCTION METER:

We envisage a Multi-function meter on the panel to provide digital display of current, voltage, Watts, VARS and Power Factor. This meter shall have scrolling facility to facilitate reading any of these parameters and it will have a size of 144 sq mm/96 sqmm . Bidders may please note that the meter shall be capable of reading voltages upto a maximum value of 150KV. This meter shall have an accuracy class of 0.5. The Multi function meter shall have four and a half digit display, say for example 110.8KV, with minimum display height of 25mm. This meter shall conform to IS 722 and shall be provided with non-reflecting glass fronts. Bidders may please note that the meter shall be suitable for DC Supply voltage of 110Volts or 220Volts as the case may be. AC Supply operated meters are not acceptable to us. Offered meter shall be of reputed make. **Bidders may please note very carefully that multifunction meter shall have communication facility through serial port RS-485 with mod bus protocol complete with down loading software and RS 232 port**

b) Bidder may please note that in addition to multifunction meter, 1 No. analogue type center zero MVAR meter is also required to be provided in each category of C&R panel covered under the bid.

10.0 ACCESSORIES & ENERGY METER:

10.1 ENERGY METERS: (TRIVECTOR METERS):

The energy meter for each circuit shall be 3 phase 4 wire, 0.2S accuracy class with availability based tariff. One meter shall be provided for each circuit, as a self-contained device for measurement of power transmittals, in each successive 15 minute block, and certain other functions. The meters provided in C&R panels shall be utilized for measurement of active energy and average frequency in a programmable time clock initially set at 15 minute blocks. Meters shall measure and display reactive energy under voltage low (97%) and voltage high (103%) condition as per tariff requirement. Meters shall measure cumulative active energy import and export on daily basis and monthly basis. The Base Computer software (BCS) shall be configurable to cater to tariff applications like Time of Day (TOD) metering. In case of change of threshold values of voltages, the supplier shall undertake to set new threshold values of voltage. It shall be possible to select parameters of Meters as per requirement of Purchaser. Meter shall be fully static having non volatile memory and fully programmable. Meter shall have four quadrant registering facility with provision for recording/display various parameters like KWh, KVAh, KVARh, Line current and voltages including power factor. Load survey capability for 35 days shall be available to forecast load growth. Meter shall have 0.2S accuracy class. **The tenderer may please note that the energy meter of 0.2S accuracy class shall have ABT features and shall have suitable for RS232 and RS485 communication protocol for remote and local communication.**

10.2.1 MEASUREMENT ACCURACY: Measurement accuracy of meters shall be as per IEC 62052-11-2003, IEC 62053-22-2003 as under:

**0.2s for Active Energy
0.5s for Reactive Energy or better**

10.2.2 APPLICABLE STANDARDS FOR METERS: The meters shall fully comply with all stipulations in IEC standards 62052-11:2003 and 62053-22:2003. The reference ambient temperature shall be 23°C as per IEC. Errors shall be reasonable for all power factor angles from 0° to 360°. For reactive power (VAR) and reactive energy (VARh) measurement, IEC 62053-23:2003 shall be complied with. The meters shall conform to following Indian standards with latest amendments.

CBIP Technical Report No.88 (with latest amendments issued – June 2000) – specifications for AC Static Electricity Energy Meters.

IS 14697(1999) – AC static transformer operated Watt-hour and VAR-hour meters for class 0.2s and 0.5s.

IS 12063 –Degree for Protection.

IS 3202 – Climatic Proofing of Electrical Equipment.

The meter shall also comply with specifications & requirement as stipulated in “Part V: Transmission Metering Code” as published in Gazette of Madhya Pradesh dated 20-08-04 by Madhya Pradesh Electricity Regulatory Commission (MPERC) as “Grid Code”.

10.3 PRINCIPAL PARAMETERS: The energy meters shall indoor type connected with the secondary side of out door current and voltage transformers.

	Item	Details
(vii)	Type of installation	Indoor Flush
(viii)	CT secondary	1 A
(ix)	VT secondary	110 V/ $\sqrt{3}$ Volts
(x)	System frequency	50 HZ \pm 5%
(xi)	Earthing System	Solidly Grounded
(xii)	Auxiliary DC supply if required	110V/220V \pm 20%

Multiplying factor to arrive at actual primary values wherever applicable shall be calculated from the CT and PT ratio of the installed CT and PT using the base computer software (BCS).

10.4 SWITCHES:

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

10.4.2 Selection of operating handles for the different type of switches shall be as follows:

- | | | |
|----|----------------------------|----------------------------------|
| a) | Breaker control switches | : Pistol grip, black |
| b) | Selector switches | : Oval or knob black. |
| c) | Instrument switches | : Round, Knurled, black |
| d) | Protection transfer switch | : Pistol grip lockable and black |

10.4.3 Breaker control switch shall be of spring return to neutral 3 position type. Control springs shall be strong and robust enough to prevent inadvertent operation due

to light touch. Spring return type switch shall have spring return from close and trip positions to 'after close' and 'after trip' position respectively.

10.4.4 Instrument selection switches shall be of maintained contact(stay put) type. Ammeter selection switches shall have make-before-break type contacts so as to prevent open circuiting of CT secondary when changing the position of the switch. Voltmeter switches shall be suitable for reading all line to line voltages for effectively earthed and unearthed system.

10.4.5 Lockable switches which can be locked in selected position shall be provided for trip transfer scheme. Key locks shall be fitted on the operation handle.

10.4.6 In 132kV C&R Simplex type panel, selector switches for manual selection of Semaphore position indicator shall be provided for displaying matching position of isolators devices in the switchyard. These selection switches shall have two way selection and shall be mounted near to respective semaphore indicators for isolators.

10.5 INDICATING LAMPS:

10.5.0 All indicating lamps shall be LED Type.

10.5.1. Indicating lamps shall be panel mounting type with rear terminal connections. Lamps shall be provided with series connected resistors preferably built in the lamp assembly. Lamps shall have translucent lamp covers to diffuse various colours e.g. lights coloured red, green, amber, clear white or blue to differentiate system function. Lamp cover shall be preferably of screwed type, unbreakable and moulded from heat resistance material. Wattage of the indicating lamps shall be as follows:

- a) 220V - 5 to 10W
- b) 110V - 5 to 10W

10.5.2 Wattage of the neon lamp shall be 0.25 to 0.5W if provided. Bulbs and lenses shall be interchangeable and easily replaceable from the front of the panel. Indicating lamp with resistor shall withstand 120% of rated voltage on continuous basis.

10.6 PUSH BUTTONS:

Push buttons shall be momentary contact type with rear terminal connections. Where ever required the push buttons shall be suitably surrounded to prevent inadvertent operation. These shall be provided with integral inscription plates engraved with their functions. All push buttons shall have minimum two normally open and two normally closed contacts. Contact faces shall be silver plated. Contacts shall be suitable to make/break and carry appropriate currents for the functions desired.

11.0 RELAYS:

All electromechanical relays shall have compliance to the following requirements.

11.1 All relays shall be contained in dust proof cases. All cases shall be mounted on the control and relay panels and the details of mounting shall be to purchaser's approval. Relays shall be of the projecting pattern or flush pattern as specified.

11.2 Indicators shall also be provided on such additional equipment to identify faulty phase and type of fault. Each indicator whether electrically or mechanically operated shall be reset by hand without opening the relay case. Each indicator shall be so

designed that it should not be moved before the relay has completed its operation. It shall not be possible to test and operate any relay by hand without opening case.

11.3 All elements of relays shall be arranged such that on opening the case dust particles collected in or upon the case should not fall on the relay mechanism.

11.4 All relays shall conform to the requirement of IS-3231 or other applicable approved standards. Relays shall be suitable for flush or semi flush mounting on the front with connections from the rear. Relays shall be rectangular in shape and shall have dust proof, dull black or egg shell black enamel painted cases with transparent cover removable from the front.

11.5 All relays shall be draw out pattern or plug in type/modular construction with proper testing facilities. The testing facilities provided on the relays shall be specifically stated in the Bid. Necessary test plugs shall be supplied loose and shall be included in scope of supply. Test block and switches shall be located immediately below each relay for testing. As an alternative to "test block" and "test plug arrangements" the Bidder may supply alternative testing facility for protective relays.

11.6 All induction relays shall be designed to operate at system frequency of 50 Hz. Voltage operated relays shall be designed for star connected 110Volt VT secondary supply and current operated relays of 1 amp CT secondary as specified in the specification. DC auxiliary relays and timers shall be designed for specified DC voltage and shall operate satisfactorily at 70% to 110% rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.

11.7 Relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. Necessary auxiliary relays and timers should be provided for interlocking scheme, multiplying main contacts, switching contact of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. and also as may be required for complete Protection schemes described in specification. All protective relays shall be provided with minimum two pair of potential free contacts. Auxiliary relays and timers shall have pairs of contacts as may be required to complete the scheme. All contacts shall be silver faced with spring action. Relay case sizes should not pose limitations in using available contacts on the relay due to inadequacy of terminals. Paralleling of contacts, shall be done at the external terminals of relay if required.

11.8 All auxiliary relays except the lock out relays and interlocking relays shall be provided with self reset type contacts. All protective relays shall be provided with externally hand reset positive action operation indicators with proper inscription. All protective relays which do not have built-in-hand reset operation indicators shall be provided with additional auxiliary relay having operating indicators (Flag relays) for this purpose. Similar separate operating indicator (auxiliary relays) shall be provided in all relays associated with protection tripping such as Buchholz relays, oil and winding temperature protection, pressure relief devices, fire protection etc.

11.9 Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.

11.10 Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type. If series relays are used the following shall be strictly ensured:

- a) Operating time of the series seal-in-unit shall be sufficiently shorter than that of the trip coil or trip relay in series with which it operates to ensure definite operation of the flag indicator of the relay.
- b) Seal-in-unit shall obtain adequate current for operation when one or more relays operate simultaneously.
- c) Impedance of the seal-in-unit shall be small enough to permit satisfactory operation of the trip coil on trip relays when the DC supply voltage is minimum.

11.11 In order to minimize effect of galvanic actions associated with electro chemical effect, flag coils and DC relay operating coils shall be so placed in the circuit that these are not connected to the positive pole of the battery except through contacts which are normally open.

11.12 Numerical distance relays shall be suitable for IEC communication protocol 61850. Relays shall comply following requirements also:

- a) Printed circuit boards/cards shall be fin type and its contact shall be gold plated. All connections with the connector pegs shall be through wire wrapping. All solder joints on the printed circuit boards shall be encapsulated or covered with varnish.
- b) Components used in these relays shall be loaded under normal condition by less than half of their rated values. Resistors shall be of carbon composition or metal oxide type and the capacitors shall be plastic film or tantalum type. Stringent measures including shielding of long internal wiring should be taken to make relays immune to voltage spikes as per IEC. Relays must meet the requirements of IEC-255-4 appendix 'E' class III regarding BF, disturbance tests IEC-255-4 regarding impulse test at 5KV and transients present in CT & VT connections due to extraneous sources, do not cause damage to any of associated static circuits.
- c) All relays shall be designed for satisfactory performance under tropical and humid conditions. Special mention shall be made in the technical deviations schedule of the Bid for those relays, if any that Bidder proposes to use which differ from specified requirements.
- d) All devices required for correct operation of each relay shall be provided without any extra cost.
- e) It will be ensured that the terminals of the contacts of the relays are readily brought out for connections as required in the final approved scheme. The type of relay case size offered shall not create any restriction on availability of the contact terminals for wiring connections.
- f) DC/DC converters or power supply modules shall be provided for solid state protective relay wherever necessary in order to provide a stable auxiliary supply for relay operation.
- g) Solid state relays shall be stable and suitably protected against transient/induced over voltages and noise signals. Bidders shall state clearly in their Bids, special requirements if any for DC input arrangement

or cabling considered necessary for satisfactory operation of solid state relays quoted by him.

- h) Timers shall be of the solid state type. Short time delay in term of milliseconds may be obtained by using copper lugs on auxiliary relays. In such case it shall be ensured that the continuous rating of the relay is not affected. Time delay in terms of milliseconds obtained using external capacitor resistor combination is not preferred and shall be avoided to the extent possible.

12.0 TESTS :

Manufacturers shall carry out the type tests and routine tests on the relays and complete panels as per relevant Indian Standard or any equivalent International Standards and as specified hereunder.

12.1 ROUTINE AND ACCEPTANCE TESTS :

All modules and sub-assemblies shall be energized and tested for routine and acceptance tests jointly carried out in presence of purchaser's representative as per relevant IEC Specifications or any other international standards individually as well as in assembled form at the factory.

12.2 Relay and control panels shall be subjected to the following tests:

- a) Mechanical operation test.
- b) Verification of Degree of protection as per IS:2147
- c) High voltage test as per IS or IEC as may be applicable.
- d) Electrical control, Interlock and sequential operation tests.
- e) Verification of wiring as per approved schematic.
- f) Other routine tests on all associated equipment and relays as per relevant Indian Standards or IEC.

12.3 After all tests have been carried out, 4 (four) copies of each test report/inspection report shall be furnished. Each report shall supply the following information -

- a) Complete identification data including serial number of all the relays and their routine test reports.
- b) Routine test reports for all the panels.

12.4 Supply of equipment shall be subject to the approval of Test Certificates by purchaser.

13.0 CONTROL CONNECTIONS AND INSTRUMENT WIRING:

13.1 Connections for switchgear operation and indications between the control and relay panels where ever separate termination for instrument and relay wiring on these control & relay panels and multicore cable terminal boxes are involved, these shall form a portion of the scheme for panel and the cost shall be included in the price of the control panel as stated by the Bidder.

13.2 Panel connection shall be insulated and securely fixed neatly to the back of the panel. All instrument and panel wiring shall be fire retardant. All panel wiring shall be taken to terminal boards which shall comply with requirements of multicore cable boxes where applicable. Switch board wiring shall be PVC or VC braid impregnated with flame proof compound. Rubber insulation is not acceptable.

13.3 All wiring diagrams shall be clearly marked with the numbers which are shown on the ferrules of the individual cores. 20% spare and blank ferrule shall be supplied with each panel.

13.4 Flat washers shall not be used but both end of each instrument or control wire shall be properly crimped and terminated with a Rose Courtney or other approved type of washer.

13.5 Each set of current & voltage transformer secondary connections shall be complete in all respect and shall be connected to form common star point. Star point shall be earthed at one point only. Each such earthing connection to the earth bar shall be made in accordance with the requirement of the earthing system and shall be made through a disconnecting link of approved design which can be removed when insulation tests are required without breaking any circuit normally carrying current.

13.6 For each circuit on the panel, the control indication and trip wiring shall be suitably segregated so that these could be isolated to permit testing or other work. Semaphore and other indication circuits shall be connected to the DC bus by a set of fuses. Similarly, the trip and close circuits shall also be connected by a separate set of fuses. Fuses shall be labeled clearly showing the circuits connected.

13.7 All secondary fuses shall be of an approved type. HRC fuses of standard make shall only be used. Where ever specified test blocks shall be provided for testing of meters and relays. These shall be of the switchboard type with connection at the back, mounted on front of panel. Test blocks shall provide complete isolation of meters, instruments and relays and the arrangements shall be such that power supply for testing could be connected at the test block from the external source or may be taken from the instrument transformer. Provision shall be made for short circuiting current transformer secondary and disconnection of potential transformer, by sliding and disconnecting type connectors.

14.0 PRETREATMENT AND PAINTING PROCESS:

Sheet steel fabricated members shall be subjected to pretreatment process before painting. Process shall be carried out as under. Process can broadly be divided as 'Metal treatment and painting'.

14.1 METAL TREATMENT:

- i. **Degreasing:** This can be achieved either immersing in hot alkaline degreasing bath or in hot di-chloroethelene solution. After degreasing operation the surface shall be cleaned thoroughly with cold water.
- ii. **Pickling:** This is to remove rust and metal scales by immersing metal sheets in dilute sulphuric acid (approximately 20%) at nearly 60 deg. centigrade so as to totally remove scale and rust.
- iii. Rinse in cold water in two tanks to remove traces of acids.
- iv. Treat with phosphoric acid base neutralizer for removal of chlorine from the above acid pickling and again wash with running water.
- v. **Phosphating** Immerse in grenadine zinc phosphate solution for about 20 minutes at 80 to 90 degree centigrade . The uniform phosphate coating of 4 to 5 gm per sq. meter shall be achieved.
- vi. Swill in cold water.

- vii. Rinse in Deorylyte bath at 70 to 80 degree centigrade to neutralize any traces of salts.
- viii. Seal the above phosphate coating with hot/dilute chromate solution.
- ix. Dry with compressed air

14.2 PAINTING :

- i. **Primer spray:** One coat on wet surface by specially developed 'High luster' zinc chromate primer and to stove at 150-160 deg. Centigrade for 25 to 30 minutes. Alternatively red-oxide primer with zinc chromate contents may be used. However former process shall be preferred.
- ii. **Rubbing and putting:** Apply putty to fill up the scars if any to present smooth surface and stove 15 to 20 minutes. Apply putty several times to get the perfect smooth finish.
- iii. **Surfacing** :Sand down with mechanical abrasive and stove for 20 minutes.
- iv. **Primer** : Spray second coat of primer as per (i) above or grey primer surface on wet and stove for 20 to 40 minutes at 150 deg. centigrade.
- v. **Finish paint** : Rubbing down dry and spray first coat of synthetic enamel finish paint on wet and stove for 30 minutes.
- vi. **Surfacing** : Sand down or rub dry to prepare for final finish spray. Coats of synthetic enamel finish paint on wet and stove it at 150 deg. centigrade for 30 minutes.

- NOTE:**
- i. Necessary stiffeners may be welded between large cut ducts to provide rigidity before painting process.
 - ii. Painting process shall be done within 24 hrs. of completion of treatment.
 - iii. Small coating paint shall be supplied along with equipment for touching up at site.

15.0 DRAWING AND LITERATURE:

15.1 G.A. drawings for each type of panel shall be submitted with the Bid.

15.2 As soon as possible after award of the contract the successful Bidder shall submit GA and Schematic drawings of each panel for the approval of purchaser.

15.3 Successful Bidder shall have to furnish four sets of manuals per panel each containing of approved GA, Schematic and wiring drawings illustrative pamphlets, literature, operation and maintenance instructions of the relay/panels under his scope of supply.

16.0 GUARANTEED TECHNICAL PARTICULARS & TECHNICAL QUESTIONNAIRE:

16.1 Guaranteed technical particulars for all relays, instruments, meters and all other accessories shall be furnished along with the bid. While submitting technical particulars, please ensure to stipulate very clearly the class of accuracy, (wherever necessary), current and voltage rating physical dimensions, weight, make, model No. type etc. in

order to give a clear picture of device offered, along with literature/write-up. Unless otherwise specified, the panels shall be suitable for the auxiliary DC voltage of 110 V DC or 220V DC as per our requirement.

16.2 At the end of this specification we have attached technical questionnaire. Bidders are requested to reply various questions detailed out in the questionnaire although similar information is available elsewhere in the Bid. Please note in case Bidder does not furnish clear replies to our technical questionnaire, the offer may run the risk of rejection.

17.0 OTHER IMPORTANT REQUIREMENT:

17.1 QUALITY ASSURANCE PROGRAMME :

17.1.1 Bidders must establish that a proper quality assurance program is being followed by them for manufacture of control and relay boards. In order to ensure this, suitable QAP should form a part of the technical Bid, which will be submitted against this Bid specification. Quality Assurance Program must have a structure as detailed in the following paragraphs.

17.1.2 Quality assurance and failure prevention starts with careful study and scrutiny of our technical specifications and requirements. Bidders shall carefully study all the technical parameters and other particulars & the Bidders shall categorically give their confirmation that these requirements shall be met in a satisfactory manner.

17.1.3 Bidders shall furnish the checks exercised in design calculations particularly in selection of main protection scheme. Salient features of design & selection criteria of protection scheme will have to be made available to the Purchaser.

17.1.4 Bidders shall indicate the various sources of the bought out items. Type of checks, quantum of checks and acceptance norms shall be intimated and random test and check results should be made available for inspection whenever so desired. Vendor list for various bought out items shall be submitted with the Bid and the same shall be subject to purchaser's approval. However, no change in vendor list shall be acceptable after placement of order and list of vendors shall be freezed at the time of placement of order It will however be obligatory on the part of Bidder to allow third party inspection of all important material and in case during independent third party inspection any of the above material is found different than from approved list of vendors, Purchaser reserves the right to summarily reject complete lot and the manufacturer has to replace the entire material from the vendors approved by the Purchaser.

17.1.5 Based on above QAP and offered delivery schedule a tentative program chart indicating period for various manufacturing/ testing activities shall be submitted alongwith QAP Program chart should specify periods for various activities i.e. design, ordering of new materials, assembly, testing etc.

17.2 INSPECTION:

17.2.1 Bidders shall chalk out a detailed inspection and testing program for manufacturing activities for the various components. Purchaser reserves the right to get carried out any tests by a third party. All Cost of inspection/tests shall be borne by the Bidder. No material shall be despatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

17.2.2 Acceptance of any quantity of panel/material shall in no way relieve the successful Bidder of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipments are later found to be defective.

17.2.3 At the time of inspection, Bidder shall identify each and every item/accessories. Unless all the items are identified, the manufacture will not be treated as complete. Serial number of Relays & other accessories shall be entered into the test report. Various tests stipulated in IS shall be performed in the presence of purchaser's engineers or when the inspection waiver has been given, in such a case, the testing shall be done at the manufacturer's works as per IS stipulations and same should be confirmed by documentary evidence by way of Test Certificate which shall be got approved by the purchaser.

17.2.4 Whenever inspection call is given, the letter of inspection call will accompany the following:

- a. List of various panels and loose relays, which are ready at the works and will be offered for inspection. Inspecting Officer will carry the list and check the items declared to have been offered for inspection
- b. It is expected that before any equipment is offered for inspection, internal testing of the same for various important parameters are already done. Routine test report for such tests shall also accompany with the letter of inspection call.
- c. In case for any reasons inspection is not completed or equipment is not found complete with all accessories, the Purchaser will reserve the right to recover the complete cost of deputation of inspecting team to the works of the manufacturer.

18. COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS:

Responsibility for obtaining timely supplies of bought out items will rest on the Bidder and only on this basis, delivery period will be offered in the Bid. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and in case defective supply of any item is reported will rest on the Bidder. In case for attending to defect in any accessory or inspection/ replacement of the accessory, which may be bought out item for the Bidder; services of engineer of original manufacturer is required, the same will be organized on immediate basis by the Bidder at his cost.

18.1. Please ensure that pages have been properly numbered and signed by the Bidder. All Bid documents including schedules should be indexed properly and index of the document should be enclosed/placed at the beginning of the Bid document.

19.0 SCHEDULE OF REQUIREMENTS:

Simplex type control and relay panels for 132KV system shall have following instruments, relays and accessories to be provided per panel as per the type of protection indicated above under **clause-8** by the purchaser:

S No	PARTICULARS	TYPE-A For 132KV Feeder	TYPE-B For 132KV side of 132/33KV Transformer (63/40 MVA Capacities)	TYPE-C For 132KV Side of 220/ 132/33KV and 400/132/33 KV Transformer	TYPE-D For 132KV Transfer Bus Coupler bay
(I) CONTROL PANEL					
	Type of panel	Simplex	Simplex	Simplex	Simplex
2	Box type circuit label inscription (50x100mm) indicating Name of feeder/ transformer in side & out side of panel	TWO	TWO	TWO	TWO
3	Purchaser's order no. Serial no.& Bidder's label	TWO	TWO	TWO	TWO
4	Over laid Mimic diagram with uniform 3mm thickness, 10mm width for horizontal strip and 6mm width for droppers.	ONE MAIN AND TRANSFER BUS			
5	Red and Green lamps (LED type) with holder for circuit breaker ON/OFF position indication for each Xmer/feeder circuit.	ONE SET	ONE SET	TWO SETS	ONE SET
6	Pistol grip Circuit breaker control switch with three positions; ON, OFF & return to neutral.	ONE	ONE	TWO	ONE
7	Semaphore to indicate circuit breaker position automatically	ONE	ONE	TWO; ONE FOR 132KV & OTHER FOR 33KV BREAKER	ONE
8.	Digital Ampere meter with selector switch for monitoring circulating current in tertiary winding (Size 144 sq mm).	-	-	ONE	-
9 a	One multifunction meter to indicate phase and line currents, phase and line voltages, active power (MW), reactive power (MVAR) & Power factor. This meter shall have scrolling facility to facilitate reading any of these parameters. This meter shall be of size 144 sq. mm and it shall	ONE	ONE	ONE	ONE

S No	PARTICULARS	TYPE-A For 132KV Feeder	TYPE-B For 132KV side of 132/33KV Transformer (63/40 MVA Capacities)	TYPE-C For 132KV Side of 220/ 132/33KV and 400/132/33 KV Transformer	TYPE-D For 132KV Transfer Bus Coupler bay
	have a scale of 0 to 150KV for voltage reading (secondary rating 110V Phase to phase and 1 Amp). The meter shall have an accuracy class of 0.5, shall have LED display for letters and the size of digit shall be 25 mm.				
9 b	Analogue of type center zero MVAR meter	One	One	One	One
10	Facia window annunciator complete with flasher and function relays	18 WAYS	24 WAYS	12 WAYS	18 WAYS
11	Test plug/port for testing of Main protection Relay complete with connecting leads	ONE	ONE	ONE	ONE
12	Test terminal block for static trivector meter	ONE	ONE	ONE	ONE
13	ABT feature static trivector energy meter - 3 phase 4 wire - type of accuracy class 0.2s	ONE	ONE	TWO ONE FOR MV WIND-ING AND THE OTHER FOR TERTIARY WIND-ING	ONE
14	Push button for facia annunciator testing of all lamps/accept/ reset arrangement.	THREE	THREE	THREE	THREE
15	Four element hand reset auxiliary relay to monitor circuit breaker Parameters to display in facia annunciator.	ONE	ONE	ONE	ONE
16	Trip circuit supervision healthy indication lamp with push button to select pre & post close supervision	TWO	TWO	FOUR	TWO
17	Protection transfer switch with lock for continuous display on Facia	ONE	ONE	ONE	ONE

S No	PARTICULARS	TYPE-A For 132KV Feeder	TYPE-B For 132KV side of 132/33KV Transformer (63/40 MVA Capacities)	TYPE-C For 132KV Side of 220/132/33KV and 400/132/33 KV Transformer	TYPE-D For 132KV Transfer Bus Coupler bay
	annunciator				
18	AC panel indication lamps with holder for DC supply supervision.	TWO	TWO	TWO	TWO
19	Additional accessories & other devices required to complete the offered schemes	ONE SET	ONE SET	ONE SET	ONE SET
(II) RELAY PANEL					
20	Box type circuit label inscription (50x100mm) indicating Name of feeder/ transformer in side & out side of panel	TWO	TWO	TWO	TWO
21	Numerical Distance protection scheme complete with all modules and auxiliary relays etc. as per clause 8.2.of technical specification.	ONE	--	--	ONE
22	Numerical Differential protection relay for power transformers complete with inter posing CTs etc; in line with clause no. 8.3. of technical specification.	--	ONE	--	--
23	Pre & post close Trip circuit supervision relay .	*TWO	* TWO	FOUR FOR 132&33KV BREAKERS	*TWO
24	DC supply healthy monitoring relay.	TWO	TWO	TWO	TWO
25	Over fluxing relay complete with timer etc. *	--	ONE	--	--
26	LBB relay ** alongwith auxiliary relay having minimum 8 NO contacts as described in Clause no.8.6.1	ONE	ONE	ONE	ONE
27	Fast acting high speed/ master trip relay with contacts suitable for handling burden of 2 nos. circuit breaker trip coils in	ONE	ONE	ONE	ONE

S No	PARTICULARS	TYPE-A For 132KV Feeder	TYPE-B For 132KV side of 132/33KV Transformer (63/40 MVA Capacities)	TYPE-C For 132KV Side of 220/132/33KV and 400/132/33 KV Transformer	TYPE-D For 132KV Transfer Bus Coupler bay
	parallel.				
28	Hand reset auxiliary <u>trip relay</u> with flag indication for : i. Oil temp high trip ii. Winding temp high trip iii. Main buchholz trip iv. OLTC oil surge relay trip v. Pressure relief device trip 3 Nos vi Spare	--	Total 8 Nos (One for each)	--	--
29	Hand reset <u>alarm relay</u> with flag indication for : i. Oil temp high alarm ii. Winding temp high alarm iii. Main buchholz alarm iv.OLTC oil surge relay alarm v. Pressure relief device alarm vi. Spare	--	Total Six Nos (One for each)	--	--
30.	Numerical, Non directional, Communicable 3 O/C + 1 E/F Relay. (Directional relay for feeder and TBC panels only).	ONE (DIRECTIONAL)	ONE.	TWO	ONE (DIRECTIONAL)
31.	Single element over current relay for circulating current protection for tertiary winding	--	--	ONE	--
32.	Definite time over current relay with continuously variable current setting range from 50% to 200% of relay current with timer having setting range of 2.5 sec to 25 sec.(*)	--	ONE (Over load protection for Xmer)	--	--
33	One no six bay switch for selection of group in numerical Distance /Differential Relay				One
34	Additional aux. relays required to complete offered protection schemes with details.	As Required	As Required	As Required	As Required

S No	PARTICULARS	TYPE-A For 132KV Feeder	TYPE-B For 132KV side of 132/33KV Transformer (63/40 MVA Capacities)	TYPE-C For 132KV Side of 220/ 132/33KV and 400/132/33 KV Transformer	TYPE-D For 132KV Transfer Bus Coupler bay
35	Four element aux.Relay for monitoring Circuit breaker parameter	One	One	One	One
34	(III) EQUIPMENT MOUNTED INSIDE				
35	Space heaters with switch in each panel.	ONE	ONE		ONE
	15/5A, 250Volts power socket with protective metallic cover & Switch.	ONE	ONE		ONE
35	20Watt Tube light with door switch.	ONE	ONE		ONE
36	40Watt incandescent or 15Watt CFL lamp with switch.	TWO	TWO		TWO
37	DC bell for NON TRIP alarm complete with accept, reset and test facilities.	ONE	ONE		ONE
38	DC hooter for trip alarm complete with accepting, reset and test facility	ONE	ONE		ONE
39	AC Bell for DC supply supervision.	TWO	TWO		TWO
40	Gland plate fitted with Cable glands.	ONE SET	ONE SET		ONE SET
41	Foundation bolt	ONE SET	ONE SET		ONE SET
42	Additional relays or accessories offered by Bidder, which are essentially required for completing protection scheme.	As per Requirement	As per Requirement		As per Requirement

For the purpose of confirmation to supply all items mentioned above, Bidders shall bring out all details in a tabular form in the manner indicated above in schedule VIII.

IMPORTANT NOTE:

- i) **Bidders shall indicate Unit prices for all the gadgets and relays offered by them for the 132KV Class type A,B,C&D panels. This**

has to be strictly complied. Prices of the gadgets and relays shall form a part of the Schedule-I about details of equipment and quantity for 132KV C&R panels.

- ii)(*) In case, LBB and over-fluxing relays are built-in features of line distance protection relay and transformer differential relay, then Bidders may confirm accordingly and need not provide these relays separately.
- iii)(**) In case, definite time over current relay forms an integral part of numerical differential relay then a separate relay as envisaged need not be provided. Bidders need to clarify this point.
- iv) Bidders may please refer Clause no. 8.6.1 about the LBB relay and Sl. No. 29 of the B.O.M. and shall provide an auxiliary relay having minimum 8 NO contacts per circuit.

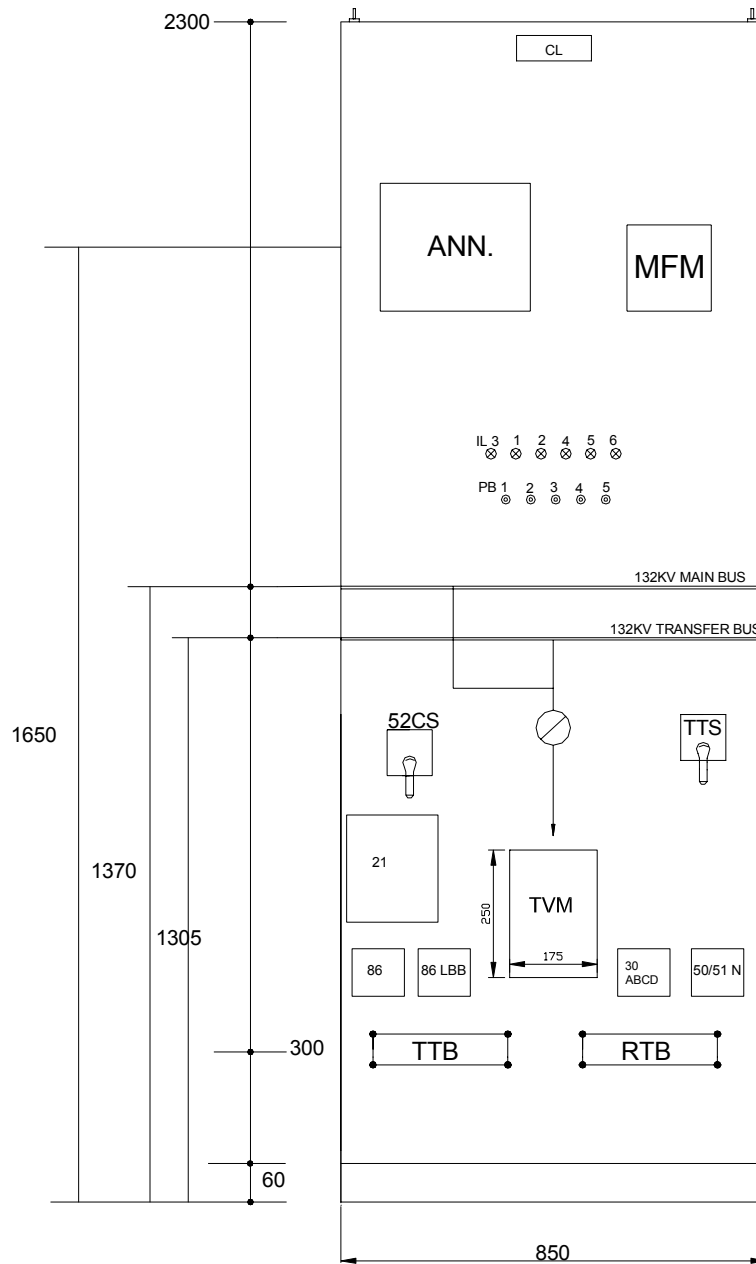
20.0 SCHEDULE OF REQUIREMENT OF RELAYS ETC :

It is obligatory on the part of bidders to furnish Schedule of Requirement of Accessories provided with equipment in the Schedule VIII of Section II of the bid document. In case Schedule VIII duly filled in complete in all respects is not furnished, the bid may be treated as non-responsive.

APPENDIX-B**DRAWINGS**

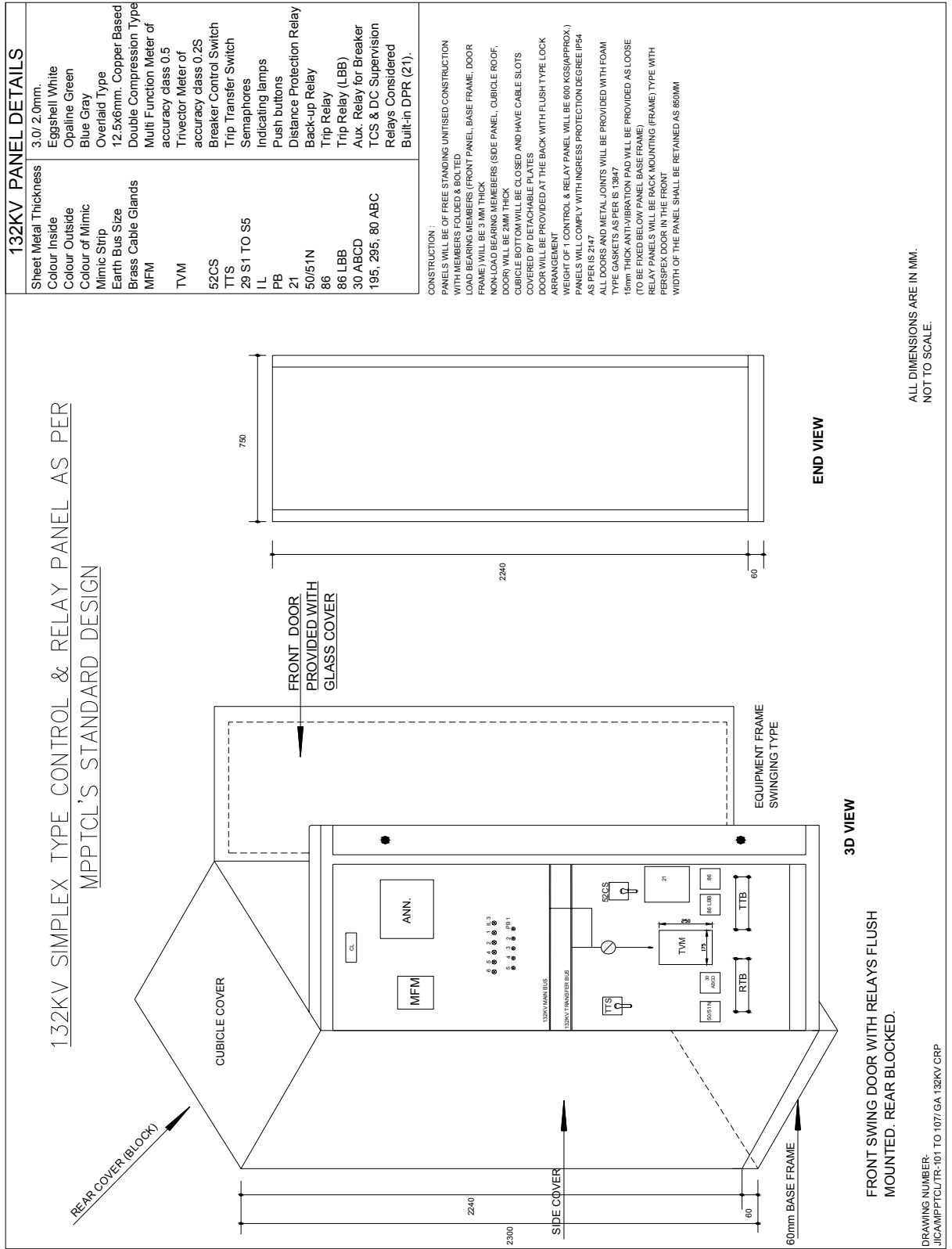
S.No.	Drawing No.	Description
1	JICA/MPPTCL/TR-101 TO 107/ EL 132KV CRP	Elevation Drawing for 132KV Control & Relay Panel
2	JICA/MPPTCL/TR-101 TO 107/ GA 132KV CRP	General Arrangement Drawing for 132KV Control & Relay Panel

GENERAL ARRANGEMENT OF 132KV SIMPLEX TYPE CONTROL & RELAY PANEL



ELEVATION

DRAWING NUMBER-
JICA/MPPTCL/TR-101 TO 107/ EL 132KV CRP



SCHEDULE-I (A)
DESCRIPTION OF EQUIPMENT FOR
SCHEDULE FOR RATES AND PRICES TO BE FURNISHED
IN VOLUME-VI

S. No.	Particulars of Item	Qty.
1(a)	132 KV Simplex design C & R panels (type A) for protection of 132KV feeder circuits complete with all relays & accessories as described in the specification	As per price shedule
2	132KV simplex design C & R panels (type B) for 63/40 MVA, 132 / 33KV X'mer complete with all relays & accessories as described in the specification	
3	132KV simplex type C & R panels (type C) for 132KV side of 160 MVA, 220/132/33 KV and 100 MVA 400/132/33 KV transformers complete with all relays & accessories as described in the specification	
4	132 KV Simplex design C & R panels (type D) for protection of 132KV Bus coupler bay complete with all relays & accessories as described in the specification	

NOTE:

1. **The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.**
2. **The quantity of above equipments has been mentioned in Volume VI.**

SECTION-II (D)

2.1.2 TECHNICAL SPECIFICATION FOR INDOOR 33KV CONTROL AND RELAY PANELS

1.0 SCOPE:

1.1 This section contains technical specification for design, manufacture, testing at manufacturer's works packing & supply of 33KV C&R Panels type (1T+1F), 3F and 1F complete with all fittings & accessories, specified herein for connecting outdoor Switchgears and other electrical equipment in EHV Sub-stations of Madhya Pradesh Power Transmission Co. Ltd. Panels shall be floor mounting free standing type, meant for indoor installation in various 400KV, 220 kV and 132 kV EHV substations located within the state of Madhya Pradesh.

1.2 The "simplex" design 33 kV control and relay panels included in this bid document are required for following applications.

TYPE – A	Control & Relay panels for one Transformer plus one Feeder circuit.
TYPE – B	Control & Relay panels for Three-Feeder circuits
TYPE – C	Control & Relay panels for one-Feeder circuit

2.0 LIMITS OF CONTRACT:

2.1 It is not the intent to specify completely all the details of design and construction of the control and relay panels. However, the panels shall conform in all respects to the high standard of engineering design and workmanship. Various control and relay panels and other requirements specified under this section shall be complete in themselves in all respect with all main and auxiliary relays, fuses, links & switches duly wired, labels terminal panels, earthing terminals, indicating lamps, mimic diagram, alarm scheme, name plate, foundation bolts, interior illumination, cable termination arrangement with cable glands fitted on base mounting plate etc. including all other accessories which are essentially required for satisfactory operation . Such components shall be deemed to be included in the scope of supply of the Bidders irrespective of whether these are specifically brought out in this specification or not.

2.2 Supply and laying of control and power cables for interconnecting various equipment is not covered under the specification. Cable terminating arrangements, viz. the cable hold support boxes, multicore cable glands, sealing ends for other types of cables that may be specified, shall however be included in the offered price. These shall be subject to approval of purchaser. It is the responsibility of Bidders to ensure that the equipment specified and complimentary equipment required for completeness of the protection/control scheme be properly accommodated in the panels without congestion and if necessary provide panels with larger dimensions in width only.

3.0 CLIMATIC CONDITIONS:

Climatic condition shall be applicable as per Section-I, Volume-II of the bid.

4.0 PANEL FINISH AND COLOUR 33KV SIMPLEX DESIGN PANEL:

33KV C&R panels covered by this Tender shall strictly conform to MPPTCL's standard drawing no. SK116.

4.1 All unfinished surfaces of steel panels and frame work shall be thoroughly cleaned by sand blasting, pickling and rinsing or by combination of processes or by other latest and improved techniques to remove dust, scales, foreign adhering matter and grease. Cleaning process shall be followed immediately by the application of rust inhibiting wash process. All surfaces shall then be given suitable rust resisting primary coat and then one or more coats of opaline green quick drying enamel to serve as a base and binder for finishing coat. Purchaser has standardized that colour scheme for 33kV panels shall be opaline green as per colour shade No.275 of IS: 5 or equivalent BS-381 or matching colour and shade of other authoritative equivalent international standards are also acceptable. Colour finish shall be applied as per above colour scheme on the exterior steel works of the panels. Exterior shall not be fully glossy. Interior of panels shall be painted with "Egg Shell White". Pretreatment & painting process is described in Clause 14.0. All steel works shall be phosphated in accordance with IS: 6005. Panels shall be provided a degree of protection not less than IP- 54 as per IS-2147.

4.2 COMPLIANCE OF PANELS, RELAYS, INSTRUMENTS AND OTHER GADGETS WITH STANDARD SPECIFICATIONS:

4.2.1 Applicable standard for the offered equipment/material shall be as per Section-I Vol.II.

4.2.2 ACCEPTANCE OF OTHER AUTHORITATIVE STANDARDS:

In the paragraph 4.2.1 above, relevant Indian /British /IEC standard specifications have been mentioned. However, the equipment meeting any other authoritative international standard, which ensures equal or better quality than the standards, mentioned shall also be acceptable. Equipment for which Indian Standards are not available, the relevant British standards and IEC recommendations will be applicable. Please attach photocopy of all such standards according to which the equipment has been offered.

4.2.3 TYPE TESTS:

All offered Numerical/ static/electromechanical relays and meters on C&R Panels indicated below shall be fully type tested as per relevant standards. In case the equipment of the type and design offered, has already been type tested, the shall invariably furnish type test reports from the reputed and approved national/international laboratory/Government approved test houses to prove that indicated accuracy and other specifications of the relays offered conform to the relevant standards. Test certificates shall clearly indicate the type and model number etc., so that relevant details of offered relays could be verified. While submitting offers the model and type etc., shall be clearly indicated. Type test reports so furnished should not pertain to the period earlier than five years from the date of opening of tender.

It may be very specifically` noted that non-submission of type test reports about numerical relays and also about static meters along with the bid shall be treated as a disqualification.

i.	Numerical IDMT relay having two over current and one earth fault element (Non directional). Time of operation 1.3. Seconds at 10 times current setting
ii.	Numerical IDMT Non-directional relay having three over current and one earth fault elements having time of operation as 3.0 Seconds at 10 times current setting
iii.	Static tri-vector meter of accuracy Class 0.2S.

iv.	Multifunction meter of accuracy Class 0.5.
-----	--

4.2.4 DISCREPANCIES IN TECHNICAL PARTICULARS :

Regarding discrepancies in technical particulars stipulation in Section-I, Volume-II shall be applicable.

4.3.0 PANEL CUT OUT AND DIMENSIONS:

4.3.1 33kV Control & relay panels shall be of "SIMPLEX" design. Each panel shall be constructed of stretch-level selected steel sheets. Panels shall be made in suitable sections so that while mounting, panels can be located side by side, bolted together to form a compact unit.

4.3.2 33 kV SIMPLEX type panels shall consist of a vertical front panel with all equipment mounted thereon including protective relay, indicating/recording instruments and energy meters etc. and having wiring access from the rear. Double leaf door with lift off hinges shall be provided at the back. Doors shall have handles with built in locking facility.

4.3.3 Control panels shall be sheet steel enclosed and shall be dust, moisture and vermin proof. Panels shall be fabricated of 2.5 mm thick steel sheet on all sides free from all surface defects. Panels shall have sufficient structural reinforcement to ensure a plain surface and rigidity to limit vibration during dispatch, installation and service.

4.3.4 Constructional details and sizes for 33 kV C&R panels shall be as under:-
(MPPTCL's standard drawing may please be referred)

S.No.	PARTICULARS	33KV PANELS
1	Type	Simplex
2	Height(mm)	2250(Panel Height 2190mm + Base frame of 60mm)
3	Depth(mm)	560 (without corridor)
4	Width (mm) (Subject to variation as per scheme requirement)	660 for 1F 1000 for 3 F 660 for 1T+1F
5	Base frame	Anti-corrosive Black painted
6	Panel exterior	Opaline Green
7	Panel Interior	Egg Shell white
8	Mimic strips over laid type	Azure blue
9	Number of feeder(F)OR Transformer(T) circuits per panel	Control panels are required in the following three formations: i. One transformer plus one feeder circuit. ii. Three feeder circuits. iii. One feeder circuit.
10	Variation in dimension of panels.	Bidders may note that the height and depth of control panels will have to be maintained as mentioned against Sl. No. 2 & 3 above. As far as width of the control panels is concerned the same may be offered based on optimum design to accommodate specified number of circuits as also the various relays and accessories, which are to be mounted on the panels.

DIMENSIONAL DETAILS FOR 33 KV C&R PANELS

S No.	Category of panels	Height (mm)	Width (mm)	Depth (mm)
1.	1T + 1F category panels having vertical versions of over current and earth fault relays	2250 (2190mm + 60 mm base pad)	660	560
2.	3F category	2250 (2190mm + 60 mm base pad)	1000	560
3.	1F category	2250 (2190mm + 60 mm base pad)	660	560

4.3.5 Preferred panel cut out dimensions for mounting of the relays shall be as per Indian Standard Specification IS-4483 (PART I & II) and MPPTCL's standard shown in drawing. Please note that since purchaser has standardised dimensions of the panels for their system, therefore no deviation in height/depth will be permitted. Bidders must submit general arrangement drawing for each type of panel offered by them.

4.3.6 Control & Relay panels shall be floor mounting dead front sheet steel assemblies of unitised design. Panels shall be made in suitable sections as described else where in the specification so that while mounting, panels can be located side by side bolted together to form a compact and composite unit. Design, material selection, workmanship and width of panels shall be such as to present a neat appearance, outside and inside with no works of welds, rivets, screw or bolts head apparently visible from the exterior surface of the control panels.

4.4.0 PANEL LIGHTING:

4.4.1 In each SIMPLEX panel, one 20W, 230 Volt tube light guarded with protected cage or CFL shall be provided below the central roof for adequate illumination & the same shall be controlled by door switch.

4.4.2 One number universal 15A/5A pin receptacle socket with cover and switch shall be provided in each control panels. Third pin of the socket shall be effectively grounded through the metallic structure. Socket shall be of industrial grade control panel's type complete with protective metallic cover.

4.5.0 AUXILIARY SUPPLY:

4.5.1 The auxiliary AC / DC supply shall be as per clause No. 6 Section-I Volume –II Part I of the specification.

4.5.2 Bidders may please note that there shall be only one source of DC supply (110 or 220 Volts) and this DC supply shall be common for protection, and indications on each of the 33KV C&R panels

4.5.3 Bidders shall arrange for providing extension of these power supplies to different circuit of the control panels group.

4.5.4 Isolating devices with H.R.C. fuses shall be provided in each panel for both A.C. and D.C. power supplies. Distribution and wiring of the same shall be unitised

through fuses and links in such a way so that isolation of respective system unit is possible without affecting the rest of the system or unit.

4.5.5 All H.R.C. fuses and links shall be with holder and the same shall be mounted on slant support with identification labels.

4.5.6 H.R.C. fuses shall be provided as per following details:

S.NO.	CIRCUIT	FUSE RATING.
1.	Circuit breaker-closing circuit.	16 A
2.	Trip circuit -I	16 A
3.	Trip circuit –II	16A
4.	Main Protection	10A
5.	Indication	6A
6.	Annunciation	6A
7.	P.T. Circuit main	6A
8.	P.T. supply for Metering circuit	2A
9.	AC supply fuses and links	10A

NOTE: Additional HRC fuses for individual circuits shall also be provided as per the requirement for completing the offered protection scheme.

4.6.0 CONTROL WIRING:

4.6.1 Successful Bidders shall furnish and install complete wiring up to the terminal block for the equipment, instrument devices mounted in the control panels strictly in accordance with the approved wiring diagram prepared by the Bidders based on the purchaser's information and schematic diagram.

4.6.2 Wiring shall be complete in all respects so as to ensure proper functioning of control, protection and metering schemes.

4.6.3 All spare relay contacts and spare contacts of switches shall be wired up to the terminal blocks.

4.6.4 Wiring shall be done with flexible heat resistant wires, PVC insulated with stranded copper conductor. Minimum number of strand in the wire shall be three. Conductor size shall be equivalent to 2.5 sq mm for Current, potential & DC Control circuit and 1.5 sq mm for other indications and annunciation circuits.

4.6.5 Coloured cores shall be used for wiring as per latest revision of IS-375 viz; red, yellow, blue and black for R Y B phases and neutral respectively. Colour code for earthing shall be Green and for annunciation circuits gray colour code shall be used. For DC circuits the colour code will be Red-positive & Black-negative.

4.6.6 Each wire shall be identified at its both ends with wire designation number by plastic ferrule as per wiring diagram based on latest revision of IS-375 to denote the different circuit functions. Bidders shall take approval for the system of wire numbering and colour coding schemes.

4.6.7 All wire terminations shall be made with compression type connectors. Wires shall not be tapped or spliced between terminal points. All wire shall have crimp type termination and direct Tee connection at any place is not at all required.

4.6.8 All series connected devices and equipment shall be wired up in sequence. Loop-in Loop out system of wiring shall be avoided as far as possible and the common buses shall normally be made through the terminal block for better reliability of testing and maintenance.

4.6.9 Fuses and links shall be provided for isolation of individual circuit from bus bars without disturbing other circuits and equipment.

4.6.10 DC trip and DC voltage supplies and wiring to main protective gear shall be segregated from those for special purposes. Each such group shall be fed through separate fuses, either direct from main supply fuses or the bus bars.

4.6.11 Since a number of wires will run from one point to another, it is desired that the support arrangement should be adequate and neat. Conventional method of bunching of wires should not be adopted since the same creates problems in case any wire is to be removed. Wires should be accommodated in suitable plastic channels with sliding plastic cover, which may be suitably mounted inside the panels neatly. Inspection/ removal of wires laid in the plastic channels should be possible by sliding the covers.

4.6.12 Blank plastic channels should be provided by the sides of the panels to accommodate incoming cables from switchyard through cable glands with suitable holding arrangement rigidly fixed so that while handling other nearby cables no jerks are transferred to the terminals inside the cubicle.

4.6.13 Wherever practicable wiring shall be accommodated in the sidewall of the cubicles. Sharp bends shall be avoided.

4.7.0 TERMINAL BLOCKS:

4.7.1 Multi-way terminal blocks complete with necessary binding screws and washers for wire connection and marking strip for circuit identification shall be furnished for terminating the panels wiring and outgoing cables. Terminals shall be suitable for receiving at least 2x7/0.737mm stranded copper conductor or equivalent Aluminium conductor wires per terminal. It may please be noted that the current rating shall be double the current rating of 2x7/0.737 non stranded copper wire and terminal shall be suitable to receive 2x2.5sq. mm or 2x4sq. mm copper conductor of control cable.

4.7.2 Terminal blocks shall have shorting and disconnection facilities, so that the panels side and outgoing wires could be disconnected just by opening the disconnecting links which slides up or down without dislodging the wires from their position.

4.7.3 Highly reliable Test terminal blocks with facilities of shorting and easy removal of connection shall be provided for CT & PT circuits. Instrument transformer wires shall be terminated through suitably mounted test terminal blocks to facilitate site testing of all main and backup protection relays.

4.7.4 Test terminal blocks shall be grouped according to the circuit functions and each terminal block group shall have at least 20% spare terminals for accommodating additional input wires.

4.7.5 Not more than two wires shall be connected to any terminal or either side of the terminal block. If necessary, a number of terminals shall be connected by jumpers to provide additional wiring points.

4.7.6 Each terminal point shall be marked with designation obtained from the purchaser's schematic drawings.

4.7.7 Adjacent rows of terminal blocks shall be spaced not less than 100mm apart. These shall be mounted vertically at the sides of the cubicle and set obliquely towards the rear doors to give easy access to terminating end to enable ferrule number to be read without difficulty.

4.7.8 Bottom of terminal blocks shall be spaced at least 200mm above the cable gland of incoming multicore cables.

4.8.0 CABLE ENTRY:

4.8.1 Control panels shall have provision of multiple cable entries from the bottom. Necessary cable glands should also be provided in the panels on a 4 mm thick mild steel gland plate to be bolted firmly with nut and bolts on base plate. Base plate shall be bolted further on the base frame with adequate number of nuts & bolts. Purchaser will arrange for necessary floor opening below the panels to suit the cable trench design of purchaser's requirement.

4.8.2 Adequate support for cables entering the panels is an utmost necessity. Cable entry and subsequent distribution of individual cables should present a tidy look and for achieving this, bunching shall be avoided. Plastic channels need necessarily be used.

4.8.3. Wiring through the terminal blocks shall be located in a manner that it becomes convenient to provide termination of control cable for floor openings.

4.8.4 Control panels shall have provisions for fixing the multicore cable glands, which shall be included by the BIDDER in scope of supply. For fixing these cable glands, detachable gland plates of 4mm thickness shall be mounted on the base frame by nuts and bolts.

4.8.5 Gland plate shall be supplied duly drilled and fitted with cable glands. Gland plate and doors shall be provided with gasket properly. Necessary glands as per clause-4.8.6 below shall be fitted on the gland plate.

4.8.6 Rigid supports shall be provided along with terminal block for holding plastic channel. Suitable clamps may also be provided in plastic channel for holding cables.

4.8.7 Following quantities of cable glands per circuit with suitable blanking arrangement shall be fitted on the gland plate that shall be fastened suitably at the bottom of the control panels in each simplex panel as per the following details:

- i. For 2 core x 2.5sqmm 1.1KV grade control cable : 3 nos.
- ii. For 8 core x 2.5sqmm 1.1KV grade control cable : 2 nos.
- iii. For 4 core x 2.5sqmm 1.1KV grade control cable : 4 nos.
- iv. For 12 core x 2.5sqmm 1.1KV grade control cable : 1 no.
- v. For 19 core x 2.5sqmm 1.1KV grade Control cable : 1 no.

4.9.0 GROUNDING:

4.9.1 Copper strip having size not less than 12.5mm x 6mm grounding bus shall be provided for each control panel extending along entire length of the panel for the purpose of effectively grounding all metal structures.

4.9.2 Each continuous length of ground bus shall have provision of two terminals at two extreme points for connection to main ground grid of the substation.

4.9.3 Common star /neutral points of Potential and current transformers shall be connected with the grounding bus through a disconnecting type connector so that purchaser may adopt single point grounding of common star point either at the terminal block in the control panels or in the marshalling box of the instrument transformer.

4.9.4 Whenever any circuit is shown grounded on the drawing a single wire for that circuit shall be run independently up to the ground bus and connected to it.

5.0 CONTROL AND RELAY PANELS:

5.1 Simplex panels shall be provided with lockable doors on rear side. All indicating instruments, controls, protective relays & mimic diagram etc. for multi feeders shall be provided on the front side of the control panels.

5.2 Labeling for each circuit shall be provided at each of the front control panels, as well as inside of the SIMPLEX panels.

5.3 Panels shall be of uniform thickness (minimum 2.5mm) and made of level sheet steel. Bottom of the cubicle shall be made in a manner to open it for the purpose of wiring and cable entry. Panels shall be designed to be of self-supporting type and wherever additional structural strength is required, inconspicuous bracing, gusset-welding etc., shall be used. All control panels and switchgear cubicles shall be made absolutely vermin proof design of the approval of the purchaser.

5.4 Panels shall be made in suitable sections to facilitate easy transport and handling and shall be later assembled at site. It may please be noted carefully that single continuous sheet steel should not be used for a substation to make a single composite panels for all the panels required. Panels should have unitised construction with facility to bolt together the panels where more than one panels is involved.

5.5 Purchaser may ask for accommodation and wiring to be provided on Panels for additional apparatus supplied under different contracts. Bidders shall agree to make such provision in accordance with the instructions of the purchaser.

6.0 CONTROL & INDICATION CIRCUITS:

6.1 Control and indication circuit for each circuit breaker controlling feeder or transformer shall generally comprise of the following:

- a. Mimic diagram
- b. A composite meter of size 144 sq mm to indicate current, voltage, Watts VARs and power factor.
- c. Circuit Breaker Control switch.
- d. "Trip Healthy" lamps.
- e. Alarm cancellation arrangement.
- f. Breaker ON/OFF indication lamps.

- g. 3 phase, 4 wire static trivector meter of accuracy class 0.2

6.2 MIMIC DIAGRAM:

6.2.1 Coloured mimic diagram and symbols shall represent the exact representation of system. The mimic diagram for 33 kV shall be made to represent "ONE MAIN & TRANSFER BUS" Scheme. Mimic diagram shall be placed at the eye level to indicate the position of each breaker. Horizontal strip and the droppers shall have width of 10mm and 6 mm respectively and the strip shall be 3mm thick. Power transformer, voltage transformer shall be fixed on mimic by suitable symbols having dark Black colour. Position indicator of isolating devices shall have matching colour in accordance with the voltage class of the mimic. Arrangement shall be of over laid design using anodized aluminum section. **Painted mimic diagram shall not be acceptable.**

6.2.2 Offered mimic diagram shall have colour scheme for representing 33 kV voltage level as per the details indicated below: -

"Azure blue shade 104 of IS 5"

6.3 SEMAPHORE INDICATOR FOR BREAKERS:

6.3.1 Rotating disc semaphore indicator to be provided for this purpose on mimic diagram shall indicate the position of 33 kV circuit breaker whether closed or open. Position indicator strip of all semaphore indicators for breaker shall have the colour scheme matching with specified colour scheme of mimic for various voltage levels.

6.3.2 ON and OFF display position of circuit breakers shall be automatically indicated by semaphore operation indicator strip on mimic of 33 kV panels using auxiliary switching contacts of outdoor equipments.

6.3.3 **For 33 kV isolators, semaphore indicators need not be provided. Instead of this, a circle indicating a 45 degree position may be indicated for the isolators.**

7.0 ANNUNCIATION SYSTEM:

7.1 Alarm annunciation system shall be provided for each panel by means of visual and audible alarm in order to draw the attention of the operating staff to the abnormal operating conditions or the operation of some protective device. Annunciation equipment shall be suitable for operation under the tolerance limit of voltages specified in this specification.

7.2 Annunciation shall be of visual and audible type. Facia annunciator, flush mounted on the front of the control panel, shall provide the visual annunciation. DC hooter or DC bell shall provide the audible alarm. Apart from requirement of facia windows for annunciating status of various relays, Bidders shall also provide spare facia annunciator window two nos. each for trip and non-trip function.

7.3 Each facia annunciator shall have a minimum size of 35 mm X 50 mm-translucent plastic window for each Trip and alarm point. Translucent plastic plates of facia window shall be engraved in black letters with respective inscriptions. All inscriptions shall be engraved on each window in not more than three lines and size of letters shall not be less than 5 mm.

7.4 Each annunciation window shall be provided with two white lamps in parallel to provide safety against lamp failure. Long life lamps shall be used. Lamp circuit shall

include series resistor of adequate rating. Cover plate of the facia windows shall flush with the panel and shall be capable of easy removal to facilitate replacement of lamps. Transparency of cover plates and wattage of the lamps provided in the facia windows shall be adequate to ensure clear visibility of the inscriptions in the control room having high illumination intensity (500 Lux) from the location of the operating staff desk.

7.5 TRIP and NON TRIP facia shall be differentiated. All trip windows shall have red colour translucent plastic window and all non-trip facia windows shall have white colour translucent plastic window.

Sequence of operation of the annunciator shall be as follows:

Alarm condition	Fault contact	Visual Annunciation	Audible Annunciation
Normal	Open	OFF	OFF
Abnormal	Close	Flashing	ON
Acknowledge push button is pressed/	a Close	Steady on	OFF
	b Open	Steady on	OFF
Reset push button is pressed.	a Close	ON	OFF
	b Open	OFF	OFF
Lamp test push button pressed.	Open	Steady on	OFF

7.6 Any new annunciation appearing after the operation of audible annunciation cancel shall provide a fresh additional annunciation with accompanied visual alarm even if acknowledging or resetting of previous alarm is in process or yet to be carried out.

7.7 Bidders may please note that minimum 6 window annunciator shall be provided for 33Kv Xmer and feeder panel for overcurrent, earthfault, trip coil one faulty, trip coil two faulty and DC fail indication in case of feeder panel whereas in addition to this intertrip indication is also required for 33KV Xmer panel.

7.8 Annunciation system described above shall meet the following additional requirements:

- a) Annunciation system shall be capable of catering to at least 80% simultaneous signals(of windows provided) at a time.
- b) One self resetting push button shall be provided on each panel for testing the facia window lamps. Push buttons for testing flasher and audible alarm circuit of annunciation system and for testing the annunciation supply failure monitoring circuit shall also be provided. These testing circuits shall also be so connected that while test is being done it shall not prevent the registering of any new annunciation that may land up during the test.
- c) One set each of the following push buttons shall be provided on each panel as shown in the front view drawing:
 - i. Reset push button for annunciation system.
 - ii. Accept push button for annunciation system.

- iii. Test push button for testing healthiness of annunciator. Operation of this button should not cause inadvertent operation of any equipment.
- d) Annunciation shall be repetitive type and shall be capable of registering the fleeting signal. Minimum duration of fleeting signal registered by the system shall be 15milli seconds.
- e) Annunciation shall be suitable for operation with normally open potential free contacts which close on a fault. It shall be possible at site to change operation of annunciator from potential free contact from "close to fault" to "open to fault" and vice versa.
- f) In case of static annunciator scheme, special precaution shall be taken by Bidder to ensure that spurious alarm condition does not appear due to influence of external electromagnetic/ electrostatic interference on the annunciator wiring and switching disturbances from the neighboring circuits within the panels.
- g) Offered annunciation scheme shall be complete in all respects including annunciator relay, flasher relay, test, accept and reset push buttons.
- h) Additional four spare windows two each for non trip and trip signals supported by trip relay for future application by the purchaser shall be provided duly wired up and terminated to the row of connectors.

8.0 PROTECTION SCHEME:

8.1 Protection scheme to be supplied for this package shall be required for the following applications:

- TYPE-A** : Control & Relay Panel for one Transformer plus one Feeder circuit.
- TYPE-B** : Control & Relay Panel for three-Feeder circuits.
- TYPE-C** : Control & Relay Panel for one Feeder circuit

Protection schemes meant for above applications are described hereunder:

8.2 PROTECTION SCHEME FOR 33KV ONE TRANSFORMER PLUS ONE FEEDER CIRCUITS (TYPE-A):

8.2.1 33KV two-circuit panels Type-A, shall have independent control and protection for one transformer circuit and one feeder circuit. All controls, relays, instruments and other devices shall be mounted on the front vertical panels. Mimic diagram shall show one main and transfer bus arrangement for feeder as well as for transformer circuit.

8.2.2 PROTECTION SCHEME FOR FEEDER CIRCUITS :

33 KV Feeder circuit shall have dedicated protection and control scheme required for 33 KV sub transmission line. This will be in the form of Numerical, non directional and communicable relay having (3 Over current +1 Earth fault relay) with an operating time of 1.3 secs at 10 times current for IDMT characteristic and from 0.01 sec

to 1 sec in step of 0.01 sec for Definite time characteristic. Over current element and earth fault element shall have IDMT and Definite time characteristic to take care of current of small as well as larger magnitude. Bidder are required to elaborate IDMT and DTOC characteristic. It may be noted that over current and Earth fault relay shall have feature of both IDMT and Definite time characteristic simultaneously. In case both IDMT characteristic and definite time characteristic cannot be provided simultaneously in a single relay than two discrete relay have to be provided by supplier so that IDMT characteristic and definite time characteristic can be applicable for feeder protection.

It may be noted that although the DC supply source is one, 33 kV circuit breakers will have two trip coils which will receive simultaneous trip command. For this purpose, contact multiplication will not be acceptable but the rating of the breaker control switch and each tripping relay contacts shall be adequate to handle the burden of two trip coils. Pistol grip type breaker control switches along with red and green indicating lamp for ON/OFF indication shall be provided.

8.2.3 PROTECTION SCHEME FOR TRANSFORMER CIRCUIT:

8.2.3.1 This protection shall be in the form of numerical , Non Directional and communicable relay and having two nos (3 over current and 1 earth fault element). It should be noted that both relay shall have IDMT and Definite time characteristic to take care of current of small as well as larger magnitude. It may be noted that over current and Earth fault relay shall have feature that both IDMT and Definite time characteristic should be applicable simultaneously in a relay. In case both IDMT characteristic and definite time characteristic cannot be provided simultaneously in a single relay than two discrete relay (total four Relay) have to be provided by supplier so that IDMT characteristic and definite time characteristic can be applicable for transformer protection by both relay. The IDMT relay shall have IDMT characteristic of operating time of 3 seconds at 10 times currents and definite time should be selected 0.01 sec. to 2.0 sec. in step of 0.01 sec.

8.2.3.2 Bidders may please note that we have envisaged under frequency relay with tripping relay in 33kV (1T + 1F) category panels. Technical details for these relays have been given under clause No. 22.0 of this section. Bidders are requested to go through technical details of these relays while submitting offer for 33 kV (1T+1F) category panels. Bidders may quote rates for 33kV (1T+1F) with/without under frequency relays and tripping relays in the Schedule-I "Price Schedule". This is mandatory requirement.

8.2.4 PROTECTION SCHEME FOR 33KV THREE FEEDER CIRCUITS (TYPE-B):

8.2.4.1 33KV three-feeder circuit panels Type-B, shall have independent control and protection for each of the three Feeder Circuits. All controls, relays, instruments and other devices shall be mounted on the front vertical panels. Mimic diagram shall show one main and transfer bus arrangement for each feeder circuit as stated earlier.

8.2.4.2 33 kV three-feeder circuit panels shall have dedicated protection and control scheme described above under clause 8.2.2 for feeder protection and mimic diagram shall have symbol for each feeder circuit.

8.2.5: PROTECTION SCHEME FOR 33KV ONE FEEDER CIRCUIT (TYPE C).

8.2.5.1 33KV Control and relay panel for one Feeder circuit shall have control and protection for one 33KV feeder. All controls, relays, instruments and other gadgets shall be mounted on front of the panel and mimic diagram shall show one main and a transfer bus arrangement for feeder circuit.

8.2.5.2 33 KV Feeder circuit shall have dedicated protection and control scheme required for 33 KV sub transmission line. This will be in the form of Numerical, non directional and communicable relay having (3 Over current +1 Earth fault relay) with an operating time of 1.3 secs at 10 times current for IDMT characteristic and from 0.01 sec to 1 sec in step of 0.01 sec for Definite time characteristic. Over current element and earth fault element shall have IDMT and Definite time characteristic to take care of current of small as well as larger magnitude. Bidder are required to elaborate IDMT and DTOC characteristic. It may be noted that over current and Earth fault relay shall have feature of both IDMT and Definite time characteristic simultaneously. In case both IDMT characteristic and definite time characteristic cannot be provided simultaneously in a single relay than two discrete relay have to be provided by supplier so that IDMT characteristic and definite time characteristic can be applicable for feeder protection.

8.2.5.3 It may be noted that although the DC supply source is one, 33 kV circuit breakers will have two trip coils which will receive simultaneous trip command. For this purpose, contact multiplication will not be acceptable but the rating of the breaker control switch and each tripping relay contacts shall be adequate to handle the burden of two trip coils. Pistol grip type breaker control switches along with red and green indicating lamp for ON/OFF indication shall be provided.

8.3 OTHER IMPORTANT PROTECTIONS:

8.3.1 TRIP CIRCUIT SUPERVISION :

Trip circuit supervision relays are envisaged for both transformer circuits and feeder circuits. It is hereby clarified that 33KV Vacuum circuit breakers shall be provided with two trip coils although source of DC 110V supply is only one. As such we envisage one Trip circuit supervision relay for each coil of the breaker to monitor protection DC exclusively. These relays shall continuously monitor trip circuit for both pre and post close conditions. Trip healthy lamps shall be provided for pre and post close monitoring and while pre close lamp shall be on demand type, the post close lamp shall be of continuous display type. During failure of trip circuit, the trip circuit supervision relay shall initiate an audible alarm.

9.0 DC SUPPLY SUPERISION:

For DC supply supervision discrete relay for both the transformer and feeder protection scheme shall have to be provided..

10. ACCESSORIES:

10.1 ENERGY METERS:

The energy meter for each circuit shall be 3 phase 4 wire, 0.2S accuracy class with availability based tariff. One meter shall be provided for each circuit, as a self-contained device for measurement of power transmittals, in each successive 15 minute block, and certain other functions. The meters provided in C&R panels shall be utilized for measurement of active energy and average frequency in a programmable time clock initially set at 15 minute blocks. Meters shall measure and display reactive energy under voltage low (97%) and voltage

high (103%) condition as per tariff requirement. Meters shall measure cumulative active energy import and export on daily basis and monthly basis. The Base Computer software (BCS) shall be configurable to cater to tariff applications like Time of Day (TOD) metering. In case of change of threshold values of voltages, the supplier shall undertake to set new threshold values of voltage. It shall be possible to select parameters of Meters as per requirement of Purchaser. Meter shall be fully static having non volatile memory and fully programmable. Meter shall have four quadrant registering facility with provision for recording/display various parameters like KWh, KVAh, KVARh, Line current and voltages including power factor. Load survey capability for 35 days shall be available to forecast load growth. Meter shall have 0.2S accuracy class. **The tenderer may please note that the energy meter of 0.2S accuracy class shall have ABT features and shall have suitable for RS232 and RS485 communication protocol for remote and local communication.**

10.2.1 MEASUREMENT ACCURACY: Measurement accuracy of meters shall be as per IEC 62052-11-2003, IEC 62053-22-2003 as under:

**0.2s for Active Energy
0.5s for Reactive Energy or better**

10.2.2 APPLICABLE STANDARDS FOR METERS: The meters shall fully comply with all stipulations in IEC standards 62052-11:2003 and 62053-22:2003. The reference ambient temperature shall be 23°C as per IEC. Errors shall be reasonable for all power factor angles from 0° to 360°. For reactive power (VAR) and reactive energy (VARh) measurement, IEC 62053-23:2003 shall be complied with. The meters shall conform to following Indian standards with latest amendments.

CBIP Technical Report No.88 (with latest amendments issued – June 2000) – specifications for AC Static Electricity Energy Meters.

IS 14697(1999) – AC static transformer operated Watt-hour and VAR-hour meters for class 0.2s and 0.5s.

IS 12063 –Degree for Protection.

IS 3202 – Climatic Proofing of Electrical Equipment.

The meter shall also comply with specifications & requirement as stipulated in “Part V: Transmission Metering Code” as published in Gazette of Madhya Pradesh dated 20-08-04 by Madhya Pradesh Electricity Regulatory Commission (MPERC) as “Grid Code”.

10.2.3 PRINCIPAL PARAMETERS: The energy meters shall indoor type connected with the secondary side of out door current and voltage transformers.

	Item	Details
(xiii)	Type of installation	Indoor Flush
(xiv)	CT secondary	1 A
(xv)	VT secondary	100 V/ $\sqrt{3}$ Volts
(xvi)	System frequency	50 HZ + 5%
(xvii)	Earthing System	Solidly Grounded
(xviii)	Auxiliary DC supply if required	110V/220V+ 20%

Multiplying factor to arrive at actual primary values wherever applicable shall be calculated from the CT and PT ratio of the installed CT and PT using the base computer software (BCS).

10.2.4 a) MULTI-FUNCTION METER:

We envisage a Multi-function meter on the panel to provide digital display of current, voltage, Watts, VARS and Power Factor. This meter shall have scrolling facility to facilitate reading any of these parameters and it will have a size of 144 sq mm/96 sqmm . Bidders may please note that the meter shall be capable of reading voltages upto a maximum value of 150KV. This meter shall have an accuracy class of 0.5. The Multi function meter shall have four and a half digit display, say for example 110.8KV, with minimum display height of 25mm. This meter shall conform to IS 722 and shall be provided with non-reflecting glass fronts. Bidders may please note that the meter shall be suitable for DC Supply voltage of 110Volts or 220Volts as the case may be. AC Supply operated meters are not acceptable to us. Offered meter shall be of reputed make. **Bidders may please note very carefully that multifunction meter shall have communication facility through serial port RS-485 with mod bus protocol complete with down loading software and RS 232 port.**

b) Bidder may please note that in addition to multifunction meter, 1 No. analogue type center zero MVAR meter is also required to be provided in each category of C&R panel covered under the bid.

10.3 SWITCHES:

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

10.3.2 Selection of operating handles for the different type of switches shall be as follows:

- a. Breaker control switches : Pistol grip, black
- b. Selector switches : Oval or knob black.
- c. Instrument switches : Round, Knurled, black

10.3.3 Breaker control switch shall be of spring return to neutral 3 position type. Control springs shall be strong and robust enough to prevent inadvertent operation due to light touch. Spring return type switch shall have spring return from close and trip positions to 'after close' and 'after trip' position respectively.

10.3.4 Lockable switches which can be locked in selected position shall be provided for trip transfer scheme. Key locks shall be fitted on the operation handle.

10.4 INDICATING LAMPS:

10.4.1 All indicating lamps shall be LED type.

10.4.2 Indicating lamps shall be panels-mounting type with rear terminal connections. Lamps shall be provided with series connected resistors preferably built in the lamp assembly. Lamps shall have translucent lamp covers to diffuse different colours e.g.

red, green, amber, clear white or blue to differentiate system function. Lamp cover shall be preferably of screwed type, unbreakable and moulded from heat resistance material. Wattage of indicating lamps shall be as follows:

- a. 220V - 5 to 10W
- b. 110V - 5 to 10W

10.4.3 Wattage of the neon lamp shall be 0.25 to 0.5W if provided.

10.4.4 Bulbs and lenses shall be interchangeable and easily replaceable from the front of the panels. Indicating lamp with resistor shall withstand 120% of rated voltage on continuous basis.

10.5 CIRCUIT BREAKER POSITION INDICATORS:

Position indicators of 'SEMAPHORE' TYPE shall be provided as part of the mimic diagrams on panels for indicating the position of circuit breakers. Indicator shall be suitable for semi-flush mounting with only front disc projecting out and with terminal connection from the rear. Colour of position indicator strips shall be matching with the colour of associated mimic. Position indicators shall be suitable for DC operation. When the supervised object is in the closed position, the pointer of the indicator shall take up a position in line with the mimic busbars and at right angles to them, when the object is in the open position. When supply failure to the indicator occurs, pointer shall take up an intermediate position to indicate the supply failure. Position indicators shall withstand 120% of rated voltage on continuous basis. **No semaphores shall be provided for isolator position . Instead, a circle showing isolator position at 45 degrees shall be made as mentioned earlier.**

10.6 PUSH BUTTONS: Push buttons shall be momentary contact type with rear terminal connections. Where ever required the push buttons shall be suitably surrounded to prevent inadvertent operation. These shall be provided with integral inscription plates engraved with their functions. All push buttons shall have minimum two normally open and two normally closed contacts. Contacts faces shall be silver plated. and shall be suitable for make/break and carry appropriate currents for the functions desired.

11.0 RELAYS:

11.1. All relays to be supplied with 33KV C&R panels covered by this bid shall be hand re-set type.

11.2 All relays shall be contained in dust proof cases. All cases shall be mounted on the control and relay panels and the details of mounting shall be to purchaser's approval. Relays shall be of the projecting pattern or flush pattern as specified.

11.3 Indicators shall also be provided on such additional equipment to identify faulty phase and type of fault. Each indicator whether electrically or mechanically operated shall be resetted by hand without opening the relay case. Each indicator shall be so designed that it should not be moved before the relay has completed its operation. It shall not be possible to test and operate any relay by hand without opening case.

11.4 All elements of relays shall be arranged such that on opening the case dust particles collected in or upon the case should not fall on the relay mechanism.

11.5 All relays shall conform to the requirement of IS-3231 or other applicable approved standards. Relays shall be suitable for flush or semi flush mounting on the front with connections from the rear. Relays shall be rectangular in shape and shall have dust proof, dull black or egg shell black enamel painted cases with transparent cover removable from the front.

11.6 All relays shall be designed to operate at system frequency of 50 Hz. Voltage operated relays shall be designed for star connected 110 Volt VT secondary supply and current operated relays of 1 amp CT secondary as specified in the specification. DC auxiliary relays and timers shall be designed for specified DC voltage and shall operate satisfactorily at 70% to 110% rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.

11.7 Relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. Necessary auxiliary relays and timers should be provided for interlocking scheme, multiplying main contacts, switching contact of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. and also as may be required for complete Protection schemes described in specification. All protective relays shall be provided with minimum two pair of potential free contacts. Auxiliary relays and timers shall have pairs of contacts as may be required to complete the scheme. All contacts shall be silver faced with spring action. Relay case sizes should not pose limitations in using available contacts on the relay due to inadequacy of terminals. Paralleling of contacts shall be done at the external terminals of relay if required.

11.8 Timers shall be of the solid-state type. Short time delay in term of milliseconds may be obtained by using copper lugs on auxiliary relays. In such case it shall be ensured that the continuous rating of the relay is not affected. Time delay in terms of milliseconds obtained using external capacitor resistor combination is not preferred and shall be avoided to the extent possible.

11.9 Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.

12.0 Numerical relays shall have compliance to following requirements -

All numerical, solid state and electronic relays shall have compliance to the following requirements:

- a. Printed circuit panels/cards shall be fin type and its contact shall be gold plated. All connections with the connector pegs shall be through wire wrapping. All solder joints on the printed circuit panels shall be encapsulated or covered with varnish.
- b. Components used in these relays shall be loaded under normal condition by less than half of their rated values. Resistors shall be of carbon composition or metal oxide type and the capacitors shall be plastic film or tantalum type. Stringent measures including shielding of long internal wiring should be taken to make relays immune to voltage spikes as per IEC. Relays must meet the requirements of IEC-255-4 appendix 'E' class III regarding BF, disturbance tests IEC-255-4 regarding impulse test at 5KV and transients present in CT & VT connections due to extraneous sources, do not cause damage to any of associated static circuits.

- c. All relays shall be designed for satisfactory performance under tropical and humid conditions. Special mention shall be made in the technical deviations schedule of the Bid for those relays, if any that Bidder proposes to use which differ from specified requirements.
- d. All devices required for correct operation of each relay shall be provided by contractor without any extra cost.
- e. It will be ensured that the terminals of the contacts of the relays are readily brought out for connections as required in the final approved scheme. Type of relay case size offered shall not create any restriction on availability of the contact terminals for wiring connections.
- f. DC/DC converter or power supply unit shall be provided for the solid state protective relay wherever necessary in order to provide a stable auxiliary supply for relay operation.
- g. Solid state relays shall be stable and suitably protected against transient/induced over voltages and noise signals. Bidders shall state clearly in their Tenders, special requirements if any for DC input arrangement or cabling considered necessary for satisfactory operation of solid state relays quoted by him.
- h. Timers shall be of the solid state type. Short time delay in term of milliseconds may be obtained by using copper lugs on auxiliary relays. In such case it shall be ensured that the continuous rating of the relay is not affected. Time delay in terms of milliseconds obtained using external capacitor resistor combination is not preferred and shall be avoided to the extent possible.

13.0 TESTS:

Manufacturers shall carry out type and routine tests on the relays and complete panels as per relevant Indian Standard or any equivalent International Standards and as specified hereunder.

13.1 ROUTINE AND ACCEPTANCE TESTS:

All modules and sub-assemblies shall be energized and tested for routine and acceptance tests jointly carried out in presence of purchaser's representative as per relevant IEC Specifications or any other international standards individually as well as in assembled form at the factory.

13.2 Relay and control panels shall be subjected to the following tests:

- i. Mechanical operation test.
- ii. Verification of Degree of protection as per IS:214
- iii. High voltage test as per IS or IEC as may be applicable.
- iv. Electrical control, Interlock and sequential operation tests.
- v. Verification of wiring as per approved schematic.
- vi. Other routine tests on all associated equipment and relays as per relevant Indian Standards or IEC.
- vii. Verification of indication and alarm operation.

13.3 After all tests have been carried out, four copies of each test report/inspection report shall be furnished. Each report shall supply the following information

- i. Complete identification data including serial number of all relays and their routine test reports.
- ii. The routine test reports for all the panels.

13.4 Supply of equipment shall be subject to the approval of Test Certificates by purchaser.

14.0 CONTROL CONNECTIONS AND INSTRUMENT WIRING:

14.1 Connections for switchgear operation and indications between the control and relay panels where ever separate termination for instrument and relay wiring on these control & relay panels and multicore cable terminal boxes are involved, these shall form a portion of the scheme for panels and under scope of supply of the control panels gear as stated by the Bidder.

14.2 Panels connection shall be insulated and shall be neatly and securely fixed to the back of the panels. All instrument and panels wiring shall be of approved type, which shall be fire retardant and shall be run in porcelain or non-rustable metal cleats or in non-rustable tubes or galvanized steel tubes as may be approved. All panel wiring shall be taken to terminal panels, which shall comply with requirements of multicore cable boxes where applicable. Panel wiring shall be PVC or VC braided impregnated with flameproof compound. Rubber insulation is not acceptable.

14.3 All wiring diagrams shall be clearly marked with the numbers, which are shown on the ferrules of the individual cores. 20% spare and blank ferrule shall be supplied with each panel.

14.4 Flat washers shall not be used but both end of each instrument or control wire shall be properly crimped and terminated with a Rose Courtney or other approved type of washer.

14.5 Each set of current & voltage transformer secondary connections shall be complete in all respect and shall be connected to form common star point. Star point shall be earthed at one point only. Each such earth connection to the earth bar shall be made in accordance with the requirement of the earth system and shall be made through a disconnecting link which can be removed when insulation tests are required without breaking any circuit normally carrying current.

14.6 For each circuit on the panels, the control indication and trip wiring shall be suitably segregated so that these could be isolated to permit testing or other work. Semaphore and other indication circuits shall be connected to the DC bus by a set of fuses. Similarly, the trip and close circuits shall also be connected by a separate set of fuses. Fuses shall be labeled clearly showing the circuits connected.

14.7 All secondary fuses shall be of an approved type. HRC fuses of standard make shall only be used. Where ever specified test blocks shall be provided for testing of meters and relays. These shall be of the switch board type with connection at the back, mounted on front of panels. Test blocks shall provide complete isolation of meters, instruments and relays and the arrangements shall be such that power supply for testing could be connected at the test block from the external source or may be taken from the instrument transformer. Provision shall be made for short circuiting current transformer secondary and disconnection of potential transformer, by sliding and disconnecting type connectors.

15.0 PRETREATMENT AND PAINTING PROCESS:

Sheet steel fabricated members shall be subjected to pretreatment process before painting. Process can be broadly divided as 'Metal treatment and painting'.

15.1 METAL TREATMENT:

- i. **Degreasing:** This can be achieved either by immersing in hot alkaline degreasing bath or in hot di-chloroethelene solution. After degreasing operation the surface shall be cleaned thoroughly with cold water.
- ii. **Pickling:** This is to remove rust and metal scales by immersing metal sheets in dilute sulphuric acid (approximately 20%) at nearly 60 deg. centigrade so as to totally remove scale and rust.
- iii. Rinse in cold water in two tanks to remove traces of acids.
- iv. Treat with phosphoric acid base neutralizer for removal of chlorine from the above acid pickling and again wash with running water.
- v. **Phosphating :** Immerse in grenadine zinc phosphate solution for about 20 minutes at 80 to 90 degree centigrade . Uniform phosphate coating of 4 to 5 gm per sq. meter shall be achieved.
- vi. Swill in cold water.
- vii. Rinse in Deorylyte bath at 70 to 80 degree centigrade to neutralize any traces of salts.
- viii. Seal the above phosphate coating with hot/dilute chromate solution.
- ix. Dry with compressed air

15.2 PAINTING:

Sequence of Processes shall be as follows:-

- i. **Primer spray:** Apply one coat of primer spray on wet surface by specially developed 'High luster' zinc chromate primer and to stove at 150-160 deg. Centigrade for 25 to 30 minutes. Alternatively red-oxide primer with zinc chromate contents may be used. However former process shall be preferred.
- ii. **Rubbing and putting :** Apply putty to fill up the scars if any to present smooth surface and stove 15 to 20 minutes. Apply putty several times to get the perfect smooth finish.
- iii. **Surfacing:** Sand down with mechanical abrasive and stove for 20 minutes.
- iv. **Primer:** Spray second coat of primer as per (i) above or grey primer surface on wet and stove for 20 to 40 minutes at 150 deg. centigrade.
- v. **Finish:** Rubbing down dry and spray first coat of synthetic enamel finish paint on wet and stove for 30 minutes.
- vi. **Surfacing:** Sand down or rub dry to prepare for final finish spray. Coats of synthetic enamel finish paint on wet and stove it at 150 deg. centigrade for 30 minutes.

NOTE:

- i Necessary stiffeners may be welded between large cut ducts to provide rigidity before painting process.
- ii Painting process shall be done within 24 hrs. of completion of treatment.

- iii Small coating paint shall be supplied along with equipment for touching up at site.

16.0 DRAWINGS & LITERATURE (PANEL METERS & RELAYS):

16.1.1 General arrangement and schematics showings with all major details shall be submitted with the tender.

16.1.2 Immediately after award of the contract, manufacturer shall submit GA and schematics drawing of each panel for the approval of the purchaser.

16.1.3 Successful Bidders shall have to supply one set of drawings and a set of manuals per panels properly packed in plastic jacket; each containing approved GA, Schematic and wiring drawings illustrative pamphlets of meters, literature and commissioning instructions for all relays under his scope of supply. Besides this, one set of drawings (GA+Schematic) and a set of manual per panels shall be forwarded to the O/o CE(PLG).THIS IS MANDATORY.

17.0 GUARANTEED TECHNICAL PARTICULARS AND TECHNICAL QUESTIONNAIRE:

17.1 Guaranteed technical particulars for all relays, instruments, meters and all other accessories shall be furnished along with the tender. While submitting technical particulars, please ensure to stipulate very clearly the class of accuracy, (wherever necessary), current and voltage rating physical dimensions, weight, make, model No. type etc. in order to give a clear picture of device offered, along with literature/write-up. Unless otherwise specified, all the 33KV panels shall be suitable for the auxiliary DC voltage of 110 V.

17.2 At the end of this specification, we have attached technical questionnaire. Bidders are requested to reply various questions detailed out in the questionnaire although similar information is available elsewhere in the tender. Please note that in case Bidders do not furnish clear replies to our technical questionnaire, their offers may run the risk of rejection.

18.0 OTHER IMPORTANT REQUIREMENT:

18.1 QUALITY ASSURANCE PROGRAMME:

18.1.1 Bidders must establish that they are following a proper quality assurance program for manufacture of control and relay panels. In order to ensure this, suitable QAP should form a part of the technical tender, which will be submitted against this Bid document. Quality Assurance Program must have a structure as detailed in the following paragraphs.

18.1.2 Quality assurance and failure prevention starts with careful study and scrutiny of our technical specifications and requirements. Suppliers shall carefully study all the technical parameters and other particulars & the supplier shall categorically give his confirmation that these requirements shall be met in a satisfactory manner.

18.1.3 Supplier shall furnish the checks exercised in design calculations particularly in selection of main protection scheme. Salient features of design & selection criteria of protection scheme will have to be made available to the Purchaser.

18.1.4 Supplier shall indicate the various sources of the bought out items. Type of checks, quantum of checks and acceptance norms shall be intimated and random test

and check results should be made available for inspection whenever so desired. Vendor list for various bought out items shall be submitted with the Bid and the same shall be subject to purchaser's approval. However, no change in vendor list shall be acceptable after placement of order and list of vendors shall be frozen at the time of placement of order. It will however be obligatory on the part of Bidders to allow third party inspection of all important material and in case during independent third party inspection any of the above material is found different than from approved list of vendors, Purchaser reserves the right to summarily reject complete lot and the manufacturer has to replace the entire material from the vendors approved by the Purchaser.

18.1.5 Based on above QAP and offered delivery schedule a tentative program chart indicating period for various manufacturing/ testing activities shall be submitted along with QAP. Program chart should specify periods for various activities i.e. design, ordering of new materials, assembly, testing etc.

18.2 INSPECTION:

18.2.1 Acceptance of any quantity of panels shall in no way relieve the successful Bidders 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.

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

18.2.3 At the time of inspection, the Bidders shall identify each and every gadget and relays on the ordered panels. Unless all the items are identified, the manufacture will not be treated as complete. Serial number of Relays & other gadgets shall be entered into the test report. Various tests stipulated in IS shall be performed in the presence of purchaser's engineers or when the inspection waiver has been given, in such a case, the testing shall be done at the manufacturer's works as per IS stipulations and same should be confirmed by documentary evidence by way of Test Certificate which shall be got approved by the purchaser.

18.2.4 Whenever inspection call is given, letter of inspection call will accompany the following:

- a. Number of panels type 1T + 1F, 1F and 3F which are ready at the works and shall be offered for inspection. The Inspecting Officer shall get the number of panels checked before commencing the inspection.
- b. The Inspecting Officer shall randomly select panels type 1T + 1F, 1F and 3F (approx. 10% quantity of the offered panels) for conducting the routine tests after all the gadgets and relays provided on the panel have been verified.
- c. In case for any reasons inspection is not completed or equipment is not found complete with all accessories, the Purchaser will reserve the right to recover the complete cost of deputation of inspecting team to the works of the manufacturer.

18.3 COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS:

Responsibility for obtaining timely supplies of bought out items will rest on the and only on this basis, delivery period will be offered in the Tender. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and in case defective supply of any item is reported will rest on the Bidder. In case for attending to defect in any accessory or inspection/ replacement of the accessory, which may be bought out item for the Bidders; services of engineer of

original manufacturer is required, the same will be organized on immediate basis by the Bidders at their cost.

18.4 Bidders may ensure that pages have been properly numbered and signed. All bid documents including schedules should be indexed properly and Index of the documents should be enclosed/placed at the beginning of the Bid document.

19.0 SCHEDULE OF REQUIREMENT:

33KV Control and relay panels shall have following instruments, relays and accessories to be provided per circuit on each feeder and transformer panels as per the type of protection indicated above under **clause-8.1** by the purchaser:

(Quantity and Number Shown Below Are Required For Each Transformer Circuit & Feeder Circuit in Single and Multi Circuit Control Panels)

S. No.	Particulars	Feeder Circuit	Transformer Circuit
1	Type of panel	Simplex	Simplex
2	Box type circuit label inscription (50x100mm) indicating Name of feeder/Xmer in side & out side of panel	Two	Two
3	Purchaser's order no. Serial no.& Bidders label to be placed inside of panel.	One	One
4	Over laid Mimic diagram with uniform 3mm thickness 10mm width for horizontal strip and 6mm width for the droppers.	One Main and Transfer Bus	One Main and Transfer Bus
5	Red and Green lamps (LED Type) with holder for circuit breaker ON/OFF position indication for each transformer/feeder circuits.	One Set	One Set
6	Pistol grip Circuit breaker control switch with three positions; ON, OFF & return to neutral.	One	One
7	Semaphore to indicate circuit breaker position automatically	One	One
8 a	One multifunction meter to indicate line and phase currents, line and phase voltages, active power (MW), reactive power (MVAR) & Power factor. This meter shall have scrolling facility to facilitate reading any of these parameters. This meter shall have four and a half digit display and shall be of size 144 sq/ 96 sq mm. and it shall have a scale of 0 to 50KV for voltage reading (secondary rating 110V Phase to phase and 1 Amp). The meter shall have an accuracy class of 0.5, shall be suitable for LED display of letters and the size of digit shall be 25 mm.	One	One
8 b	Analogue of type center zero MVAR meter	One	One
9	Test terminal block for 3phase 4wire static energy meter. (Make of the TTB shall be to purchaser's approval).	One	One
10	Static trivector Energy meter - 3 phase 4 wire type having an accuracy class of 0.2S	One	One

S. No.	Particulars	Feeder Circuit	Transformer Circuit
11	Push buttons for DC supply fail test/accept/reset facilities.	Three	Three
12 (A)	Trip circuit supervision relays for pre and post close supervision (*)	Two	Two(One For Each Trip Coil)
12 (B)	DC supply supervision relay	One	One
12 (C)	Facia window annunciator complete with flasher and function relays	6 ways	6 ways
13	Trip circuit supervision healthy indication lamp with push button to select pre & post close supervision. The pre close supervision shall be "on demand" and post close supervision shall be continuous.	Two	Two
14	Numerical, non-directional and communicable IDMT and Definite time relay having three overcurrent and one earthfault elements having time of operation at 1.3 Sec. at 10 times current settings for IDMT Characteristic and from 0.01 secs to 2 secs for definite time characteristic for protection of 33 kV feeder circuits. The Over current and earthfault element shall have IDMT characteristics as well as Definite Time characteristic (as described in Clause no. 8.2.2 of the specification.)	One	-
15	Numerical, non-directional and communicable IDMT relay and Definite time having three overcurrent and one earthfault elements and also having time of operation at 3.0 Sec. at 10 times current settings for IDMT Characteristic and 0.01 secs to 2secs for Definite time characteristic (as described in Clause no. 8.2.3 of the specification)	--	Two
16	Fast acting master trip/high speed trip relay with contacts suitable for handling burden of 2 nos. circuit breaker trip coils in parallel.	One	One
17	Under Frequency Relay	--	One
18	Tripping relays for u/f relay with 10 Nos NO contacts	--	One
19	Space heaters with switch in each panel.	One	One
20	15/5A, 250Volts universal power socket with plug with protective metallic cover & switch.	One	One
21	20Watt Tube light or CFL with door switch.	One	One
22	DC hooter for trip signals	One	One
23	AC Bell for DC supply supervision	One	One
24	Gland plate fitted with Cable glands.	One Set	One Set
25	Fixing bolts	One Set	One Set
26	Any other accessories/gadget/relay needed for correct and successful operation/protection for the control and relay panel offered by the Bidders.	One Set	One Set

For the purpose of confirmation to supply all items mentioned above the Bidders shall bring out all details in a tabular form in the manner indicated above in schedule VIII.

()Bidders may please note that although the breaker shall have two trip coils, the source of DC supply shall be only one. Accordingly, two trip circuit supervision relays are envisaged for the transformer circuits and feeder circuit.**

IMPORTANT NOTE:

- 1. Bidders shall indicate Unit prices for all the gadgets and relays for the 33KV Class panels for feeder and transformer circuits offered by them. This has to be strictly complied. Prices of the gadgets and relays shall form a part of the Schedule-I about details of equipment and quantity for 33KV C&R panels.**
- 2. Bidders may elaborate the setting possibilities available in the over current as well as earthfault elements of IDMT numerical relays offered by them.**

20.0 SCHEDULE OF REQUIREMENT OF RELAYS:

It is obligatory on the part of Bidders to furnish Schedule of Requirement of Accessories provided with equipment in the Schedule VIII of Section II of the bid document. In case Schedule VIII duly filled in complete in all respects is not furnished, the bid may be treated as non-responsive.

21.0 DOUBLE STAGE UNDER FREQUENCY RELAY WITH CONTACT MULTIPLIERS TRIPPING RELAY:

21.1 These relays are required to monitor the System frequency on continuous basis. Sudden tripping / outage of generator sets or sudden increase in load in integrated grid system operation, always results in lowering down of system frequency, which may lead to emergency conditions. Under such system distress conditions it becomes necessary to resort to immediate load relief to control system frequency for maintaining load and generation balance. Under frequency relays should be able to sense lowering of system frequency and shall have provision to initiate trip command to trip circuit breakers of identified feeders for load shedding. Our requirement in this regard is described below:-

21.2 It is desired that the load shedding is to be resorted to, in two stages through under frequency relays. i.e. on a particular set frequency the circuit breakers of one group of feeders may be tripped, and in addition at another frequency setting, the circuit breakers of another group of feeders are made to trip. Initiation of tripping commands for both groups will be based on operation of under frequency relays on account of decrease in system frequency. Feeder trippings sometimes are also required to be delayed and therefore in each stage of under frequency relay separate timer is required for our load shedding scheme. Since in every EHV substation there may be more than one feeder which is to be tripped simultaneously, thus the offered under frequency relays shall have independent tripping relays having minimum 10 pairs of normally open contacts in addition to a timer. The N/O contacts of trip relay shall be hand reset type.

21.3 Both the stages of under frequency relay shall have provision for independent frequency setting, independent timers for time delay settings and independent tripping relays for tripping of minimum eight breakers of group of feeders. The contact rating of tripping relays shall be such that these are capable of handling normal wattage of 200 Watts of the trip coils.

21.4. We have to ensure to provide specified load relief to the system under varying under frequency conditions. This calls for a relay of high accuracy and also calls for sure setting arrangement to detect lowering of frequency. In case of relays having potentiometer setting arrangement, accurate setting of the order 0.05Hz is not possible and may lead to doubtful performance. Therefore preference will be given for under frequency relays with digital matrix setting. Please specify the method adopted in the

offered relays. As stated earlier, bidders may please note that the under frequency relays covered by this bid shall be hand reset type.

21.5. Each timer of the double stage under frequency relay should have a provision for minimum setting of time delay continuously varying from 0.05 to 5 seconds in step of 0.05 seconds. Each independent tripping relay should have minimum 10 pairs of normally open hand reset type contacts with flag indicating arrangement. Each pair of contact of a tripping relay shall be adequately rated to break inductive DC current of trip coils having approximate 200 Watt burden as stated earlier.

21.6 In addition to the requirements indicated above the under frequency relay should meet following specifications :

i.	Input to the relay	110V AC ph to ph from Bus PT.
ii.	Auxiliary DC voltage	110V OR 220 V.
iii.	Range of setting of each stage of double stage Under frequency relay	47 to 53Hz in steps of not more than 0.05Hz.
iv.	Accuracy	Within (+)/(-) 5% of setting
v.	AC burden	Should be low so that existing PTs are not overloaded. In any case combined burden should be less than 10VA for double stage.
vi.	No. of Contacts for tripping relays	10 pairs of N/O contacts are required. These contacts should be liberally rated to handle trip coil DC inductive burden of approx. 200 Watt. Contacts shall preferably be H/R type.
vii.	No. of Contacts for under frequency relay	2 pairs of NO contact for each stage
viii.	Indicator	Operation indicator is required for each stage of U/F relay.
ix.	Range of Timer	Continuously varying from 0.05 to 5 secs. in steps of 0.05 sec for both the states separately.
x.	Case	The relays shall be panel mounting type of flush pattern.

SECTION-II (E)

2.1.2 TECHNICAL SPECIFICATION FOR INDOOR 33KV CONTROL AND RELAY PANELS FOR CAPACITOR BANK

1.0 SCOPE:

The scope of this specification covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the ‘MPPTCL’.

In case bidder is not OEM, sole responsibility of offering equipments/material of manufacturer as per this specification requirement shall rest on the bidder.

1.1 The “Simplex” design 33 kV control and relay panels included in the instant bid are required for the Protection of Shunt Capacitor Bank.

2.0 LIMITS OF CONTRACT:

2.1 It is not the intent to specify completely all the details of design and construction of the control and relay panels. However, the panels shall conform in all respects to the high standard of engineering design and workmanship. Various control and relay panels and other requirements specified under this section shall be complete in themselves in all respect with all main and auxiliary relays, fuses, links & switches duly wired, labels terminal panels, earthing terminals, indicating lamps, mimic diagram, alarm scheme, name plate, foundation bolts, interior illumination, cable termination arrangement with cable glands fitted on base mounting plate etc. including all other accessories which are essentially required for satisfactory operation . Such components shall be deemed to be included in the scope of supply of the Bidders irrespective of whether these are specifically brought out in this specification or not.

2.2 Supply and laying of control and power cables for interconnecting various equipments is not covered under the specification. Cable terminating arrangements, viz. the cable hold support boxes, multicore cable glands, sealing ends for other types of cables that may be specified, shall however be included in the offered price. These shall be subject to approval of purchaser. It is the responsibility of Bidders to ensure that the equipment specified and complimentary equipment required for completeness of the protection/control scheme be properly accommodated in the panels without congestion and if necessary provide panels with larger dimensions in width only.

3.0 CLIMATIC CONDITIONS:

3.1 Applicable climatic conditions shall be as per Section-I Volume-II.

5.0 PANEL FINISH AND COLOUR 33KV SIMPLEX DESIGN PANEL:

33KV C&R panels covered by this Tender shall strictly conform to MPPTCL’s standard drawing no. SK116.

4.1 All unfinished surfaces of steel panels and frame work shall be thoroughly cleaned by sand blasting, pickling and rinsing or by combination of processes or by other latest and improved techniques to remove dust, scales, foreign adhering

matter and grease. Cleaning process shall be followed immediately by the application of rust inhibiting wash process. All surfaces shall then be given suitable rust resisting primary coat and then one or more coats of opaline green quick drying enamel to serve as a base and binder for finishing coat. Purchaser has standardized that colour scheme for 33kV panels shall be opaline green as per colour shade No.275 of IS: 5 or equivalent BS-381 or matching colour and shade of other authoritative equivalent international standards are also acceptable. Colour finish shall be applied as per above colour scheme on the exterior steel works of the panels. Exterior shall not be fully glossy. Interior of panels shall be painted with "Egg Shell White". Pretreatment & painting process is described in Clause 14.0. All steel works shall be phosphated in accordance with IS: 6005. Panels shall be provided a degree of protection not less than IP- 54 as per IS-2147.

4.2 COMPLIANCE OF PANELS, RELAYS, INSTRUMENTS AND OTHER GADGETS WITH STANDARD SPECIFICATIONS:

4.2.1 Applicable Standards for the offered equipments/items shall be as per Section-I Volume-II.

4.2.2 ACCEPTANCE OF OTHER AUTHORITATIVE STANDARDS:

In the paragraph 4.2.1 above, relevant Indian /British /IEC standard specifications have been mentioned. However, the equipment meeting any other authoritative international standard, which ensures equal or better quality than the standards, mentioned shall also be acceptable. Equipment for which Indian Standards are not available, the relevant British standards and IEC recommendations will be applicable. Please attach photocopy of all such standards according to which the equipment has been offered.

4.2.3 TYPE TESTS:

All offered Numerical/Static/Electromechanical relays and meters on C&R Panels indicated below shall be fully type tested as per relevant standards. In case the equipment of the type and design offered, has already been type tested, the shall invariably furnish type test reports from the reputed and approved national/international laboratory/Government approved test houses to prove that indicated accuracy and other specifications of the relays offered conform to the relevant standards. Test certificates shall clearly indicate the type and model number etc., so that relevant details of offered relays could be verified. While submitting offers the model and type etc., shall be clearly indicated. Type test reports so furnished should not pertain to the period earlier than five years from the date of opening of Tender.

It may be very specifically` noted that non-submission of type test reports about conventional relays and also about static meters along with the Bid shall be treated as a disqualification.

(A) Details of Relays & Meters to be used with C&R Panels for Capacitor Bank:-

i.	Numerical IDMT relay having two over current and one earth fault element (Non directional). Time of operation 1.3. Seconds at 10 times current setting
ii.	Over Voltage & Under Voltage Protection Relays
iii.	Unbalance Protection relay
iv	Ammeter and Voltmeter having accuracy class 0.5
v	MVAR meter having accuracy class 0.5

4.2.4 DISCREPANCIES IN TECHNICAL PARTICULARS:

Regarding discrepancy in technical particulars stipulation under Section-I Volume-II shall be applicable.

4.3.0 PANEL CUT OUT AND DIMENSIONS:

4.3.1 33kV Control & relay panels shall be of "SIMPLEX" design. Each panel shall be constructed of stretch-level selected steel sheets. Panels shall be made in suitable sections so that while mounting, panels can be located side by side, bolted together to form a compact unit.

4.3.2 33 kV SIMPLEX type panels shall consist of a vertical front panel with all equipment mounted thereon including protective relay, indicating/recording instruments and energy meters etc. and having wiring access from the rear. Double leaf door with lift off hinges shall be provided at the back. Doors shall have handles with built in locking facility.

4.3.3 Control panels shall be sheet steel enclosed and shall be dust, moisture and vermin proof. Panels shall be fabricated of 2.5 mm thick steel sheet on all sides free from all surface defects. Panels shall have sufficient structural reinforcement to ensure a plain surface and rigidity to limit vibration during dispatch, installation and service.

4.3.4 Constructional details and sizes for both type 33 kV C&R panels shall be as under:-

(MPPTCL's standard drawing may please be referred)

S.No.	Particulars	33KV Panels
1	Type	Simplex
2	Height(mm)	2250(Panel Height 2190mm + Base frame of 60mm)
3	Depth(mm)	560 (without corridor)
4	Width (mm) (Subject to variation as per scheme requirement)	660
5	Base frame	Anti-corrosive Black painted
6	Panel exterior	Opaline Green
7	Panel Interior	Egg Shell white
8	Mimic strips over laid type	Azure blue
9	Number of feeder(F)OR Transformer(T) circuits per panel	Control panels are required in the following three formations: i. One transformer plus one feeder circuit. ii. Three feeder circuits. iii. One feeder circuit.
10	Variation in dimension of panels.	Bidders may note that the height and depth of control panels will have to be maintained as mentioned against Sl. No. 2 & 3 above. As far as width of the control panels is concerned the same may be offered based on optimum design to accommodate specified number of circuits as also the various relays and accessories, which are to be mounted on the panels.

DIMENSIONAL DETAILS FOR 33 KV C&R PANELS

S No.	Category of panels	Height (mm)	Width (mm)	Depth (mm)
1.	Capacitor Bank Panel	2250 (2190mm + 60 mm base pad)	660	560

4.3.5 Preferred panel cut out dimensions for mounting of the relays shall be as per Indian Standard Specification IS-4483 (PART I & II) and MPPTCL's standard shown in drawing. Please note that since purchaser has standardised dimensions of the panels for their system, therefore no deviation in height/depth will be permitted. Bidders must submit general arrangement drawing for each type of panel offered by them.

4.3.6 Control & Relay panels shall be floor mounting dead front sheet steel assemblies of unitised design. Panels shall be made in suitable sections as described else where in the specification so that while mounting, panels can be located side by side bolted together to form a compact and composite unit. Design, material selection, workmanship and width of panels shall be such as to present a neat appearance, outside and inside with no works of welds, rivets, screw or bolts head apparently visible from the exterior surface of the control panels.

4.4.0 PANEL LIGHTING:

4.4.1 In each SIMPLEX panel, one 20W, 230 Volt tube light guarded with protected cage shall be provided below the central roof for adequate illumination & the same shall be controlled by door switch.

4.4.2 One number universal 15A/5A pin receptacle socket with cover and switch shall be provided in each control panels. Third pin of the socket shall be effectively grounded through the metallic structure. Socket shall be of industrial grade control panels type complete with protective metallic cover.

4.5.0 AUXILIARY SUPPLY:

4.5.1 The auxiliary AC / DC supply shall be as per clause No. 6 Section-I Volume –II Part I of the specification

4.5.2 Bidders may please note that there shall be only one source of DC supply (110 or 220 Volts) and this DC supply shall be common for protection, and indications on each of the 33KV C&R panels

4.5.3 Bidders shall arrange for providing extension of these power supplies to different circuit of the control panels group.

4.5.5 Isolating devices with H.R.C. fuses shall be provided in each panel for both A.C. and D.C. power supplies. Distribution and wiring of the same shall be unitised through fuses and links in such a way so that isolation of respective system unit is possible without affecting the rest of the system or unit.

4.5.5 All H.R.C. fuses and links shall be with holder and the same shall be mounted on slant support with identification labels.

4.5.6 H.R.C. fuses shall be provided as per following details:

S.NO.	CIRCUIT	FUSE RATING.
1.	Circuit breaker-closing circuit.	16A
2.	Trip circuit -I	16A
3.	Trip circuit –II	16A
4.	Main Protection	10A
5.	Indication	6A
6.	Annunciation	6A
7.	P.T. Circuit main	6A
8.	P.T. supply for Metering circuit	2A
9.	AC supply fuses and links	10A

NOTE: Additional HRC fuses for individual circuits shall also be provided as per the requirement for completing the offered protection scheme.

4.6.0 CONTROL WIRING:

4.6.1 Successful Bidders shall furnish and install complete wiring up to the terminal block for the equipment, instrument devices mounted in the control panels strictly in accordance with the approved wiring diagram prepared by the Bidders based on the purchaser's information and schematic diagram.

4.6.2 Wiring shall be complete in all respects so as to ensure proper functioning of control, protection and metering schemes.

4.6.3 All spare relay contacts and spare contacts of switches shall be wired up to the terminal blocks.

4.6.4 Wiring shall be done with flexible heat resistant wires, PVC insulated with stranded copper conductor. Minimum number of strand in the wire shall be three. Conductor size shall be equivalent to 2.5 sq mm for Current, potential & DC Control circuit and 1.5 sq mm for other indications and annunciation circuits.

4.6.5 Coloured cores shall be used for wiring as per latest revision of IS-375 viz; red, yellow, blue and black for R Y B phases and neutral respectively. Colour code for earthing shall be Green and for annunciation circuits gray colour code shall be used. For DC circuits the colour code will be Red-positive & Black-negative.

4.6.6 Each wire shall be identified at its both ends with wire designation number by plastic ferrule as per wiring diagram based on latest revision of IS-375 to denote the different circuit functions. Bidders shall take approval for the system of wire numbering and colour coding schemes.

4.6.7 All wire terminations shall be made with compression type connectors. Wires shall not be tapped or spliced between terminal points. All wire shall have crimp type termination and direct Tee connection at any place is not at all required.

4.6.8 All series connected devices and equipment shall be wired up in sequence. Loop-in Loop out system of wiring shall be avoided as far as possible and the common buses shall normally be made through the terminal block for better reliability of testing and maintenance.

4.6.9 Fuses and links shall be provided for isolation of individual circuit from bus bars without disturbing other circuits and equipment.

4.6.10 DC trip and DC voltage supplies and wiring to main protective gear shall be segregated from those for special purposes. Each such group shall be fed through separate fuses, either direct from main supply fuses or the bus bars.

4.6.11 Since a number of wires will run from one point to another, it is desired that the support arrangement should be adequate and neat. Conventional method of bunching of wires should not be adopted since the same creates problems in case any wire is to be removed. Wires should be accommodated in suitable plastic channels with sliding plastic cover, which may be suitably mounted inside the panels neatly. Inspection/removal of wires laid in the plastic channels should be possible by sliding the covers.

4.6.12 Blank plastic channels should be provided by the sides of the panels to accommodate incoming cables from switchyard through cable glands with suitable holding arrangement rigidly fixed so that while handling other nearby cables no jerks are transferred to the terminals inside the cubicle.

4.6.13 Wherever practicable wiring shall be accommodated in the sidewall of the cubicles. Sharp bends shall be avoided.

4.7.0 TERMINAL BLOCKS:

4.7.1 Multi-way terminal blocks complete with necessary binding screws and washers for wire connection and marking strip for circuit identification shall be furnished for terminating the panels wiring and outgoing cables. Terminals shall be suitable for receiving at least 2x7/0.737mm stranded copper conductor or equivalent Aluminium conductor wires per terminal. It may please be noted that the current rating shall be double the current rating of 2x7/0.737 non stranded copper wire and terminal shall be suitable to receive 2x2.5sq. mm or 2x4sq. mm copper conductor of control cable.

4.7.2 Terminal blocks shall have shorting and disconnection facilities, so that the panels side and outgoing wires could be disconnected just by opening the disconnecting links which slides up or down without dislodging the wires from their position.

4.7.3 Highly reliable Test terminal blocks with facilities of shorting and easy removal of connection shall be provided for CT & PT circuits. Instrument transformer wires shall be terminated through suitably mounted test terminal blocks to facilitate site testing of all main and backup protection relays.

4.7.4 Test terminal blocks shall be grouped according to the circuit functions and each terminal block group shall have at least 20% spare terminals for accommodating additional input wires.

4.7.5 Not more than two wires shall be connected to any terminal or either side of the terminal block. If necessary, a number of terminals shall be connected by jumpers to provide additional wiring points.

4.7.6 Each terminal point shall be marked with designation obtained from the purchaser's schematic drawings.

4.7.7 Adjacent rows of terminal blocks shall be spaced not less than 100mm apart. These shall be mounted vertically at the sides of the cubicle and set obliquely towards

the rear doors to give easy access to terminating end to enable ferrule number to be read without difficulty.

4.7.8 Bottom of terminal blocks shall be spaced at least 200mm above the cable gland of incoming multicore cables.

4.8.0 CABLE ENTRY:

4.8.1 Control panels shall have provision of multiple cable entries from the bottom. Necessary cable glands should also be provided in the panels on a 4 mm thick mild steel gland plate to be bolted firmly with nut and bolts on base plate. Base plate shall be bolted further on the base frame with adequate number of nuts & bolts. Purchaser will arrange for necessary floor opening below the panels to suit the cable trench design of purchaser's requirement.

4.8.2 Adequate support for cables entering the panels is an utmost necessity. Cable entry and subsequent distribution of individual cables should present a tidy look and for achieving this, bunching shall be avoided. Plastic channels need necessarily be used.

4.8.3. Wiring through the terminal blocks shall be located in a manner that it becomes convenient to provide termination of control cable for floor openings.

4.8.4 Control panels shall have provisions for fixing the multicore cable glands, which shall be included by the BIDDER in scope of supply. For fixing these cable glands, detachable gland plates of 4mm thickness shall be mounted on the base frame by nuts and bolts.

4.8.5 Gland plate shall be supplied duly drilled and fitted with cable glands. Gland plate and doors shall be provided with gasket properly. Necessary glands as per clause-4.8.6 below shall be fitted on the gland plate.

4.8.6 Rigid supports shall be provided along with terminal block for holding plastic channel. Suitable clamps may also be provided in plastic channel for holding cables.

4.8.7 Following quantities of cable glands per circuit with suitable blanking arrangement shall be fitted on the gland plate that shall be fastened suitably at the bottom of the control panels in each simplex panel as per the following details:

i.	For 8 core x 2.5sqmm 1.1KV grade control cable	:	2 nos.
ii.	For 4 core x 2.5sqmm 1.1KV grade control cable	:	4 nos.
iii.	For 12 core x 2.5sqmm 1.1KV grade control cable	:	1 no.
iv.	For 19 core x 2.5sqmm 1.1KV grade Control cable	:	1 no.

4.9.0 GROUNDING:

4.9.1 Copper strip having size not less than 12.5mm x 6mm or alternatively 25 mm x 3 mm grounding bus shall be provided for each control panel extending along entire length of the panel for the purpose of effectively grounding all metal structures.

4.9.2 Each continuous length of ground bus shall have provision of two terminals at two extreme points for connection to main ground grid of the substation.

4.9.3 Common star /neutral points of Potential and current transformers shall be connected with the grounding bus through a disconnecting type connector so that

purchaser may adopt single point grounding of common star point either at the terminal block in the control panels or in the marshalling box of the instrument transformer.

4.9.4 Whenever any circuit is shown grounded on the drawing a single wire for that circuit shall be run independently up to the ground bus and connected to it.

5.0 CONTROL AND RELAY PANELS:

5.1 Simplex panels shall be provided with lockable doors on rear side. All indicating instruments, controls, protective relays & mimic diagram etc. for feeder & Capacitor bank shall be provided on the front side of the control panels.

5.2 Labeling for each circuit shall be provided at each of the front control panels, as well as inside of the SIMPLEX panels.

5.3 Panels shall be of uniform thickness (minimum 2.5mm) and made of level sheet steel. Bottom of the cubicle shall be made in a manner to open it for the purpose of wiring and cable entry. Panels shall be designed to be of self-supporting type and wherever additional structural strength is required, inconspicuous bracing, gusset-welding etc., shall be used. All control panels and switchgear cubicles shall be made absolutely vermin proof design of the approval of the purchaser.

5.4 Panels shall be made in suitable sections to facilitate easy transport and handling and shall be later assembled at site. It may please be noted carefully that single continuous sheet steel should not be used for a substation to make a single composite panels for all the panels required. Panels should have unitised construction with facility to bolt together the panels where more than one panels is involved.

5.5 Purchaser may ask for accommodation and wiring to be provided on Panels for additional apparatus supplied under different contracts. Bidders shall agree to make such provision in accordance with the instructions of the purchaser.

6.0 CONTROL & INDICATION CIRCUITS:

6.1 Control and indication circuit for Capacitor Bank shall generally comprise of the following:

- a. Mimic diagram
- b. Ammeter & Voltmeter (144 Sq.mm size)
- c. MVAR meter (144 Sq.mm size)
- d. Circuit Breaker Control switch.
- e. "Trip Healthy" lamps.
- f. Alarm cancellation arrangement.
- g. Facia annunciating windows Breaker ON/OFF indication lamps. Test terminal block and Relay Test Block.
- j. Any other devices which may be necessary for completing scheme based on improvement in design and adoption of new technology by the Bidder

6.2 MIMIC DIAGRAM:

6.2.1 Coloured mimic diagram and symbols shall represent the exact representation of system. The mimic diagram for 33 kV shall be made to represent "ONE MAIN & TRANSFER BUS" Scheme. Mimic diagram shall be placed at the eye level to indicate the position of each breaker. Horizontal strip and the droppers shall have width of 10mm and 6 mm respectively and the strip shall be 3mm thick. Power transformer, voltage

transformer shall be fixed on mimic by suitable symbols having dark Black colour. Position indicator of isolating devices shall have matching colour in accordance with the voltage class of the mimic. Arrangement shall be of over laid design using anodized aluminum section. **Painted mimic diagram shall not be acceptable.**

6.2.2 Offered mimic diagram shall have colour scheme for representing 33 kV voltage level as “Azure blue shade 104 of IS 5”

6.3 SEMAPHORE INDICATOR FOR BREAKERS:

6.3.1 Rotating disc semaphore indicator to be provided for this purpose on mimic diagram shall indicate the position of 33 kV circuit breaker whether closed or open. Position indicator strip of all semaphore indicators for breaker shall have the colour scheme matching with specified colour scheme of mimic for various voltage levels.

6.3.2 ON and OFF display position of circuit breakers shall be automatically indicated by semaphore operation indicator strip on mimic of 33 kV panels using auxiliary switching contacts of outdoor equipments.

6.3.3 **For 33 kV isolators, semaphore indicators need not be provided. Instead of this, a circle indicating a 45 degree position may be indicated for the isolators.**

7.0 ALARM AND ANNUNCIATION SCHEMES:

7.1 (A) ANNUNCIATION SCHEME FOR CAPACITOR BANK

- (i)** Alarm annunciation system shall be provided for each panel by means of visual and audible alarm in order to draw the attention of the operating staff to the abnormal operating conditions or the operation of some protective device. The annunciation equipment shall be suitable for operation under the tolerance limit of voltages specified in this specification.
- (ii)** The annunciation shall be of visual and audible type. Facia annunciator, flush mounted on the front of the control panel, shall provide the visual annunciation. The DC hooter or DC bell shall provide the audible alarm.
- (iii)** Each facia annunciator shall have a minimum size of 35 mm x 50 mm translucent plastic window for each Trip and alarm point. The translucent plastic plates of facia window shall be engraved in black letters with respective inscriptions. All inscriptions shall be engraved on each window in not more than three lines and size of letters shall not be less than 5 mm.
- (iv)** Each annunciation window shall be provided with two white lamps in parallel to provide safety against lamp failure. Long life lamps shall be used. The lamp circuit shall include series resistor of adequate rating. The cover plate of the facia windows shall flush with the panel and shall be capable of easy removal to facilitate replacement of lamps. The transparency of cover plates and wattage of the lamps provided in the facia windows shall be adequate to ensure clear visibility of the inscriptions in the control room having high illumination intensity (500 Lux) from the location of the operating staff desk.
- (v)** TRIP and NON TRIP facia shall be differentiated. All trip windows shall have red colour translucent plastic window and all non-trip facia windows shall have white colour translucent plastic window.

- (vi) The annunciation system described above shall meet the following additional requirements:
- a) Annunciation system shall be capable of catering to atleast 80% simultaneous signals (of windows provided) at a time.
 - b) One self-resetting push button shall be provided on each panel for testing the facia window lamps. Push buttons for testing flasher and audible alarm circuit of annunciation system and for testing the annunciation supply failure monitoring circuit shall also be provided. These testing circuits shall also be so connected that while test is being done it shall not prevent the registering of any new annunciation that may land up during the test.
 - c) One set each of the following push buttons shall be provided on each panel as shown in the front view drawing:
 - i Reset push button for annunciation system.
 - ii Accept push button for annunciation system.
 - iii Test push button for testing healthiness of annunciator. The operation of this button should not cause inadvertent operation of any equipment.
 - d) Annunciation shall be repetitive type and shall be capable of registering the fleeting signal. Minimum duration of fleeting signal registered by the system shall be 15 milli-seconds.
 - e) Annunciation shall be suitable for operation with normally open potential free contacts, which close on a fault. It shall be possible at site to change operation of annunciator from potential free contact from "close to fault" to "open to fault" and vice versa.
 - f) In case of static annunciator scheme, special precaution shall be taken by Bidder to ensure that spurious alarm condition does not appear due to influence of external electromagnetic/ electrostatic interference on the annunciator wiring and switching disturbances from the neighboring circuits within the panels.
 - g) Offered annunciation scheme shall be complete in all respects including annunciator relay, flasher relay, test, accept and reset push buttons.

7.1 (B) ALARM SCHEME FOR CAPACITOR BANK:

Automatic tripping of the circuit breaker due to operation of protective relays shall be indicated by a common audible alarm. The offered alarm scheme shall be complete in all respects including one DC bell for non-trip alarm and one DC hooter for trip alarm with relays and other accessories if any. With each panel one alarm scheme will be required.

8.0 PROTECTION SCHEME:

8.1 Protection scheme to be supplied for Capacitor Bank Control & Relay Panel against this bid are described hereunder: -

8.2 PROTECTION SCHEME FOR SHUNT CAPACITOR BANKS:

8.2.1 Two Nos. 36 KV, 12 MVAR capacitor bank will be installed at 33KV bus of EHV substations. Capacitor banks in double star formation will be controlled by a connection of One No. 33KV Vacuum Circuit Breaker. For protection of capacitor bank following will be applicable;

8.2.2 Over Current & Earth Fault Protection:

The capacitor bank shall be protected by over current relay and protection of triple pole IDMT relay with two poles for over current protection and one pole for earth fault protection. This will be in the form of a Numerical, non-directional and non-communicable relay having (2O/C + 1E/F elements) an operating time of 1.3 secs at 10 times current setting. Definite time for the over current element shall be continuously variable and the earth fault element shall have IDMT characteristics as well as high set feature to take care of currents of smaller as well as larger magnitudes. Bidders shall elaborate the IDMT characteristics as well as the setting ranges available for high set feature in the earthfault element.

It may be noted that although the DC supply source is one, 33 kV circuit breakers will have two trip coils which will receive simultaneous trip command. For this purpose, contact multiplication will not be acceptable but the rating of the breaker control switch and each tripping relay contacts shall be adequate to handle the burden of two trip coils. Pistol grip type breaker control switches along with red and green indicating lamp for ON/OFF indication shall be provided. All controls, relays, instruments and other gadgets shall be mounted on front of the panel and mimic diagram shall show one main and a transfer bus arrangement for feeder circuit. The range of over current relay shall be 50 to 200% in steps of 25%. In case of earth fault relay the range shall be 10 to 40% or 20 to 80% in steps of 5%.

8.2.3 Over Voltage & Under Voltage Protection:

The over voltage relay shall be provided with adjustable voltage setting in steps of 5% in the range of 110 to 140%. The relays shall be provided with suitable timer to give fixed time delay to avoid tripping of capacitor bank due to inrush during switching or in transit. The under voltage relay shall be provided with adjustable voltage setting in steps of 10% in the range of 30 to 60%. The over voltage and under voltage protection shall include time delay relay and auxiliary relay. The over voltage relay shall be energized from 33 KV PT connected to main bus bars on the source side of circuit breaker controlling the capacitor banks.

8.2.4 Unbalance Protection (NDR):

The unbalance protection relays shall be current operated. In this scheme capacitor bank is connected in double star formation with neutral interconnection through Neutral Current Transformer (NCT) for each bank. The unbalance protection relay shall be of instantaneous type having range of 20 to 80% in steps of 10%. The relays used shall detect two current levels one for alarm and one for trip and be able to provide an alarm in the event of failure of one or two units, before tripping. Number of capacitor units on failure of which alarm shall sound and tripping is initiated shall be clearly mentioned in the Tender. **Bidder may please note that each panel shall be supplied with two nos. unbalance protection relay (NDR) so that the same panel could be utilized for two set of 12 MVAR capacitor bank as and when required.**

8.3 OTHER IMPORTANT PROTECTION:

8.3.1 Trip circuit supervision: (on panels for Capacitor Bank only)

Separate trip circuit supervision relay shall be provided for each of the two trip coils in all panels, for continuous monitoring of trip circuit i.e. for both pre and post close conditions. The trip healthy lamp for each trip coil shall be provided separately for pre and post close monitoring. During unhealthy condition of trip circuit the relay shall initiate an audible alarm and visual indication on fascia window. All circuit breakers are provided with two trip coils and hence separate trip circuit pre and post supervision for each trip coil is to be provided by Bidder. Each trip circuit supervision relay shall be provided with operation indicator. Also for each trip coil circuit, separate DC circuit with fuses will be used.

9.0 ACCESSORIES FOR CAPACITOR BANK PANELS:

9.1 All indicating instruments shall conform to IS-722 and shall have a size of 144 sq.mm. These shall be suitable for semi flush mounting with only flanges projecting on vertical panels. These shall be capable of carrying 150% rated full load current continuously without undue heating. All indicating instruments shall be provided with non-reflecting glass fronts. Selection shall be available to display dual ratio by toggle switch based on dual ratio current transformer. In case of digital type instrument, the display shall have 8 digits with minimum 25 mm display height. In case of analog meter they shall have long, clearly divided indelibly marked scales of engraved or enameled metal and the pointers shall be of clean outline. The pointers and scales shall be of purchaser's approval.

9.2 The instruments shall not be damaged by the passage of fault current through the primary of corresponding instrument transformer and approved means shall be provided for zero adjustment without dismantling the instrument. Voltmeters shall be calibrated while hot. All potential circuits to instruments shall be protected by a fuse on each pole of the circuit placed as close as possible to the instruments transformer terminals or where instruments are directly connected as close as possible to the main connection. All instruments and apparatus shall be back connected and all instrument cases shall be earthed. Where specified, selection switch shall be provided to connect the main ammeter to measure the current flowing in each of the three phases. All indicating instruments shall be of accuracy class 0.5.

9.3 Ammeters and current coils of watt meters and VAR meters shall continuously withstand 150% of rated current. Potential coils of wattmeters VAR meters and Voltmeters shall withstand 110% of rated voltage continuously and twice the rated voltage for 0.5 Second without loss of accuracy.

9.4 ENERGY METERS:

The energy meter for each circuit shall be 3 phase 4 wire, 0.2S accuracy class with availability based tariff. One meter shall be provided for each circuit, as a self-contained device for measurement of power transmittals, in each successive 15 minute block, and certain other functions. The meters provided in C&R panels shall be utilized for measurement of active energy and average frequency in a programmable time clock initially set at 15 minute blocks. Meters shall measure and display reactive energy under voltage low (97%) and voltage high (103%) condition as per tariff requirement. Meters shall measure cumulative active energy import and export on daily basis and monthly basis. The Base Computer software (BCS) shall be configurable to cater to tariff applications like Time of Day (TOD) metering. In case of change of threshold values of voltages, the supplier shall undertake to set new threshold values of voltage. It shall be possible to select parameters of Meters as per requirement of Purchaser. Meter shall be fully static having non volatile memory and fully

programmable. Meter shall have four quadrant registering facility with provision for recording/display various parameters like KWh, KVAh, KVARh, Line current and voltages including power factor. Load survey capability for 35 days shall be available to forecast load growth. Meter shall have 0.2S accuracy class. **The tenderer may please note that the energy meter of 0.2S accuracy class shall have ABT features and shall have suitable for RS232 and RS485 communication protocol for remote and local communication.**

9.4.1 MEASUREMENT ACCURACY: Measurement accuracy of meters shall be as per IEC 62052-11-2003, IEC 62053-22-2003 as under:

0.2s for Active Energy
0.5s for Reactive Energy or better

9.4.2 APPLICABLE STANDARDS FOR METERS: The meters shall fully comply with all stipulations in IEC standards 62052-11:2003 and 62053-22:2003. The reference ambient temperature shall be 23°C as per IEC. Errors shall be reasonable for all power factor angles from 0° to 360°. For reactive power (VAR) and reactive energy (VARh) measurement, IEC 62053-23:2003 shall be complied with. The meters shall conform to following Indian standards with latest amendments.

CBIP Technical Report No.88 (with latest amendments issued – June 2000) – specifications for AC Static Electricity Energy Meters.

IS 14697(1999) – AC static transformer operated Watt-hour and VAR-hour meters for class 0.2s and 0.5s.

IS 12063 –Degree for Protection.

IS 3202 – Climatic Proofing of Electrical Equipment.

The meter shall also comply with specifications & requirement as stipulated in “Part V: Transmission Metering Code” as published in Gazette of Madhya Pradesh dated 20-08-04 by Madhya Pradesh Electricity Regulatory Commission (MPERC) as “Grid Code”.

9.4.3 PRINCIPAL PARAMETERS: The energy meters shall indoor type connected with the secondary side of out door current and voltage transformers.

	Item	Details
(xix)	Type of installation	Indoor Flush
(xx)	CT secondary	1 A
(xxi)	VT secondary	110 V/ $\sqrt{3}$ Volts
(xxii)	System frequency	50 HZ \pm 5%
(xxiii)	Earthing System	Solidly Grounded
(xxiv)	Auxiliary DC supply if required	110V/220V+ 20%

Multiplying factor to arrive at actual primary values wherever applicable shall be calculated from the CT and PT ratio of the installed CT and PT using the base computer software (BCS).

10.0 SWITCHES:

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

10.2 Selection of operating handles for the different type of switches shall be as follows:

- a. Breaker control switches : Pistol grip, black
- b. Selector switches : Oval or knob black.
- c. Instrument switches : Round, Knurled, black
- d. Protection transfer switch : Pistol grip lockable and black.

10.3 Breaker control switch shall be of spring return to neutral 3 position type. Control springs shall be strong and robust enough to prevent inadvertent operation due to light touch. Spring return type switch shall have spring return from close and trip positions to 'after close' and 'after trip' position respectively.

10.4 Lockable switches which can be locked in selected position shall be provided for trip transfer scheme. Key locks shall be fitted on the operation handle.

10.5 In 33 KV panels, knob switch for manual selection of semaphore position indicator strip position shall be provided for displaying matching position of isolating devices in the switchyard. These selection switches shall have three way selections and shall be mounted near to respective semaphore device.

11.0 INDICATING LAMPS:

11.1 All indicating lamps shall be LED type.

11.2 Indicating lamps shall be panels-mounting type with rear terminal connections. Lamps shall be provided with series connected resistors preferably built in the lamp assembly. Lamps shall have translucent lamp covers to diffuse different colours e.g. red, green, amber, clear white or blue to differentiate system function. Lamp cover shall be preferably of screwed type, unbreakable and moulded from heat resistance material. Wattage of indicating lamps shall be as follows:

- a. 220V - 5 to 10W
- b. 110V - 5 to 10W

11.3 Wattage of the neon lamp shall be 0.25 to 0.5W if provided.

11.4 Bulbs and lenses shall be interchangeable and easily replaceable from the front of the panels. Indicating lamp with resistor shall withstand 120% of rated voltage on continuous basis.

12.0 CIRCUIT BREAKER POSITION INDICATORS:

Position indicators of 'SEMAPHORE' TYPE shall be provided as part of the mimic diagrams on panels for indicating the position of circuit breakers. Indicator shall be suitable for semi-flush mounting with only front disc projecting out and with terminal connection from the rear. Colour of position indicator strips shall be matching with the colour of associated mimic. Position indicators shall be suitable for DC operation. When the supervised object is in the closed position, the pointer of the indicator shall take up a

position in line with the mimic busbars and at right angles to them, when the object is in the open position. When supply failure to the indicator occurs, pointer shall take up an intermediate position to indicate the supply failure. Position indicators shall withstand 120% of rated voltage on continuous basis. **No semaphores shall be provided for isolator position . Instead, a circle showing isolator position at 45 degrees shall be made as mentioned earlier.**

13.0 PUSH BUTTONS:

Push buttons shall be momentary contact type with rear terminal connections. Where ever required the push buttons shall be suitably surrounded to prevent inadvertent operation. These shall be provided with integral inscription plates engraved with their functions. All push buttons shall have minimum two normally open and two normally closed contacts. Contacts faces shall be silver plated. and shall be suitable for make/break and carry appropriate currents for the functions desired.

14.0 RELAYS:

14.1. All relays to be supplied with 33KV C&R panels covered by this Bid shall be hand re-set type.

14.2 All relays shall be contained in dust proof cases. All cases shall be mounted on the control and relay panels and the details of mounting shall be to purchaser's approval. Relays shall be of the projecting pattern or flush pattern as specified.

14.3 Indicators shall also be provided on such additional equipment to identify faulty phase and type of fault. Each indicator whether electrically or mechanically operated shall be resetted by hand without opening the relay case. Each indicator shall be so designed that it should not be moved before the relay has completed its operation. It shall not be possible to test and operate any relay by hand without opening case.

14.4 All elements of relays shall be arranged such that on opening the case dust particles collected in or upon the case should not fall on the relay mechanism.

14.5 All relays shall conform to the requirement of IS-3231 or other applicable approved standards. Relays shall be suitable for flush or semi flush mounting on the front with connections from the rear. Relays shall be rectangular in shape and shall have dust proof, dull black or egg shell black enamel painted cases with transparent cover removable from the front.

14.6 All induction relays shall be designed to operate at system frequency of 50 Hz. Voltage operated relays shall be designed for star connected 110/220 Volt VT secondary supply and current operated relays of 1 amp CT secondary as specified in the specification. DC auxiliary relays and timers shall be designed for specified DC voltage and shall operate satisfactorily at 70% to 110% rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.

14.7 Relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. Necessary auxiliary relays and timers should be provided for interlocking scheme, multiplying main contacts, switching contact of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. and also as may be required for complete Protection schemes described in specification. All protective relays shall be provided with minimum two pair of potential free contacts. Auxiliary relays and timers shall have pairs of contacts as may be required to complete the scheme. All contacts shall be silver faced with spring action.

Relay case sizes should not pose limitations in using available contacts on the relay due to inadequacy of terminals. Paralleling of contacts shall be done at the external terminals of relay if required.

14.8 Timers shall be of the solid-state type. Short time delay in term of milliseconds may be obtained by using copper lugs on auxiliary relays. In such case it shall be ensured that the continuous rating of the relay is not affected. Time delay in terms of milliseconds obtained using external capacitor resistor combination is not preferred and shall be avoided to the extent possible.

14.9 Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.

15.0 Numerical relays shall have compliance to following requirements:

All numerical, solid state and electronic relays shall have compliance to the following requirements:

- a. Printed circuit panels/cards shall be fin type and its contact shall be gold plated. All connections with the connector pegs shall be through wire wrapping. All solder joints on the printed circuit panels shall be encapsulated or covered with varnish.
- b. Components used in these relays shall be loaded under normal condition by less than half of their rated values. Resistors shall be of carbon composition or metal oxide type and the capacitors shall be plastic film or tantalum type. Stringent measures including shielding of long internal wiring should be taken to make relays immune to voltage spikes as per IEC. Relays must meet the requirements of IEC-255-4 appendix 'E' class III regarding BF, disturbance tests IEC-255-4 regarding impulse test at 5KV and transients present in CT & VT connections due to extraneous sources, do not cause damage to any of associated static circuits.
- c. All relays shall be designed for satisfactory performance under tropical and humid conditions. Special mention shall be made in the technical deviations schedule of the Bid for those relays, if any that Bidder proposes to use which differ from specified requirements.
- d. All devices required for correct operation of each relay shall be provided by contractor without any extra cost.
- e. It will be ensured that the terminals of the contacts of the relays are readily brought out for connections as required in the final approved scheme. Type of relay case size offered shall not create any restriction on availability of the contact terminals for wiring connections.
- f. DC/DC converter or power supply unit shall be provided for the solid state protective relay wherever necessary in order to provide a stable auxiliary supply for relay operation.
- g. Solid state relays shall be stable and suitably protected against transient/induced over voltages and noise signals. Bidders shall state clearly in their Tenders, special requirements if any for DC input arrangement or cabling considered necessary for satisfactory operation of solid state relays quoted by him.
- h. Timers shall be of the solid state type. Short time delay in term of milliseconds may be obtained by using copper lugs on auxiliary relays. In such case it shall be

ensured that the continuous rating of the relay is not affected. Time delay in terms of milliseconds obtained using external capacitor resistor combination is not preferred and shall be avoided to the extent possible.

16.0 TESTS:

Manufacturers shall carry out type and routine tests on the relays and complete panels as per relevant Indian Standard or any equivalent International Standards and as specified hereunder.

16.1 ROUTINE AND ACCEPTANCE TESTS:

All modules and sub-assemblies shall be energized and tested for routine and acceptance tests jointly carried out in presence of purchaser's representative as per relevant IEC Specifications or any other international standards individually as well as in assembled form at the factory.

16.2 Relay and control panels shall be subjected to the following tests:

- I. Mechanical operation test.
- II. Verification of Degree of protection as per IS:214
- III. High voltage test as per IS or IEC as may be applicable.
- IV. Electrical control, Interlock and sequential operation tests.
- V. Verification of wiring as per approved schematic.
- VI. Other routine tests on all associated equipment and relays as per relevant Indian Standards or IEC.

16.3 After all tests have been carried out, four copies of each test report/inspection report shall be furnished. Each report shall supply the following information

- i. Complete identification data including serial number of all relays and their routine test reports.
- ii. The routine test reports for all the panels.

16.4 Supply of equipment shall be subject to the approval of Test Certificates by purchaser.

17.0 CONTROL CONNECTIONS AND INSTRUMENT WIRING:

17.1 Connections for switchgear operation and indications between the control and relay panels where ever separate termination for instrument and relay wiring on these control & relay panels and multicore cable terminal boxes are involved, these shall form a portion of the scheme for panels and under scope of supply of the control panels gear as stated by the BIDDER.

17.2 Panels connection shall be insulated and shall be neatly and securely fixed to the back of the panels. All instrument and panels wiring shall be of approved type, which shall be fire retardant and shall be run in porcelain or non-rustable metal cleats or in non-rustable tubes or galvanized steel tubes as may be approved. All panel wiring shall be taken to terminal panels, which shall comply with requirements of multicore cable boxes where applicable. Panel wiring shall be PVC or VC braided impregnated with flameproof compound. Rubber insulation is not acceptable.

17.3 All wiring diagrams shall be clearly marked with the numbers, which are shown on the ferrules of the individual cores. 20% spare and blank ferrule shall be supplied with each panel.

17.4 Flat washers shall not be used but both end of each instrument or control wire shall be properly crimped and terminated with a Rose Courtney or other approved type of washer.

17.5 Each set of current & voltage transformer secondary connections shall be complete in all respect and shall be connected to form common star point. Star point shall be earthed at one point only. Each such earth connection to the earth bar shall be made in accordance with the requirement of the earth system and shall be made through a disconnecting link which can be removed when insulation tests are required without breaking any circuit normally carrying current.

17.6 For each circuit on the panels, the control indication and trip wiring shall be suitably segregated so that these could be isolated to permit testing or other work. Semaphore and other indication circuits shall be connected to the DC bus by a set of fuses. Similarly, the trip and close circuits shall also be connected by a separate set of fuses. Fuses shall be labeled clearly showing the circuits connected.

17.7 All secondary fuses shall be of an approved type. HRC fuses of standard make shall only be used. Where ever specified test blocks shall be provided for testing of meters and relays. These shall be of the switch board type with connection at the back, mounted on front of panels. Test blocks shall provide complete isolation of meters, instruments and relays and the arrangements shall be such that power supply for testing could be connected at the test block from the external source or may be taken from the instrument transformer. Provision shall be made for short circuiting current transformer secondary and disconnection of potential transformer, by sliding and disconnecting type connectors.

18.0 PRETREATMENT AND PAINTING PROCESS:

Sheet steel fabricated members shall be subjected to pretreatment process before painting. Process can be broadly divided as 'Metal treatment and painting'.

18.1 METAL TREATMENT:

- i. **Degreasing:** This can be achieved either by immersing in hot alkaline degreasing bath or in hot di-chloroethelene solution. After degreasing operation the surface shall be cleaned thoroughly with cold water.
- ii. **Pickling:** This is to remove rust and metal scales by immersing metal sheets in dilute sulphuric acid (approximately 20%) at nearly 60 deg. centigrade so as to totally remove scale and rust.
- iii. Rinse in cold water in two tanks to remove traces of acids.
- iv. Treat with phosphoric acid base neutralizer for removal of chlorine from the above acid pickling and again wash with running water.

- v. **Phosphating:** Immerse in grenadine zinc phosphate solution for about 20 minutes at 80 to 90 degree centigrade. Uniform phosphate coating of 4 to 5 gm per sq. meter shall be achieved.
- vi. Swill in cold water.
- vii. Rinse in Deorylyte bath at 70 to 80 degree centigrade to neutralize any traces of salts.
- viii. Seal the above phosphate coating with hot/dilute chromate solution.
- ix. Dry with compressed air

18.2 PAINTING:

Sequence of Processes shall be as follows :-

- i. **Primer spray:** Apply one coat of primer spray on wet surface by specially developed 'High luster' zinc chromate primer and to stove at 150-160 deg. Centigrade for 25 to 30 minutes. Alternatively red-oxide primer with zinc chromate contents may be used. However former process shall be preferred.
- ii. **Rubbing and putting :** Apply putty to fill up the scars if any to present smooth surface and stove 15 to 20 minutes. Apply putty several times to get the perfect smooth finish.
- iii. **Surfacing:** Sand down with mechanical abrasive and stove for 20 minutes.
- iv. **Primer:** Spray second coat of primer as per (i) above or grey primer surface on wet and stove for 20 to 40 minutes at 150 deg. centigrade.
- v. **Finish:** Rubbing down dry and spray first coat of synthetic enamel finish paint on wet and stove for 30 minutes.
- vi. **Surfacing:** Sand down or rub dry to prepare for final finish spray. Coats of synthetic enamel finish paint on wet and stove it at 150 deg. centigrade for 30 minutes.

NOTE:

- i Necessary stiffeners may be welded between large cut ducts to provide rigidity before painting process.
- ii Painting process shall be done within 24 hrs. of completion of treatment.
- iii Small coating paint shall be supplied along with equipment for touching up at site.

19.0 DRAWINGS & LITERATURE (PANEL METERS & RELAYS):

19.1 General arrangement and schematics showings with all major details shall be submitted with the Tender.

19.2 Immediately after award of the contract, manufacturer shall submit GA and schematics drawing of each panel for the approval of the purchaser.

19.3 Successful BIDDER shall have to supply one set of drawings and a set of manuals per panels properly packed in plastic jacket; each containing approved GA, Schematic and wiring drawings illustrative pamphlets of meters, literature and commissioning instructions for all relays under his scope of supply. Besides this, one set of drawings (GA+Schematic) and a set of manual per panels shall be forwarded to the O/o CE(PLG).THIS IS MANDATORY.

20.0 GUARANTEED TECHNICAL PARTICULARS AND TECHNICAL QUESTIONNAIRE:

20.1 Guaranteed technical particulars for all relays, instruments, meters and all other accessories shall be furnished along with the Tender. While submitting technical particulars, please ensure to stipulate very clearly the class of accuracy, (wherever necessary), current and voltage rating physical dimensions, weight, make, model No. type etc. in order to give a clear picture of device offered, along with literature/write-up. Unless otherwise specified, all the 33KV panels shall be suitable for the auxiliary DC voltage of 110 V.

20.2 At the end of this specification, we have attached technical questionnaire. Bidders are requested to reply various questions detailed out in the questionnaire although similar information is available elsewhere in the Tender. Please note that in case Bidders do not furnish clear replies to our technical questionnaire, their offers may run the risk of rejection.

21.0 OTHER IMPORTANT REQUIREMENT:

21.1 QUALITY ASSURANCE PROGRAMME:

21.1.1 Bidders must establish that they are following a proper quality assurance program for manufacture of control and relay panels. In order to ensure this, suitable QAP should form a part of the technical Tender, which will be submitted against this Bid document. Quality Assurance Program must have a structure as detailed in the following paragraphs.

21.1.2 Quality assurance and failure prevention starts with careful study and scrutiny of our technical specifications and requirements. Suppliers shall carefully study all the technical parameters and other particulars & the supplier shall categorically give his confirmation that these requirements shall be met in a satisfactory manner.

21.1.3 Supplier shall furnish the checks exercised in design calculations particularly in selection of main protection scheme. Salient features of design & selection criteria of protection scheme will have to be made available to the Purchaser.

21.1.4 Supplier shall indicate the various sources of the bought out items. Type of checks, quantum of checks and acceptance norms shall be intimated and random test and check results should be made available for inspection whenever so desired. Vendor list for various bought out items shall be submitted with the Bid and the same shall be subject to purchaser's approval. However, no change in vendor list shall be acceptable

after placement of order and list of vendors shall be freezed at the time of placement of order It will however be obligatory on the part of Bidders to allow third party inspection of all important material and in case during independent third party inspection any of the above material is found different than from approved list of vendors, Purchaser reserves the right to summarily reject complete lot and the manufacturer has to replace the entire material from the vendors approved by the Purchaser.

21.1.5 Based on above QAP and offered delivery schedule a tentative program chart indicating period for various manufacturing/ testing activities shall be submitted alongwith QAP. Program chart should specify periods for various activities i.e. design, ordering of new materials, assembly, testing etc.

21.2 INSPECTION:

21.2.1 Acceptance of any quantity of panels shall in no way relieve the successful Bidders of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipments are later found to be defective.

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

21.2.3 At the time of inspection, the Bidders shall identify each and every gadget and relays on the ordered panels. Unless all the items are identified, the manufacture will not be treated as complete. Serial number of Relays & other gadgets shall be entered into the test report. Various tests stipulated in IS shall be performed in the presence of purchaser's engineers or when the inspection waiver has been given, in such a case, the testing shall be done at the manufacturer's works as per IS stipulations and same should be confirmed by documentary evidence by way of Test Certificate which shall be got approved by the purchaser.

21.2.4 Whenever inspection call is given, letter of inspection call will accompany the following:

- a. Number of panels i.e. one feeder or capacitor bank panel which are ready at the works and shall be offered for inspection. The Inspecting Officer shall get the number of panels checked before commencing the inspection.
- b. The Inspecting Officer shall randomly select panels of one feeder & capacitor bank (approx. 10% quantity of the offered panels) for conducting the routine tests after all the gadgets and relays provided on the panel have been verified.
- c. In case for any reasons inspection is not completed or equipment is not found complete with all accessories, the Purchaser will reserve the right to recover the complete cost of deputation of inspecting team to the works of the manufacturer.

21.3 COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS:

Responsibility for obtaining timely supplies of bought out items will rest on the and only on this basis, delivery period will be offered in the Tender. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and in case defective supply of any item is reported will rest on the BIDDER. In case for attending to defect in any accessory or inspection/ replacement

of the accessory, which may be bought out item for the Bidders; services of engineer of original manufacturer is required, the same will be organized on immediate basis by the Bidders at their cost.

21.4 Bidders may ensure that pages have been properly numbered and signed. All Bid documents including schedules should be indexed properly and Index of the documents should be enclosed/placed at the beginning of the Bid document.

22.0 SCHEDULE OF REQUIREMENT:

33KV Control and relay panels shall have following instruments, relays and accessories to be provided per circuit on each feeder and transformer panels as per the type of protection indicated above under **clause-8.1** by the purchaser:

A - Quantity and Number Shown Below are Required For Capacitor Bank Control & Relay Panels :-

S. NO.	PARTICULARS	QUANTITY
I – CONTROL & RELAY PANEL		
1.	Type of panel	Simplex
2.	Box type circuit label inscription (50x100mm) indicating Name of CIRCUIT	One
3.	Purchaser's order no. Serial no.& Bidder's label	One
4.	Over laid Mimic diagram with uniform 3mm thickness and 10mm width.	One
5.	Red and Green lamps with holder for circuit breaker ON/OFF position indication.	One Set
6.	Pistol grip Circuit breaker control switch three position ON, Off & return to neutral.	One
7.	Semaphore to indicate circuit breaker position automatically	One
8.	Ampere meter with selector switch for reading individual phase current (144 sq.mm size)	One
9.	Voltmeter (0-40KV) with selector switch for reading individual line voltage (144 sq.mm size)	One
10.a	3 phase 3 wire MVAR meter (0-50 MVAR) (144 sq.mm size)	One
10.b	3 phase 4 wire ABT Energy meter 0.2s accuracy class	One
11.	Facia window annunciator complete with flasher and function relays	6 Ways
12.	Test plug/port for testing of Main protection Relay complete with connecting leads	One
13.	Test terminal block for MVAR meter	One
14.	Push button for facia annunciator testing of all lamps /accept/ reset arrangement.	Three
15.	Push button for main DC supply fail test/accept	Two
16.	Indicating lamp for DC fail.	One
17.	Trip circuit supervision healthy indication lamp with push button to select pre-close & post-close supervision.	Two
18.	Additional accessories & other devices required completing the offered schemes.	One Set
19.	Neutral current unbalance relay (NDR) alongwith timer and auxiliary relay for Alarm & Trip	Two
20.	Pre & post close Trip circuit supervision relay.	Two

S. NO.	PARTICULARS	QUANTITY
21.	Numerical, non-directional and non-communicable IDMT relay having two overcurrent and one earthfault elements having time of operation at 1.3 Sec. at 10 times current settings for protection of 33 kV feeder circuits. The earthfault element shall have IDMT characteristics as well as high set feature (as described in Clause no. 8.2.2 of the specification.	One
22.	High speed tripping relay	One
23.	Under voltage protection scheme including time delay relay and auxiliary relay	One Set
24.	Over voltage protection scheme including time delay relay and auxiliary relay	One Set
25.	Additional aux. relays required to complete offered protection schemes with details.	As Required
II – EQUIPMENT MOUNTED INSIDE		
1.	Space heaters with switch in each panel.	One
2.	15/5A, 230Volts power socket with protective metallic cover & Switch.	One
3.	20Watt Tube light with door switch.	One
4.	DC bell for NON TRIP alarm complete with accept, reset and test facilities	One
5.	DC hooter for trip alarm complete with accept reset and test facility	One
6.	Glands plate fitted with Cable glands.	One Set
7.	Foundation bolts	One Set
8.	Additional relays or accessories offered by Bidder, which are essentially required for completing protection scheme.	As per Requirement

For the purpose of confirmation to supply all items mentioned above the Bidders shall bring out all details in a tabular form in the manner indicated above in schedule VIII.

() Bidders may please note that although the breaker shall have two trip coils, the source of DC supply shall be only one. Accordingly, two trip circuit supervision relays are envisaged for the transformer circuits only.**

IMPORTANT NOTE:

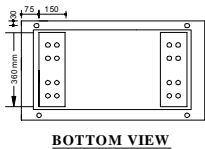
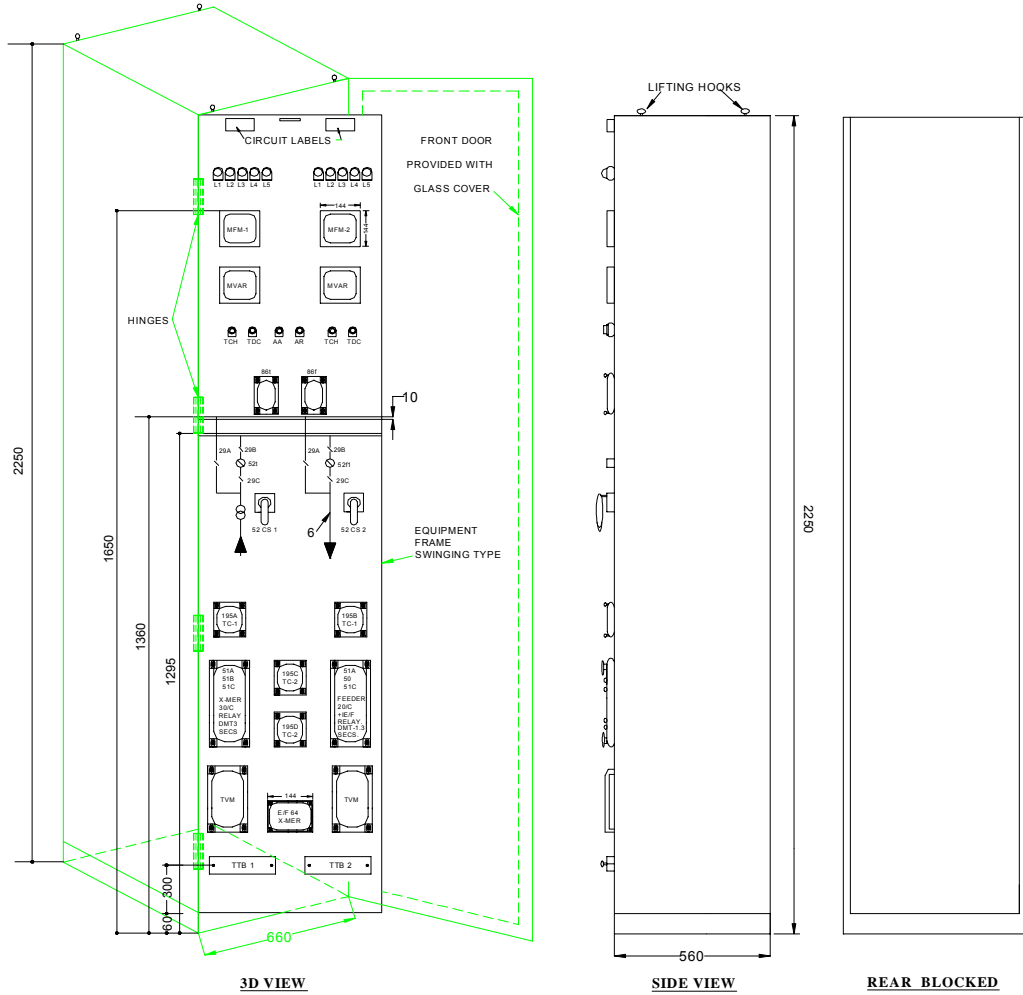
1. Bidders shall indicate Unit prices for all the gadgets and relays for the 33KV Class panels for feeder capacitor banks offered by them. This has to be strictly complied. Prices of the gadgets and relays shall form a part of the Schedule-I about details of equipment and quantity for 33KV C&R panels.

2. Bidders may elaborate the setting possibilities available in the overcurrent as well as earthfault elements of IDMT numerical relays offered by them.

APPENDIX-B
DRAWINGS

S.No.	Drawing No.	Description
1	JICA/MPPTCL/TR-101 TO 107/ GA 33KV 1T+1F CRP	General Arrangement Drawing for 33KV 1T+1F Control & Relay Panel
2	JICA/MPPTCL/TR-101 TO 107/ GA 33KV 3F CRP	General Arrangement Drawing for 33KV 3F Control & Relay Panel
3	JICA/MPPTCL/TR-101 TO 107/ GA 33KV 1F CRP	General Arrangement Drawing for 33KV 1F Control & Relay Panel
4	JICA/MPPTCL/TR-101 TO 107/ GA 33KV CAP BANK CRP	General Arrangement Drawing for 33KV Capacitor Bank Control & Relay Panel

**GENERAL ARRANGEMENT OF 33 KV TWO CIRCUIT (ONE X-MER & ONE FEEDER)
CONTROL AND RELAY PANEL AS PER MPPTCL'S STANDARD DESIGN**



ALL DIMENSIONS ARE IN MM.
NOT TO SCALE

STANDARD DIMENSIONAL DETAILS

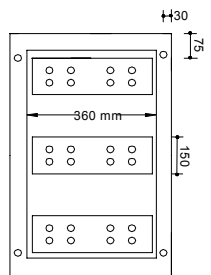
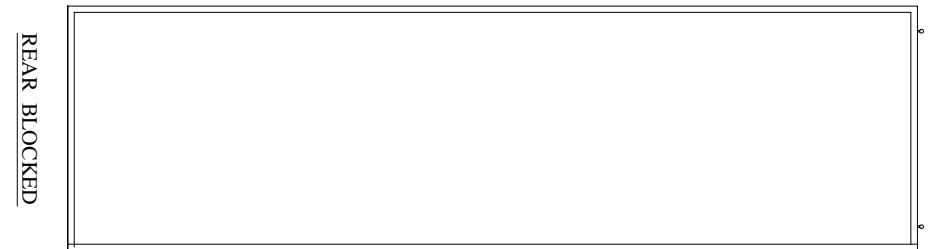
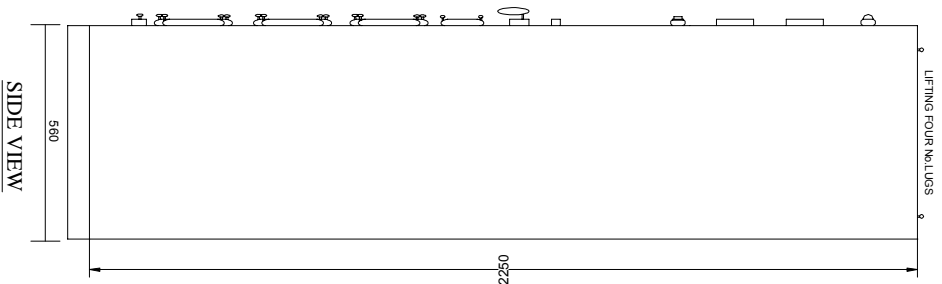
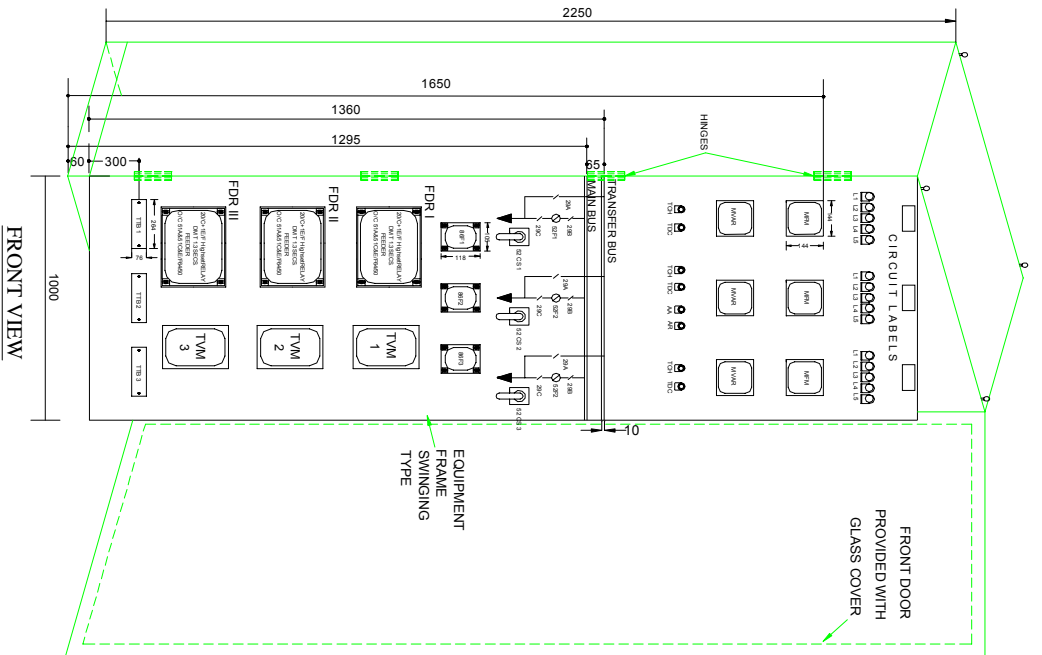
CATEGORY	WIDTH	DEPTH	HEIGHT
1 T/1F	660	560	2250
1T+1F	660	560	2250
3F	1000	560	2250

Sheet Metal Thickness	2.5mm.
Colour Inside	Eggshell White
Colour Outside	Opaline Green
Colour of Mimic	Azure Blue
Mimic Strip	Overlaid Type
Earth Bus Size	12.5x6mm. Copper Strip
Brass Cable Glands	Double Compression Type
Multifunction Meters	Accuracy Class 0.5
Trivector Meters	Accuracy Class 0.2S

M. P. POWER TRANSMISSION Co. LTD. JABALPUR

DRAWING NO:- JICA/MPPTCL/TR-101 TO 107/GA 33KV 1T+1F CRP

33 KV THREE FEEDER CONTROL & REALY PANEL AS PER MPPTCL's STANDARD DESIGN.



BOTTOM VIEW

NOTE:-

1. IN CASE OF PANELS COMPRISING THREE CIRCUITS THE DOORS SHOULD BE OF CENTRE OPENING TYPE HAVING HINGES ON BOTH OUTER SIDES.
2. THE SPACE AVAILABLE BETWEEN THE METERS WILL BE AROUND 20mm THEREFORE PROPER REINFORCEMENT SHOULD BE PROVIDED IN THE SHEET FROM INSIDE SHOULD BE AROUND 1000mm.
3. THE DRAWING IS ONLY TO INDICATE REFERENCE HEIGHTS OF INSTRUMENTS CONTROL SWITCH MIND ETC.

ALL DIMENSIONS ARE IN MM.
NOT TO SCALE

STANDARD DIMENSIONAL DETAILS

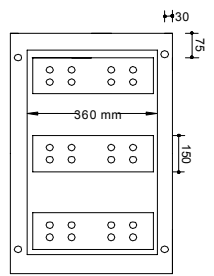
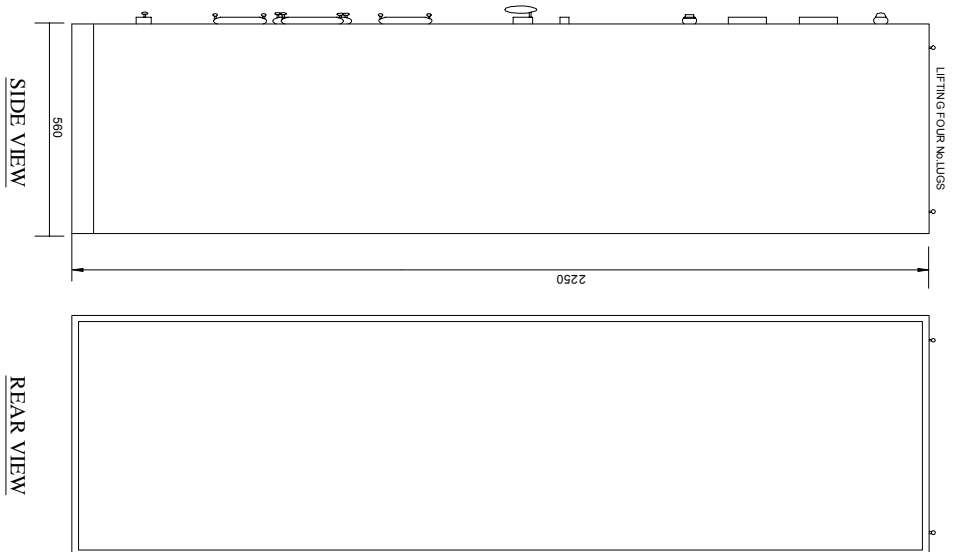
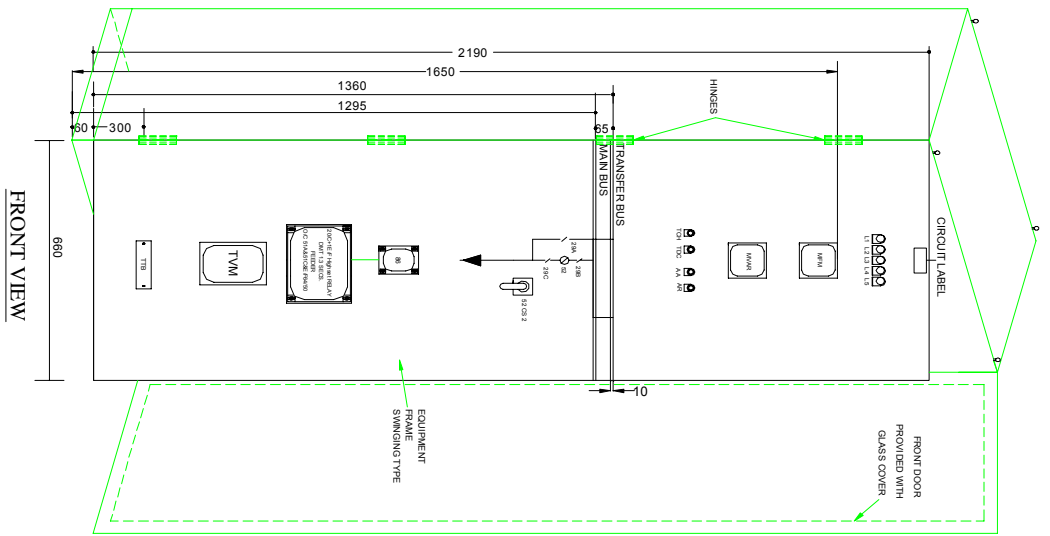
CATEGORY	WIDTH	DEPTH	HEIGHT
1 T/F	680	560	2250
1 T + 1 F	680	560	2250
3 F	1000	560	2250

Sheet Metal Thickness	2.5mm.
Colour Inside	Eggshell White
Colour Outside	Opaline Green
Colour of Mimic	Azure Blue
Mimic Strip	Overlaid Type
Earth Bus Size	12.5x8mm. Copper Strip
Brass Cable Glands	Double Compression Type
Multifunction Meters	Accuracy Class 0.5
Trivector Meters	Accuracy Class 0.2S

M. P. POWER TRANSMISSION Co. LTD. JABALPUR

DRAWING No:- JICA/MPPTCL/TR-101-107/GA 33KV 3Feeder CRP

33 KV ONE FEEDER CONTROL & REPLY PANEL AS PER M.P.P.T.C.L.'S. STANDARD DESIGN.



BOTTOM VIEW

- NOTE:-**
1. THE SPACE AVAILABLE BETWEEN THE METERS WILL BE AROUND 20mm THEREFORE PROPER REINFORCEMENT SHOULD BE PROVIDED IN THE SHEET FROM INSIDE SHOULD BE AROUND 1000mm.
 2. THE DRAWING IS ONLY TO INDICATE REFERENCE HEIGHTS OF INSTRUMENTS CONTROL SWITCH MIMIC ETC.

TCH = Trip Circuit Healthy Check
 TDC = DC Fail Test
 AA = Alarm Accept
 AR = Alarm Reset
 86 = Trip Relay
 MFM = Multi Function Meter

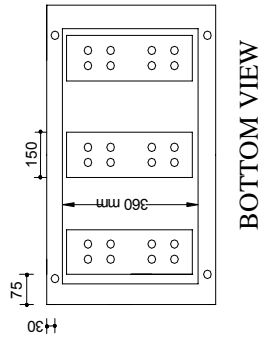
ALL DIMENSIONS ARE IN MM NOT TO SCALE

STANDARD DIMENSIONAL DETAILS			
CATEGORY	WIDTH	DEPTH	HEIGHT
1F	660	560	2250
Sheet Metal Thickness	2.5mm.		
Colour Inside	Eggshell White		
Colour Outside	Opaline Green		
Colour of Mimic	Azure Blue		
Mimic Strip	Overhead Type		
Earth Bus Size	12.5x6mm. Copper Strip		
Brass Cable Glands	Double Compression Type		
Multifunction Meters	Accuracy Class 0.5		
Trivector Meters	Accuracy Class 0.25		

M. P. POWER TRANSMISSION Co. LTD. JABALPUR

DRAWING No:- JICAM/PTCL/TR-101-107/GA 33KV 1F CRP

33 KV CAPACITOR BANK CONTROL & RELAY PANEL AS PER M.P.P.T.C.L.'s. STANDARD DESIGN.



NOTE:-

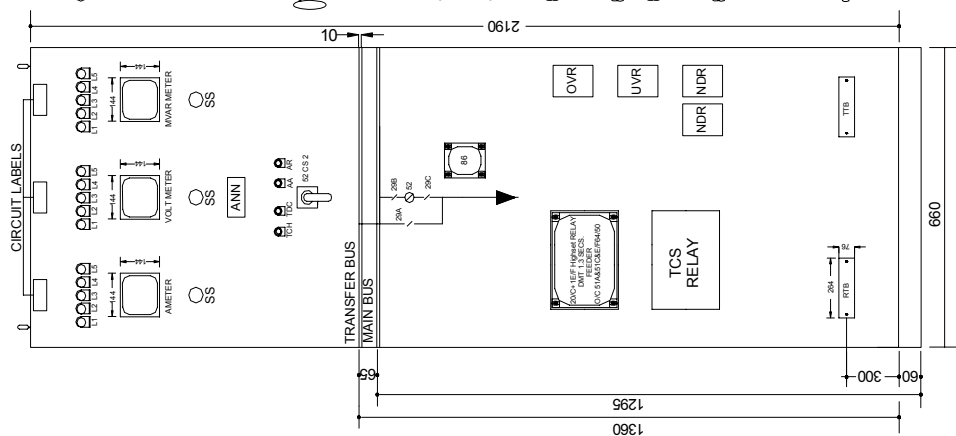
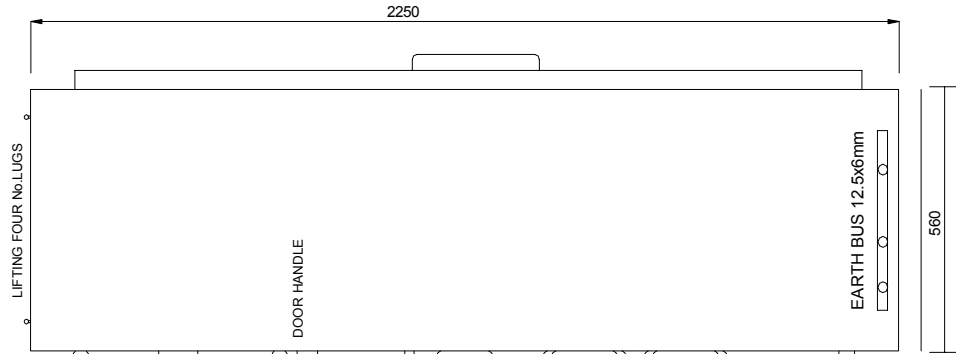
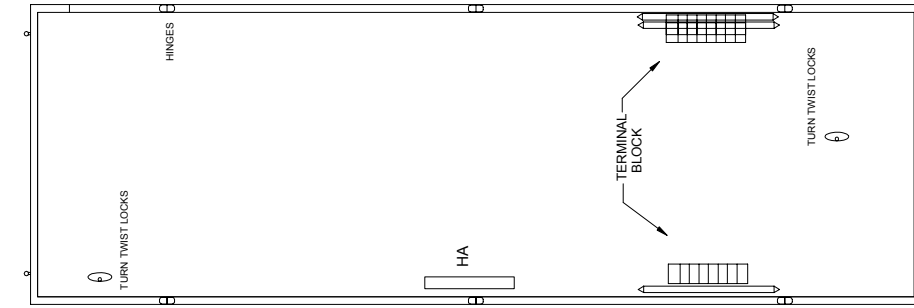
- SS = Selector Switch
- UVR = Under Voltage Relay
- OVR = Over Voltage Relay
- NDR = Un Balance Relay
- TCS = Trip Circuit Supervision Relay
- ANN = Annunciator
- TCH = Trip Circuit Healthy Check
- TDC = DC Fail Test
- AA = Alarm Accept
- AR = Alarm Reset
- 86 = Trip Relay

ALL DIMENSIONS ARE IN MM. NOT TO SCALE

REAR VIEW

STANDARD DIMENSIONAL DETAILS

CATEGORY	WIDTH	DEPTH	HEIGHT
CAPS. BANK	660	560	2250
Sheet Metal Thickness	2.5mm.		
Colour Inside	Eggshell White		
Colour Outside	Opaline Green		
Colour of Mimic	Azure Blue		
Mimic Strip	Overlaid Type		
Earth Bus Size	12.5x6mm. Copper Strip		
Brass Cable Glands	Double Compression Type		
Ammeter, Volt Meter, MV/AR Meter	Accuracy Class 0.5		



REAR VIEW

SIDE VIEW

FRONT VIEW

SK.1117
DRAWING NO. JICA/MPPPTCL/TR-101 TO 107/GA 33KV CAP. BANK CRP

10.05.2007

SCHEDULE-I(A)**DESCRIPTION OF EQUIPMENT FOR
SCHEDULE FOR RATES AND PRICES TO BE FURNISHED
IN BIDDING FORM OF SECTION-IV, VOLUME-I**

S. No.	Particulars Of Item	Qty.
1(a)	33KV C & R panels for protection of one transformer and one feeder circuit complete with all relays & accessories as described in the tech. specification with u/f and tripping relays alongwith	As per Price schedule
2	33KV C & R panels for protection of three feeder circuits complete with all relays & accessories as described in the tech. specification.	
3	33KV C & R panels for protection of one feeder circuit complete with all relays & accessories as described in the tech. specification.	
4	C & R panels for protection of 2 Nos. 36KV, 12 MVAR Shunt Capacitor Bank complete with all relays & accessories as described in the tech. specification.	

NOTE:

1. **The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.**
2. **The quantity of above equipments has been mentioned in Volume VI**

2.1.3 (A) TECHNICAL SPECIFICATION FOR 400 kV CURRENT TRANSFORMERS

1.0 SCOPE :

The scope of this specification covers design, manufacturing and supply of equipments as per Volume-II, Part-8, Book-I. The bidder mentioned in the Section of the Technical Specification means "Original Equipment Manufacturer (OEM)". The Purchaser means the "MPPTCL".

In case bidder is not OEM, sole responsibility of offering equipment/ material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS :

Applicable Standards for the offered equipments / items shall be as per Volume-II, Part-8, Book-I.

3.0 CLIMATIC CONDITIONS :

Applicable climatic conditions shall be as per Volume-II, Part-8, Book-I.

4.0 SYSTEM PARTICULARS :

Applicable System Particulars shall be as per Volume-II, Part-8, Book-I.

5.0 BASIC DESIGN AND TECHNICAL REQUIREMENT FOR 400 kV CURRENT TRANSFORMERS:

5.1 BASIC DESIGN:

- a. The 400 kV Current Transformer will be of dead tank or live tank type. In case of dead tank CT, only hair-pin design shall be acceptable. The 400 kV Current Transformer will have a top dome/ tank to accommodate primary terminal assembly, oil level gauge, pressure relief device, secondary cores (in case of live tank type) and a bottom tank to accommodate terminal box, secondary cores (in case of dead tank type) etc. In live tank type CT, the secondary cores shall be shielded in metallic case which should be grounded through connections capable of carrying fault current. The arrangement made in this regard shall be explained by the bidder. The equipment shall be outdoor, single phase, oil immersed and self cooled type, suitable for services indicated as above complete in all respect and conforming to modern practices of design and manufacture.

As stated, Current transformers shall be paper insulated, oil filled, dead tank / live tank type. The Current transformer after providing paper insulation shall be housed in the tank containing oil. Please note epoxy casting in primary & secondary cores is not acceptable. The compound filled CTs are also not acceptable. Manufacturers should briefly describe complete process of manufacturing.

Current Transformer with cascade design / interposing CTs / auxiliary CTs are not acceptable.

As stated, all current transformers shall be paper insulated and oil filled. The Current Transformer after providing paper insulation shall be housed in the tank containing oil. Please note epoxy casting in primary & secondary cores is not acceptable. The

compound filled CTs are also not acceptable. Manufacturers should briefly describe complete process of manufacturing.

- b. The insulation as per the latest version of IS:4800 or equivalent International Standard of the current transformers shall be so designed that the internal insulation shall have higher electrical withstand capability than the external insulation. The designed dielectric withstand values of external and internal insulations shall be clearly brought out in the guaranteed technical particulars. The dielectric withstand values specified in this specification are meant for fully assembled current transformers.
- c. The current transformers covered under this specification shall meet the technical requirements indicated in Annexure I & Annexure II enclosed with the specification.

5.2 PORCELAIN HOUSING:

- a. The Current transformer should be designed using single porcelain housing. No metallic joints shall be provided in the porcelain. The housing shall be made of homogeneous, vitreous porcelain of high mechanical and electric 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 profile of porcelain shall be aerodynamic type as per latest version of IEC-815.
- b. Details of attachment of metallic flanges to the porcelain shall be brought out in the Bid.

5.3 METAL TANK :

Special precaution will have to be taken towards selection of material for the metal tank and the following will have to be ensured.

- i. Material for metal tank which should be minimum 3 mm. thick (i. e. mild steel/stainless steel/aluminium alloy) shall be carefully selected depending upon the primary current and the material should be clearly mentioned against technical questionnaire.
- ii. The practice of providing inserts of non-magnetic material in the body of the tank with suitable welding to reduce eddy current shall not be acceptable. This problem should be avoided by selection of tank of suitable material.
- iii. Welded joints have to be minimised to avoid possibility of oil leakage. In any case welding in horizontal plane shall be avoided.
- iv. The slot / hole cutting in the bottom tank should be done smoothly to avoid any sharp edges within the tank. All welded surfaces need to be smoothed and shall be covered with pressboard or other insulating material of good mechanical properties.
- v. The bottom tank should not have any dents and pitting to ensure proper tightening of gasket and to avoid any oil leakage. Fabrication of bottom tank shall be done by utilizing fresh sheet steel only.

The material selected for the tank shall be justified with suitable explanation.

5.4 PREVENTION OF OIL LEAKAGES AND ENTRY OF MOISTURE:

- a. The sealing of Current transformer shall be properly achieved. The following should be properly taken care of & arrangement provided by the bidder shall be described.

- i. Locations of emergence of primary and secondary terminals.
 - ii. Interface between porcelain housing and metal tank.
 - iii. Cover of the secondary terminal box.
- b. For gasketed joints, wherever used, nitrile butyl rubber gaskets, neoprene or any other improved material shall be used. No cork gaskets shall be used. The nitrile butyl rubber 'O' Ring should be fitted in properly machined groove with adequate space for accommodating the gasket under compression at interface between main porcelain bottom flange and main tank neck cover. You have to submit complete details and justify that the quality of gaskets which will be used between the joints will be of best quality to avoid leakage of oil. The quality of gasket should be selected keeping in mind that the ambient temperature in MP now touches 50 deg. centigrade.
- c. The CT shall be of dead tank or live tank design and shall be so constructed that it can be easily transported to site within the allowable transport limitation and in horizontal position if the transport limitations so demand. The CTs shall be hermetically sealed and method of such sealing shall be detailed out in the bid.

5.5 TERMINAL CONNECTORS:

The terminal connectors required for connection of the current transformer to owner's bus bar, shall be in the bidder's scope. The terminal connectors shall be suitable for 4 inch IPS tube / Twin Moose ACSR conductor. The terminal connector shall conform to the latest version of IS: 5561 or equivalent International Standard. The drawing of terminal connector is enclosed with bid document for guidance. The type of terminal connectors for 400 kV CT shall be as under:-

- i) Expansion type terminal connector for 4 inch IPS tube suitable for horizontal take off.
- ii) Rigid type terminal connector for 4 inch IPS tube suitable for vertical take off.
- iii) Rigid type terminal connector for twin moose ACSR suitable for vertical take off.

The design of clamp shall be to our approval. The details of current take off as required by us should be detailed out in drawing and should be submitted along with the bid. In respect of the terminal connectors, following should be ensured: -

- a. The terminal connector should be made of A6 Aluminium Alloy and by pressure/gravity diecast only. Sand casted terminal connectors are not acceptable. The current rating of terminal connector will be 1.5 times the rated current. The current density shall not exceed 1 Amp/sq.mm. in any part.
- b. All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges should be rounded off.
- c. No part of clamp shall be less than 12mm thick.
- d. All current carrying parts shall be designed and manufactured to have minimum contact resistance. The bimetallic strips/sleeve shall be 2 mm thick.
- e. All nuts/bolts/washers shall be made of HDG Mild steel with minimum diameter of 12 mm.
- f. The conductor should be tightened by six bolts. Conductor hold length must not be less than 100mm.
- g. The clamp for Twin Moose ACSR conductor shall be made of three pieces so that each conductor may be tightened separately.

- h. Size of terminal connector for which the clamp is designed and also rated current under site conditions shall be embossed / punched on each part of clamp except hardware.
- i. The surface of clamps to be tightened by six bolts should be flat in shape so that it may be possible to open the nuts and bolts by normal spanners. Therefore, any type of groove in the clamp body for fixing of nuts should be avoided.
- j. The portion of clamp to hold the conductor should be flat and straight and not zig-zag in construction, at both the sides, so that heating of clamp by throttling action of current may be avoided.
- k. Space of at least 50% of diameter of nuts should be available after the hole at both the sides of conductor holding portion for better mechanical strength.

5.6 MOUNTING :

The Current transformer shall be suitable for mounting on our steel structure, which shall be arranged by the purchaser. The mounting dimensions of equipment shall match with the mounting dimensions of structure indicated in enclosed Annexure-III.

5.7 INSULATING OIL :

The insulating oil for first filling of oil in each transformer shall be in the scope of bidder. Only best quality new EHV Grade transformer oil should be used with the equipments with minimum BDV of 70kV. The oil shall comply in all respect with the provisions of the latest version of IS: 335 or IEC publication no. 60296 (as amended up to date). The oil parameters viz., Tan Delta value, resistivity, PPM and BDV of oil filled in the CTs shall be recorded in the test certificates of respective CT.

5.8 SURFACE FINISH :

The metal tanks shall be coated with atleast two coats of zinc rich epoxy paint or hot dip galvanised. All the ferrous hardware, exposed to atmosphere, shall be hot dip galvanised conforming to the latest version of IS: 2629 or equivalent International Standard. All other fixing nuts, bolts, washers shall be made out of HDG Mild steel.

It has been observed that certain CTs received by us in the past did not have good quality painting and with passage of time flakes of paint got peeled off. The internal and external surfaces of metal tanks to be painted shall be shot or sand blasted to remove all rust and scale of foreign adhering matter or grease. All steel surfaces in contact with insulating oil shall be hot dip galvanized or painted with two coats of heat resistant, oil insulating varnish. All paints shall be carefully selected to withstand extremes of weather. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

5.9 TEMPERATURE RISE :

The temperature rise of a current transformer winding when carrying a primary current equal to 125% of rated current at a rated frequency and with a unity power factor burden corresponding to rated output connected at the secondary winding shall be 5° (five degrees) less than the permissible values given in the latest version of IS : 2705 or equivalent international standard.

5.10 ARRANGEMENT FOR COMPENSATION OF OIL VOLUME :

For compensation of variation in the oil volume due to variation in ambient temperature, stainless steel bellows shall be used. No other arrangement for this purpose shall be acceptable. For indication of oil level, a ground glass window shall be provided to monitor the position of metal bellow.

5.11 SECONDARY TERMINALS TERMINATION :

The following may please be noted for strict compliance:-

- (a) The secondary terminals shall be terminated to stud type non-disconnecting terminal blocks inside the terminal box.
- (b) The outer secondary terminal box should have two separate compartments with separate covers for the purpose of sealing. Each compartment will have the terminals of each metering core. Suitable gland plates for both the compartments will have to be provided. This is required because covers of metering cores compartment will be provided with suitable seals to be operated by separate agencies who will verify the cover periodically for metering purpose.
- (C) 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 cable.
- (d) The terminal box shall be dust and vermin proof. Suitable arrangement shall be made for drying of air inside the secondary terminal box.
- (e) The dimensions of the terminal box and its openings shall be adequate to enable easy access and working space with use of normal tools.
- (f) The outer cover of secondary terminal box shall have provision for sealing by way of insertion of wire in the bolt hole. A drawing indicating above arrangement may please be furnished alongwith the bid.
- (g) For measuring tan delta values, a separate tan delta test terminal shall be provided on the opposite side of the secondary terminal box.

5.12 POLARITY :

Polarity shall be invariably marked on each primary and secondary terminal. Facility shall be provided for short circuiting & grounding of the CT secondary terminals inside the terminal box. All marking shall be engraved or through anodized plate which should be firmly fixed.

5.13 RATING PLATE :

The CT shall be provided with a rating plate with dimensions and markings as per the latest version of IS: 2705/IEC-60044 (1). This rating plate shall also contain our purchase order no. & date, date of pre-dispatch inspection of CT, values of tan delta & capacitance (measured at 10kV) and guarantee period of equipment. The markings shall be punched/ engraved and not painted.

5.14 OIL FILLING AND SEALING :

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 sampling valve provided at the bottom of CT should be protected by providing metallic cover or blanking plug/plate. Valve should be welded to avoid any leakage. The method adopted for hermetic sealing shall be described in the bid.

5.15 CASTING :

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

5.16 INSTRUMENT SECURITY FACTOR :

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 the latest version of IS:2705 or IEC-60044 (1).

5.17 EARTHING :

Current transformer shall be provided with two separate earthing terminals for bolted connection to 75 x 10 mm MS flat to be provided by the Purchaser for connection to station earth-mat.

5.18 LIFTING ARRANGEMENT :

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 as to avoid any damage to the porcelain housing or the tanks during lifting for installation/ transport. Necessary sling guides shall be offered which shall be of removable type.

5.19 PRIMARY WINDING :

- a) Primary winding shall be made out of electrolytic grade 99.9% conductivity copper or electrical conductor grade aluminium. Conductors used for the primary winding shall be rigid and housed in rigid metallic shell. Joints in the primary winding shall not be provided. For primary winding, current density shall not exceed 1.50 Amp / sq.mm in case of copper and 1.0 Amp / sq.mm in case of aluminium, at continuous overloading of 25% above rated current.
- (b) The design density for short circuit current as well as conductivity of the metal used for primary winding shall meet the requirement of latest version of IS:2705 or IEC-60044 (1). The bidder shall in his bid furnish detailed calculations for selection of winding cross-sections. The selected amp-turns for CTs shall be justified on the basis of type test reports.
- (c) It is desired that from the point of view of adequate mechanical strength in the normal course and also during short circuit, proper precaution should be taken. The following arrangement or any equivalent suitable arrangement, which should be described in the bid, shall be provided for this purpose for dead tank type CTs:-
 - i. The primary conductor should be housed in suitable tube of adequate mechanical strength. The arrangement shall be explained through suitable drawing and material of tube should be indicated.
 - ii. The primary conductor should be held firmly and for this purpose suitable clamping arrangement at the bottom shall be provided and explained through suitable sketch. Firm clamping arrangement is a must and holding of winding using nylon rope etc. shall not be acceptable.
 - iii. The neck of tube should be properly fixed to support the primary windings of CT. It is suggested that piece of strong material of length around 8 inches on both the sides of tube should be fixed to properly hold the primary windings so that dislocation of primary windings during transport is avoided.

- iv. The edges of the pipe should be smoothed to avoid any damage to insulation.
- v. A sturdy arrangement should be provided to secure the bottom of primary winding in place. Also separate arrangement will be necessary to hold the secondary windings in place. The arrangements for primary winding and for secondary cores shall be independent of each other. Any common arrangement is not acceptable.
- vi. At least two clampings should be done on each side of the primary winding and a minimum number of 4 No. nuts and bolts should be provided on each side. The nuts and bolts arrangement used for holding active parts should be suitably dimensioned. The bolts should be tightened with the nuts and also a check nut for proper locking.
- vii. The arrangement for bringing out connection from outer shielding for grounding purpose should be made properly. For this purpose the full length copper strip of width around 2 cm. may be used on the outer dia. of bottom portion to ensure proper shielding / earthing of outer condenser. For shielding preferably aluminium foil should be used.
- viii. Minimum 10 mm space should be available between insulation and porcelain for adequate passage of oil.

5.20 SECONDARY WINDINGS :

Suitably insulated copper wire of 99.9% conductivity electrolytic grade shall be used for secondary windings. The exciting current of the CT shall be as low as possible. The bidder shall furnish along with his bid the magnetization curve / s for all the core/s.

Enamel, if used for conductor insulation, shall be either polyvinyl acetate type or amide type and shall meet the requirements of latest version of IS: 4800 or equivalent International Standard.

5.21 PRIMARY TERMINALS:

For various ratings of CTs selection of primary terminal shall be made carefully. Primary terminal on either side of tank should be of minimum 100 mm length. to accommodate terminal connector. The dia / size of the primary terminal shall be such that the current rating available is at least 1.5 times the rated current of the CT. It would be obligatory on the part of the tenderer to specify material, diameter, length and current rating of primary terminal which shall be used for CTs of different ratio. The primary terminal studs to accommodate terminal connector for take-off shall be plain and not threaded. The details may be explained through suitable sketch.

The primary terminals shall be 99.9% conductivity heavily tinned electrolytic copper or aluminium alloy of 99.9% conductivity. The minimum thickness of tinning shall be 15 microns.

5.22 SECONDARY TERMINALS:

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 studs shall be 8 mm. The length of at least 15 mm shall be available on the studs for inserting the leads. The horizontal spacing between centres of the adjacent studs shall be at least 1.5 times the outside circumdia of the nuts. The arrangement should be shown through suitable sketch.

5.23 CORE :

The grade M4 toroidal core or any equivalent/superior grade core material shall be of high-grade non-ageing electrical silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy at both normal and over currents. The current transformer core to be used for metering shall be made of mumetal / nano crystalline or similar high grade magnetic material and shall be of accuracy class specified. The saturation factor of this core shall be low enough not to cause any damage to measuring instruments in the event of maximum short circuit current. The 5P10 core shall be designed for a minimum saturation factor of 10 for the highest setting. The magnetization curves for this core shall be furnished with the bid. As far as PS class core is concerned all precautions shall be taken in design to achieve the knee point voltage without exceeding requirement of excitation current as specified in Annexure-II. Magnetisation curve for the same shall be furnished.

5.24 RATIO CHANGING ARRANGEMENT:

Primary current ratio changing arrangement in 400 kV CTs shall be provided by way of tapings on secondary windings.

5.25 SPECIAL REQUIREMENT FOR CURRENT TRANSFORMERS:

a) OVERLOADING:

The CTs shall be suitable for continuous overloading upto 125% maximum rated primary current. The following requirements therefore should be noted:-

- i). It should be specifically confirmed that the CTs offered against the specification are suitable for continuous overloading of 25% above rated current. For this purpose, precaution taken in design of equipment may be suitably explained.
- ii) For all the CTs which are to be designed for 25% overloading, the permissible temperature rise of CT winding over the reference ambient temperature of 50° C at 125% rated current, rated frequency and with a unity power factor burden corresponding to the rated output connected to the secondary windings shall not exceed 45°, i.e. 5° less than the permissible values as specified in IS.

b) CONSISTENCY OF ACCURACY:

It should be specifically confirmed that with 25% continuous overloading, the ratio/phase angle errors of the CTs shall be maintained strictly within specified limits without any drift and no variation shall take place due to overloading of Current Transformers.

5.26 MEASUREMENT OF CAPACITANCE AND TAN DELTA:

For monitoring the condition of insulation, tan delta and capacitance values shall be measured periodically by the purchaser after commissioning of CT. The values of tan delta and capacitance measured at 10 kV & $U_m/\sqrt{3}$ for all CTs should be mentioned in the routine test report. In this regard, following may be noted by the tenderers:-

- a. If the value of tan delta, measured at 10 kV, during guarantee period of CT is found to be more than 0.7%, the supplier shall replace the CT free of cost.

- b. If the value of capacitance, measured at 10 kV, during guarantee period of CT is found to have increased by more than 3% in comparison to the factory test value, the supplier shall replace the CT free of cost.

6.0 TESTS :

6.1 TYPE TEST :

All the equipments offered, shall be fully type tested as per relevant Indian Standards or any equivalent International Standard during the last five years from the date of bid opening. Copy of type test reports shall be enclosed with the bid. For any change in the design/ type already type tested and the design/ type offered against this bid, the Purchaser reserves the right to demand repetition of same or all type tests without any extra cost.

In the event of our order, the supplier has to furnish type test report for the following tests:-

- i. Chopped Impulse Test
- ii. Multiple Chopped Impulse Test
- iii. RIV Test
- iv. Mechanical Test on Terminals
- v. Seismic Test
- vi. Tan Delta Test at full Voltage
- vii. Thermal Stability Test
- viii. Temperature Coefficient Test

6.2 ACCEPTANCE AND ROUTINE TESTS :

6.2.1 The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards or equivalent International Standards in presence of purchaser's representative.

6.2.2 In addition to other acceptance tests for CTs, the following tests shall also be carried out:-

a/ Sealing test :

The sealing test shall be carried out on minimum one randomly selected CT out of each offered lot of CTs. The procedure for sealing test is as under:-

- i. Test shall be performed on completely assembled unit.
- ii. Test shall be performed on proto-type as well as during acceptance test on minimum one randomly selected unit.
- iii. Temperature of CT under test will be elevated and maintained at 50°C and simultaneously it shall be subjected to internal pressure of 103 kPa (@1.1 kg / sq.cm) for 12 hours.
- iv. Arrangement shall be made by manufacturer to maintain required pressure and temperature for 12 hours.
- v. During and after the test, there shall not be any oil leakage from any part or joint of CT.
- vi. Readings of temperature, internal pressure applied and duration of test along with observation of leakage, if any, shall be noted in inspection report.

b/ Temperature Coefficient Test:

This test will be carried out on minimum one randomly selected CT out of each offered lot of CTs.

c/ Thermal Stability Test:

This test will be carried out on minimum one randomly selected CT out of each offered lot of CTs.

d/ Tests on Oil:

The following tests shall be carried out on minimum one randomly selected CT out of each offered lot and shall be conducted after HV test:-

- i) BDV Test
- ii) Tan Delta Test
- iii) Water ppm Test
- iv) Specific Resistance at 75 Deg C & 90 deg C
- v) Viscosity
- vi) Total Acidity
- vii) Dissolved Gas Analysis Test

Copy of test report received from oil manufacturer will have to be submitted.

e/ Measurement of tan delta and capacitance at 5 kV, 10 kV & $U_m/\sqrt{3}$ also shall be recorded in the acceptance and routine test report of 400 kV CT.

6.2.3 Immediately after finalization of the programme of type/ acceptance/ routine testing, the manufacturer shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

6.2.4 During measurement of errors, the resistance of leads connecting the CT under test, the burden box and the standard CT to the measuring bridge should be kept minimum so that accuracy of measurement of CT errors is negligible.

7.0 INSPECTION :

- i. The Purchaser shall have access at all times to the works and all other places of manufacture, where the current transformers and potential transformers are being manufactured and the bidder shall provide all facilities for unrestricted inspection of the bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.
- ii. The successful bidder 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 arrangements could be made for inspection.
- iii. The Purchaser reserves the right to carry out thorough internal inspection of one or two randomly selected CTs out of offered lot, at the time of final inspection of CTs, during which the CTs will be completely opened to verify the dimensional and other details.
- iv. Besides above, the Purchaser reserves the right to carry out type test at NABL accredited laboratory on one of the randomly selected CT out of the supplied / offered CTs. The supplier shall extend co-operation for organizing the type tests in the presence of Purchaser's representative.

- v. For the purpose of inspection, it will be duty of the supplier to provide, to the inspecting officer, the detailed order, approved drawings, comments, if any, on the drawings and all amendments(if any) made in any term/condition/specification/ GTP of the order and all relevant IS, IEC, standards. Failure to provide documents demanded by the inspector shall render the inspection as “Fake Inspection Call” and relevant penalty may be imposed on the supplier on this account
- vi. No material shall be dispatched from the point of manufacture unless the material has been satisfactorily inspected and tested.
- vii. The acceptance of any quantity of the equipments shall in no way relieve the successful bidder 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.

8.0 QUALITY ASSURANCE PLAN & STAGE INSPECTION :

8.1 For the purpose of supply of above equipments, you will have to follow strict quality assurance programme, which will include thorough verification of samples of critical assemblies and accessories by us, verification of sources of raw materials, detailed verification of your drawing & design, checking up of all calculations regarding size of terminals, primary winding etc, stage inspection at various critical stages of manufacture and minor modifications consequent to such stage inspections as per our requirements and all other related requirements, which have generally been brought out in bidding documents and the detailed contract. It is expected that you would be very serious and prudent in meeting these requirements without any loss of time, so that supply of equipments in line with quality assurance programme is ensured within targeted schedule.

The purchaser reserves the right to specify various stages for stage inspections and also for manufacture of a proto type unit for inspection & testing, before according clearance for bulk manufacturing.

8.2 The bidder must establish that they are following a proper quality assurance programme for manufacture of current transformers and potential transformers.

The bidder shall invariably furnish following information along with his bid.

- i. Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material 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. Levels 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 equipment available with the bidder for final testing of equipment specified and test plant limitations, if any vis-à-vis type, special, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

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

- i. List of raw materials as well as bought out accessories and the names of sub supplier selected from the lists furnished along with bid.
- ii. Type test certificate of the raw material and bought out accessories.
- iii. Quality Assurance Plan (QAP) with hold points for purchaser's inspection. The quality assurance plans and holds points shall be discussed between the Purchaser and Bidder before the QAP is finalized.

8.4 The successful Bidder shall submit the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

9.0 DOCUMENTATION :

9.1 All drawings shall conform to the latest version of international standards organization (ISO) 'A' series of drawing sheet/ Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. Units.

9.2 LIST OF DRAWINGS AND DOCUMENTS :

The Bidder shall furnish four sets of following details and drawings along with his bid :-

- a. General outline and assembly drawings of the equipments.
- b. Graphs showing the performance of equipments in regard to magnetization characteristics.
- c. Sectional views showing:
General Constructional Features.
Materials/ Gaskets/ Sealings used.
The insulation of the winding arrangements, method of connection of the primary/ secondary winding to the primary/ secondary terminals etc.
Porcelain used and its dimensions alongwith the mechanical and electrical characteristics.
- d. Complete primary terminal assembly which should include the following:-
 - i. Complete primary terminal.
 - ii. All sub-assemblies with the help of which the primary terminal shall be brought out from the top tank including washers/ locking arrangements, check nut, main nut etc.
 - iii. Sub-assembly to demonstrate the arrangement of connection of primary winding to primary terminal inside the tank.
 - iv. Terminal connectors suitable for 4 inch IPS tube/ Twin Moose ACSR Conductor.
- e. Name plate.
- f. Schematic drawing.
- g. Type Test reports in case the equipment has already been type tested.

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

- 9.3** The successful Bidder shall within two weeks of placement of order, submit four sets of final versions of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/approval on the drawings to the Bidder within reasonable time. The Bidder 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 Purchaser's comments. After receipt of Purchaser's approval, the Bidder shall within three weeks submit 20 prints and two good quality reproducible of the approved drawings for Purchaser's use.
- 9.4** The Bidder, for distribution before commencement of supply, shall submit six sets of the type test reports, duly approved by the Purchaser. Adequate copies of acceptance and routine tests certificates, duly approved by the Purchaser shall accompany the dispatched consignment.
- 9.5** The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Bidder's risk.
- 9.6** Twenty (20) copies of nicely printed and bound volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment supplied shall be submitted by the Bidder for distribution, prior to the dispatch of the equipments. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. The manual shall also contain a set of all the approved drawings, type test reports etc.
- 9.7** Approval of drawings/ work by Purchaser shall not relieve the Bidder of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material, which in his judgment is not in full accordance therewith.
- 10.0 Important Requirements for ensuring quality of manufacture and processing of equipments.**
- 10.1** For processing and vacuum treatment of core / coil assembly, it is desired that a separate heating chamber and a separate vacuum chamber should have been installed for vacuum treatment of core / coil assembly. Facility should be available to measure quantum of water released during vacuum treatment of core/coil assembly. Make, quality and capacity of vacuum chamber alongwith vacuum level may be brought out.
- 10.2** Completely dust free shop should be available for preparation of winding. This should be confirmed.
- 10.3** What is the process employed for wrapping of insulation on primary winding. Is it being done manually or through suitable wrapping machine.
- 10.4** Various stages of quality checks during manufacture should be highlighted.

11.0 PACKING AND FORWARDING :

11.1 The equipment shall be packed in crates suitable for vertical/ horizontal transport, as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The Bidder shall be responsible for any damage during transit, due to improper and inadequate packing and handling. 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. Bidder shall supply any material found short inside the packing cases without any extra cost.

11.2 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.

11.3 The Bidder shall ensure that the packing list and bill of material are approved by the Purchaser before dispatch.

12.0 DEVIATION IN TECHNICAL PARTICULARS :

No deviation from technical particulars of equipment and materials will be allowed, which may please be noted.

ANNEXURE-I

PRINCIPAL TECHNICAL PARAMETERS OF 400 kV CURRENT TRANSFORMERS

SNo.	Item	Specification for 400 kV Current Transformers
1	Type of CT/Installation	Single phase, dead tank / live tank, oil filled, hermetically sealed, outdoor type
2	Type of mounting	Pedestal Type
3	Suitable for system Frequency	50 Hz
4	Highest System voltage (kV rms)	420
5	Current Ratio	2000-1000-500/1-1-1-1 Amp
6	No. of Secondary Cores	Five
7	Ratio taps	On secondary side
8	Method of earthing of the system to be connected to	Effectively earthed
9	Rated continuous thermal current	125% of rated current.
10	Acceptable limit of temperature rise above the specified ambient temperature for continuous operation at rated current	5 degrees centigrade less than the limits specified in IS 2705 taking ambient temperature as 50 degree centigrade
11	Acceptable partial discharge level at 1.1 times the rated voltage	Less than 10 picocoulombs
12	Max. radio interference voltage at 1.1 times the rated voltage	Less than 500 microvolts
13	1.2/50 microsecond lightning impulse withstand voltage (kVp)	1425
14	250/2500 microsecond switching impulse withstand voltage (kVp) dry & wet	1050
15	1 minute dry power frequency withstand voltage for primary winding (kV rms)	630
16	Power frequency withstand voltage for secondary winding (kV rms).	5
17	Min. creepage distance of porcelain housing (mm)	10500
18	Rated short time withstand current with duration (kA rms for seconds)	40
19	Rated dynamic withstand current (kAp)	100
20	Visual corona extinction voltage (kV rms)	320
21	Seismic acceleration (horizontal)	0.3g
22	Tan Delta at 90 °C	0.005 (Max)
23	Capacitance value	Not less than 700 picofarads
24	Material for Primary Winding	Copper/ Al
25	Material for Secondary Winding	Copper
26	Terminal Connector	
a.	Type	Rigid/ Flexible Type
b.	Quantity	3 No.
c.	Conductor	4 inch Al. IPS tube/Twin Moose ACSR
d.	Arrangement for current take off	Horizontal Take off for 4 inch IPS tube/ Vertical Take off for Twin Moose ACSR
27	Mounting details (mm)	600 x 600

ANNEXURE-II
DETAILS OF RATIO AND CORE PARTICULARS
FOR 400 kV CT

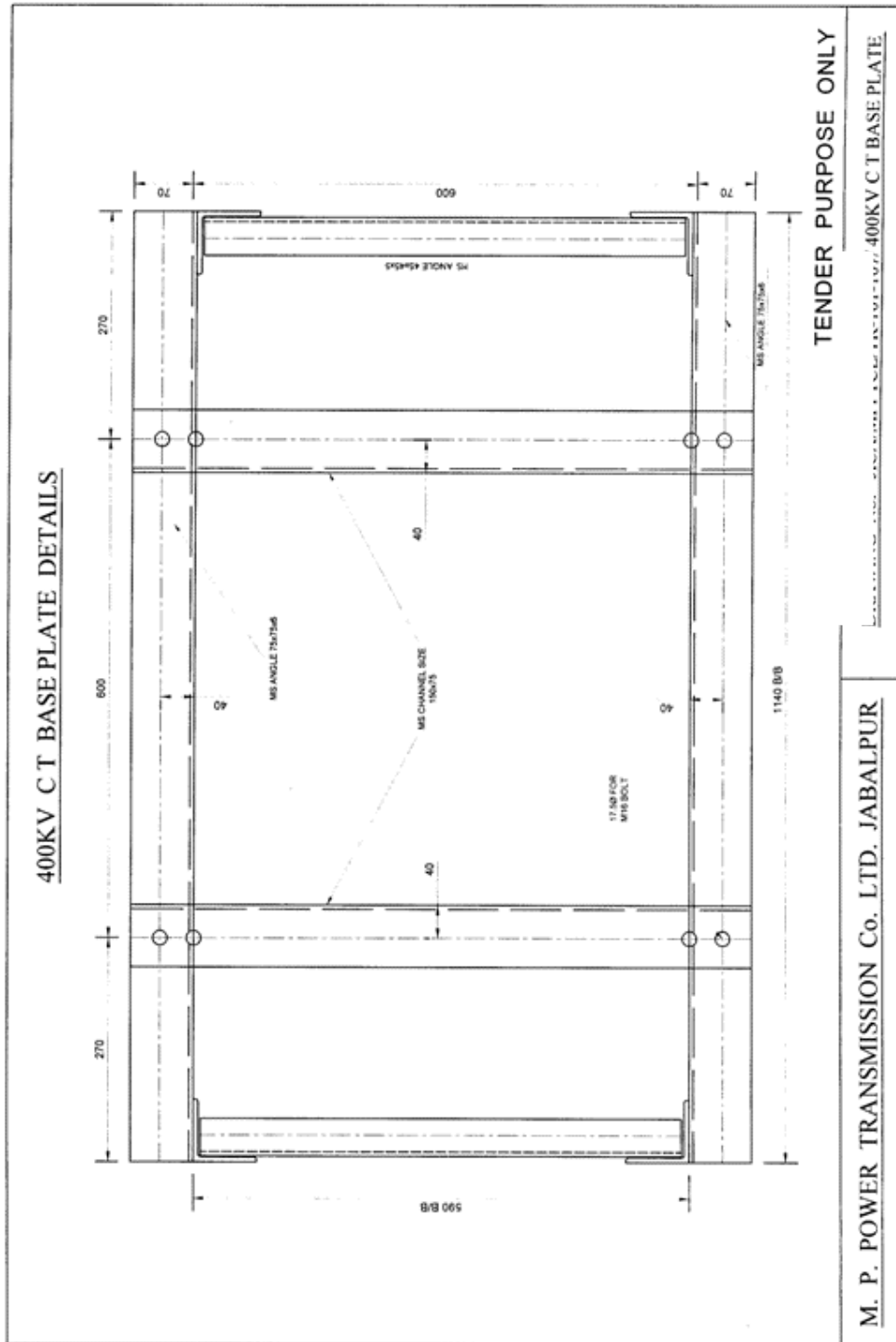
No. of cores	Core no.	Application	Current ratio	Output burden (VA)	Accuracy Class as per IEC 185	Min. knee point voltage (Volts)	Max. CT Sec. Winding resistance at 75° C (Ohms)	Max. Exciting current at knee point voltage (mA)	Instrument Security factor
1	2	3	4	5	6	7	8	9	10
5	1	BUS DIFF. CHECK	2000-1000-500/1	N.A.	PS	2000/1000/500	10/5/2.5	30 on 2000/1 Tap 60 on 1000/1 Tap & 120 on 500/1Tap	-
	2	BUS DIFF. MAIN	2000-1000-500/1	N.A.	PS	2000/1000/500	10/5/2.5	30 on 2000/1 Tap 60 on 1000/1 Tap & 120 on 500/1Tap	-
	3	METERING	2000-1000-500/1	20	0.2S	N.A.	N.A.	N.A.	5 or Less
	4	TRANSFORMER BACKUP/ LINE PROTECTION	2000-1000-500/1	N.A.	PS	4000/2000/1000	10/5/2.5	30 on 2000/1 Tap 60 on 1000/1 Tap & 120 on 500/1Tap	-
	5	TRANSFORMER DIFF./ LINE PROTECTION	2000-1000-500/1	N.A.	PS	4000/2000/1000	10/5/2.5	30 on 2000/1 Tap 60 on 1000/1 Tap & 120 on 500/1Tap	-

NA-Not applicable
mA- milli Amperes

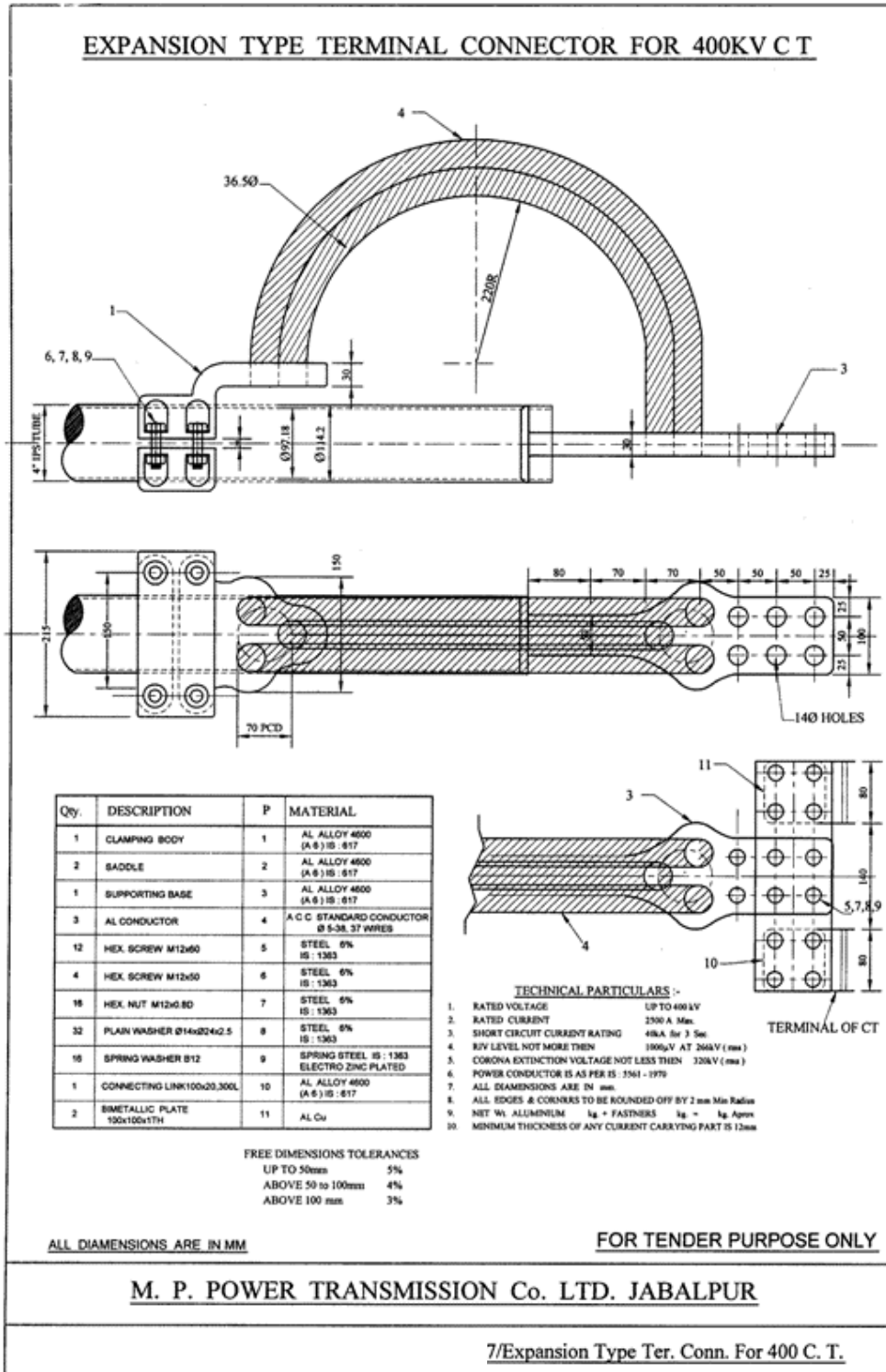
ANNEXURE-III

The following drawings showing mounting dimensions of structure for 400 kV Current Transformer and general requirement of terminal connector are enclosed herewith for general guidance:

SNo.	Description
1.	Base Plate details for mounting of 400 kV CT
2.	Expansion Type terminal connector for 4 inch IPS tube



EXPANSION TYPE TERMINAL CONNECTOR FOR 400KV C T



Qty.	DESCRIPTION	P	MATERIAL
1	CLAMPING BODY	1	AL. ALLOY 4600 (A 6) IS : 617
2	SADDLE	2	AL. ALLOY 4600 (A 6) IS : 617
1	SUPPORTING BASE	3	AL. ALLOY 4600 (A 6) IS : 617
3	AL CONDUCTOR	4	A.C.C. STANDARD CONDUCTOR Ø 5-38, 37 WIRES
12	HEX. SCREW M12x60	5	STEEL 6% IS : 1363
4	HEX. SCREW M12x50	6	STEEL 6% IS : 1363
16	HEX. NUT M12x60	7	STEEL 6% IS : 1363
32	PLAIN WASHER Ø14xØ24x2.5	8	STEEL 6% IS : 1363
16	SPRING WASHER Ø12	9	SPRING STEEL IS : 1363 ELECTRO ZINC PLATED
1	CONNECTING LINK 100x20.300L	10	AL. ALLOY 4600 (A 6) IS : 617
2	BIMETALLIC PLATE 100x100x1TH	11	AL. Cu

- TECHNICAL PARTICULARS :-**
1. RATED VOLTAGE UP TO 400 kV
 2. RATED CURRENT 2500 A. Max.
 3. SHORT CIRCUIT CURRENT RATING 40KA for 3 Sec
 4. RIV LEVEL NOT MORE THAN 1000µV AT 260kV (rms)
 5. CORONA EXTINCTION VOLTAGE NOT LESS THAN 320kV (rms)
 6. POWER CONDUCTOR IS AS PER IS : 1561 - 1979
 7. ALL DIMENSIONS ARE IN mm.
 8. ALL EDGES & CORNERS TO BE ROUNDED OFF BY 2 mm Min Radius
 9. NET Wt. ALUMINIUM kg + FASTENERS kg = kg Approx
 10. MINIMUM THICKNESS OF ANY CURRENT CARRYING PART IS 12mm

FREE DIMENSIONS TOLERANCES
 UP TO 50mm 5%
 ABOVE 50 to 100mm 4%
 ABOVE 100 mm 3%

ALL DIMENSIONS ARE IN MM

FOR TENDER PURPOSE ONLY

M. P. POWER TRANSMISSION Co. LTD. JABALPUR

7/Expansion Type Ter. Conn. For 400 C. T.

**2.1.3 (B) TECHNICAL SPECIFICATION FOR
220 kV, 132 kV & 33 kV CURRENT TRANSFORMERS**

1.1 SCOPE :

The scope of this specification covers design, manufacturing and supply of equipment as per Volume-II, Part-8, Book-I. The bidder mentioned in the Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The Purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment/material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS :

Applicable Standards for the offered equipments / items shall be as per Volume-II, Part-8, Book-I.

3.0 CLIMATIC CONDITIONS :

Applicable climatic conditions shall be as per Volume-II, Part-8, Book-I.

4.0 SYSTEM PARTICULARS :

Applicable System Particulars shall be as per Volume-II, Part-8, Book-I.

5.0 BASIC DESIGN AND TECHNICAL REQUIREMENT FOR CURRENT TRANSFORMER :

5.1 BASIC DESIGN :

5.1.1 The 220 kV and 132 kV Current Transformer will be dead tank or live tank type. In case of dead tank design, only hair pin design shall be accepted. The 33 kV Current transformer will be of dead tank type. The CT will have a top dome/ tank to accommodate primary terminal assembly, oil level gauge, pressure relief device secondary core (in case of live tank type) and a bottom tank to accommodate terminal box, secondary cores (in case of dead tank type) etc. In live tank type CT, the secondary cores shall be shielded in metallic case which should be grounded through connections capable of carrying fault current. The arrangement made in this regard shall be explained by the bidder. The equipment shall be outdoor, single phase, oil immersed and self cooled type suitable for services indicated as above complete in all respect, conforming to modern practices of design and manufacture.

The Current Transformer with cascade design / interposing CTs / auxiliary CTs are not acceptable

As stated, all Current transformers shall be paper insulated oil filled and dead tank type. The Current transformer after providing paper insulation shall be housed in the tank containing oil. Please note epoxy casting in primary & secondary cores is not acceptable. The compound filled CTs are also not acceptable. Manufacturers should briefly describe complete process of manufacturing.

5.1.2 The insulation as per latest version of IS:4800 or equivalent International Standard of the current transformers shall be so designed that the internal insulation shall have

higher electrical withstand capability than the external insulation. The designed dielectric withstand values of external and internal insulations shall be clearly brought out in the guaranteed technical particulars. The dielectric withstand values specified in this specification are meant for fully assembled current transformers.

5.1.3 The Current transformers covered under this specification shall meet the technical requirements indicated in Appendix-C1 enclosed with the specification.

5.2 PORCELAIN HOUSING:

5.2.1 The Current Transformer should be designed using single porcelain housing. No metallic joints shall be provided in the porcelain. The housing shall be made of homogeneous, vitreous porcelain of high mechanical and electrical 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 profile of porcelain shall be aerodynamic type as per latest version of IEC-815.

5.2.2 Details of attachment of metallic flanges to the porcelain shall be brought out in the Bid.

5.3 METAL TANK :

Special precaution will have to be taken towards selection of material for the metal tank and the following will have to be ensured.

- i. Material for metal tank which should be minimum 3 mm thick (i.e. mild steel/ stainless steel/ aluminium alloy) shall be carefully selected depending upon the primary current and the material should be clearly mentioned against technical questionnaire.
- ii. The practice of providing inserts of non-magnetic material in the body of the tank with suitable welding to reduce eddy current shall not be acceptable. This problem should be avoided by selection of tank of suitable material.
- iii. Welded joints have to be minimized to avoid possibility of oil leakage. In any case welding in horizontal plane shall be avoided.
- iv. The slot/ hole cutting in the bottom tank should be done smoothly to avoid any sharp edges within the tank. All welded surfaces need to be smoothed and shall be covered with pressboard or other insulating material of good mechanical properties.
- v. The bottom tank should not have any dents and pitting to ensure proper tightening of gasket and to avoid any oil leakage. Fabrication of bottom tank shall be done by utilizing fresh sheet steel only.

The material selected for the tank shall be justified with suitable explanation.

5.4 PREVENTION OF OIL LEAKAGES AND ENTRY OF MOISTURE :

5.4.1 The sealing of Current Transformer shall be properly achieved. The following should be properly taken care of & arrangement provided by the Bidder shall be described.

- i. Locations of emergence of primary and secondary terminals.
- ii. Interface between porcelain housing and metal tank.
- iii. Cover of the secondary terminal box.

- 5.4.2 For gasketed joints, wherever used, nitrile butyl rubber gaskets, neoprene or any other improved material shall be used. No cork gaskets shall be used. The gasket shall be fitted in properly machined groove with adequate space for accommodating the gasket under compression. The bidder will have to submit complete details and justify that the quality of gaskets which will be used between the joints and also for mounting of oil level indicator will be of best quality to avoid leakage of oil. The quality of gasket should be selected keeping in mind that the ambient temperature in MP now touches 50 deg centigrade.
- 5.4.3 The CT shall be of dead tank/ live tank design and shall be so constructed that it can be easily transported to site within the allowable transport limitation and in horizontal position if the transport limitations so demand. The CTs shall be hermetically sealed and method of such sealing shall be detailed out in the bid.

5.5 TERMINAL CONNECTORS :

The terminal connectors required for connection of the current transformer to Owner's bus bar, shall be in Bidder's scope. Terminal connector suitable for Twin Zebra ACSR with arrangement for horizontal and vertical takeoff shall be provided for 220 kV, 132 kV & 33 kV, 800 Amp CTs whereas for 33 kV, 2000 Amp CTs, terminal connector suitable for 4" IPS Aluminum tube with arrangement for horizontal takeoff shall be provided.

The terminal connector shall conform to the latest version of IS:5561 or equivalent International Standard. The drawings for terminal connectors are enclosed with Bid document for guidance.

The design of clamp shall be to our approval. The details of current take off as required by us shall be detailed out in drawing and shall be submitted along with the bid. In respect of the terminal connectors following should be ensured:-

- a. The terminal connector should be made of A6 Aluminium Alloy and by gravity/pressure die cast only. Sand casted terminal connectors are not acceptable. The current rating of terminal connector will be 1.5 times the rated current. The current density shall not exceed 1 Amp/sq.mm. in any part.
- b. All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges should be rounded off.
- c. No part of clamp shall be less than 12mm thick.
- d. All current carrying parts shall be designed and manufactured to have minimum contact resistance. The bimetallic strips/sleeve shall be 2 mm thick.
- e. All nuts/bolts/washers shall be made of HDG Mild steel with minimum diameter of 12 mm.
- f. The conductor should be tightened by six bolts. Conductor hold length must not be less than 100mm.
- l. The clamp for Twin Zebra ACSR conductor shall be made in three pieces so that each conductor may be tightened separately.
- m. Size of terminal connector for which the clamp is designed and also rated current under site conditions shall be embossed / punched on each part of clamp except hardware.
- n. The surface of clamps to be tightened by six bolts should be flat in shape so that it may be possible to open the nuts and bolts by normal spanners. Therefore, any type of groove in the clamp body for fixing of nuts should be avoided.
- o. The portion of clamp to hold the conductor should be flat and straight and not zig-zag in construction, at both the sides, so that holding of clamp by throttling action of current may be avoided.

- p. Space of at least 50% of diameter of nuts should be available after the hole at both the sides of conductor holding portion for better mechanical strength.

5.6 MOUNTING :

The Current Transformer shall be suitable for mounting on our steel structure. The mounting dimensions are indicated in enclosed Appendix-C2.

5.7 INSULATING OIL :

The insulating oil for first filling of oil in each transformer shall be in the scope of bidder. Only best quality new EHV Grade transformer oil should be used with the equipments with minimum BDV of 70 kV. The BDV of oil will have to be recorded in the test certificate. The oil shall comply in all respect with the provisions of the latest version of IS: 335 or IEC publication no. 296 (as amended up to date). The oil parameters viz., Tan Delta value, resistivity, PPM and BDV of oil filled in the CTs shall be recorded in the test certificates of respective CT.

5.8 SURFACE FINISH :

The metal tanks shall be coated with atleast two coats of zinc rich epoxy painting or hot dip galvanised. All the ferrous hardware, exposed to atmosphere, shall be hot dip galvanised conforming to the latest version of IS: 2629 or equivalent International Standard. All other fixing nuts, bolts, washers shall be made out of HDG Mild steel.

It has been observed that certain CTs received by us in the past did not have good quality painting and with passage of time, flakes of paint got peeled off. The internal and external surfaces of metal tanks to be painted shall be shot/ sand blasted to remove all rust and scale of foreign adhering matter or grease. All steel surfaces in contact with insulating oil shall be hot dip galvanised or painted with two coats of heat resistant, oil insulating varnish. All paints shall be carefully selected to withstand extremes of weather. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

5.9 TEMPERATURE RISE :

The temperature rise of current transformer when carrying a primary current equal to 125% of rated current at a rated frequency and with a unity power factor burden corresponding to rated output connected at the secondary winding shall be 5° (five degrees) less than the permissible values given in the latest version of IS:2705 or equivalent international standard.

5.10 ARRANGEMENT FOR COMPENSATION OF OIL VOLUME :

5.10.1 In 220 kV and 132 kV Current Transformer, , stainless steel bellows shall be used for compensation of variation in the oil volume due to variation in ambient temperature. No other arrangement for this purpose shall be accepted. For indication of oil level, a ground glass window shall be provided to monitor the position of metal bellow.

5.10.2 In 33 kV current Transformer, for compensation of variation in the oil volume due to variation in ambient temperature, stainless steel bellows or any other proven suitable arrangement which may be equal or superior shall be used. Rubber diaphragms shall not be permitted for this purpose. For indication of oil level, a ground glass window shall be provided to monitor the position of metal bellow.

5.11 SECONDARY TERMINALS TERMINATION :

The following may please be noted for strict compliance: -

- (a) The secondary terminals shall be terminated to stud type non-disconnecting terminal blocks inside the terminal box.
- (b) The outer secondary terminal box should have two separate compartments with separate covers for the purpose of sealing. Each compartment will have the terminals of each metering core. Suitable gland plates for both the compartments will have to be provided. This is required because covers of metering cores compartment will be provided with suitable seals to be operated by separate agencies who will verify the cover periodically for metering purpose.
- (c) The terminal box shall be provided with removable gland plate and gland/s suitable for 1100 volts grade, PVC insulated, PVC sheathed multicore 2.5 sq.mm. stranded copper cable.
- (d) The terminal box shall be dust and vermin proof. Suitable arrangement shall be made for drying of air inside the secondary terminal box.
- (e) The dimensions of the terminal box and its openings shall be adequate to enable easy access and working space with use of normal tools.
- (f) The outer cover of secondary terminal box shall have provision for sealing by way of insertion of wire in the bolt hole. A drawing indicating above arrangement may please be furnished alongwith the bid.
- (g) For measuring tan delta values, separate tan delta test terminal shall be provided on the opposite side of secondary terminal box for 220 kV & 132 kV CTs.

5.12 POLARITY :

Polarity shall be invariably marked on each primary and secondary terminal. Facility shall be provided for short circuiting & grounding of the CT secondary terminals inside the terminal box. All markings shall be engraved or through anodized plate which should be firmly fixed.

5.13 RATING PLATE :

The CT shall be provided with a rating plate with dimensions and markings as per the latest version of IS: 2705/IEC-60044 (1). This rating plate shall also contain our purchase order no. & date, date of pre-dispatch inspection of CT, values of tan delta & capacitance measured at 10 kV (in case of 220 kV & 132 kV CTs) and guarantee period of equipment. The markings shall be punched/ engraved and not painted.

5.14 OIL FILLING AND SEALING :

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 sampling valve provided at the bottom of CT should be protected by providing metallic cover or blanking plug / plate. Valve should be welded to avoid any leakage. Nitrogen filling valve should be fitted with an indicator or cap to prevent leakage of nitrogen. The method adopted for hermetic sealing shall be described in the bid.

5.15 CASTING :

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

5.16 INSTRUMENT SECURITY FACTOR :

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 latest version of IS:2705 or IEC-60044(1).

5.17 EARTHING :

Current transformer shall be provided with two separate earthing terminals for bolted connection to 75 x 10 mm / 50 x 8 mm MS flat to be provided by the Purchaser for connection to station earth-mat.

5.18 LIFTING ARRANGEMENT :

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 as to avoid any damage to the porcelain housing or the tanks during lifting for installation/transport. Necessary sling guides shall be offered which shall be of removable type.

5.19 PRIMARY WINDING :

- (a) For 220 kV and 132 kV Current Transformer, primary winding shall be made out of electrolytic grade 99.9% conductivity Copper/ Aluminium conductor. Conductors used for the primary winding shall be rigid and housed in rigid metallic shell. Joints in the primary winding shall not be provided. For primary winding current density shall not exceed 1.50 Amp. / sq.mm in case of copper and 1.00 Amp/ sq.mm in case of Aluminium, at continuous overloading of 25% above rated current.
- (b) For 33 kV Current Transformers, primary winding shall be made out of electrolytic grade 99.9% conductivity copper. Conductors used for the primary winding shall be rigid and housed in rigid metallic shell. Joints in the primary winding shall not be provided. For primary winding current density shall not exceed 1.50 Amp / sq.mm at continuous overloading of 25% above rated current.
- (c) The design density for short circuit current as well as conductivity of the metal used for primary winding shall meet the requirement of latest version of IS:2705 or IEC-60044(1). The Bidder in his bid shall furnish detailed calculations for selection of winding cross-sections. The selected amp-turns for CTs shall be justified on the basis of type test reports.
- (d) It is desired that from the point of view of adequate mechanical strength in the normal course and also during short circuit, proper precaution should be taken. The following arrangement or any equivalent suitable arrangement, which should be described in the bid, shall be provided for this purpose for dead tank type CT:
 - i. The primary conductor should be housed in suitable tube of adequate mechanical strength. The arrangement shall be explained through suitable drawing and material of tube should be indicated.
 - ii. The primary conductor should be held firmly and for this purpose suitable clamping arrangement at the bottom shall be provided and

- explained through suitable sketch. Firm clamping arrangement is a must and holding of winding using nylon rope etc. shall not be acceptable.
- iii. The neck of tube should be properly fixed to support the primary windings of CT. It is suggested that piece of strong material of length around 8 inches on both the sides of tube should be fixed to properly hold the primary windings so that dislocation of primary windings during transport is avoided.
 - iv. The edges of the pipe should be smoothed to avoid any damage to insulation.
 - v. A sturdy arrangement should be provided to secure the bottom of primary winding in place. Also separate arrangement will be necessary to hold the secondary windings in place. The arrangements for primary winding and for secondary cores shall be independent of each other. Any common arrangement is not acceptable.
 - vi. At least two clampings should be done on each side of the primary winding and a minimum number of 4 No. nuts and bolts should be provided on each side. The nuts and bolts arrangement used for holding active parts should be suitably dimensioned. The bolts should be tightened with the nuts and also a check nut for proper locking.
 - vii. The arrangement for bringing out connection from outer shielding for grounding purpose should be made properly. For this purpose the full length copper strip of width around 2 cm. may be used on the outer dia. of bottom portion to ensure proper shielding / earthing of outer condenser. For shielding preferably aluminium foil should be used.
 - viii. Minimum 10 mm space should be available between neck of eye bolt and porcelain for adequate passage of oil.

5.20 SECONDARY WINDINGS :

Suitably insulated copper wire of 99.9% conductivity electrolytic grade shall be used for secondary windings. The exciting current of the CT shall be as low as possible. The Bidder shall furnish along with his bid the magnetization curve/s for all the core/s.

Enamel, if used for conductor insulation, shall be either polyvinyl acetate type or amide type and shall meet the requirements of latest version of IS: 4800 or equivalent International Standard.

5.21 PRIMARY TERMINALS :

For various ratings of CTs selection of primary terminal shall be made carefully. The primary terminal on either side of the tank shall be of proper length preferably not less than 80 mm to accommodate terminal connector and ratio changing strip. The dia/ size of the primary terminal shall be such that the current rating available is at least 1.5 times the rated current of the CT. For 33 kV, 2000 Amp CTs, twin studs shall be provided for each primary terminal. It would be obligatory on the part of the bidder to specify material, diameter, length and current rating of primary terminal which shall be used for CTs of different ratio. The primary terminal studs to accommodate terminal connector for take off shall be plain and not threaded. The details may be explained through suitable sketch.

The primary terminals shall be of 99.9% conductivity heavily tinned electrolytic copper or aluminium alloy. The minimum thickness of tinning shall be 15 microns.

5.22 SECONDARY TERMINALS :

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 studs shall be of proper size preferably not less than 8 mm. The length of at least 15 mm shall be available on the studs for inserting the leads. The horizontal spacing between centres of the adjacent studs shall be at least 1.5 times the outside diameter of the nuts. The arrangement should be shown through suitable sketch.

5.23 CORE:

The grade M4 toroidal core or any equivalent/ superior grade core material shall be of high-grade non-ageing electrical silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy at both normal and over currents. The current transformer core to be used for metering shall be made of mumetal / nano crystalline or similar high grade magnetic material and shall be of accuracy class specified. The saturation factor of this core shall be low enough not to cause any damage to measuring instruments in the event of maximum short circuit current. The 5P10 core shall be designed for a minimum saturation factor of 10 for the highest setting. The magnetization curves for this core shall be furnished with the bid. As far as PS class core is concerned all precautions shall be taken in design to achieve the knee point voltage without exceeding requirement of excitation current as specified in Annexure-II. Magnetisation curve for the same shall be furnished.

5.24 RATIO CHANGING ARRANGEMENT :

Primary current ratio changing arrangement in 220 kV CTs of dual ratio shall be made by providing ratio changing strip on the primary side.

5.25 SPECIAL REQUIREMENT FOR CURRENT TRANSFORMERS :

5.25.1 OVERLOADING:

The CTs shall be suitable for continuous overloading upto 125% maximum rated primary current. The following requirements therefore should be noted:-

- a) It should be specifically confirmed that the CTs offered against the specification are suitable for continuous overloading of 25% above rated current. For this purpose, precaution taken in design of equipment may be suitably explained.
- b) For all the CTs which are to be designed for 25% overloading, the permissible temperature rise of CT winding over the reference ambient temperature of 50° C at 125% rated current, rated frequency and with a unity power factor burden corresponding to the rated output connected to the secondary windings shall not exceed 45°, i.e. 5° less than the permissible value as specified in IS.

5.25.2 CONSISTENCY OF ACCURACY :

It should be specifically confirmed that with 25% continuous overloading, the ratio/ phase angle errors of the CTs shall be maintained strictly within specified limits without any drift and no variation shall take place due to overloading of Current Transformers.

5.26 MEASUREMENT OF CAPACITANCE AND TAN DELTA:

For monitoring the condition of insulation, tan delta and capacitance values of 220 kV & 132 kV CTs shall be measured periodically by the purchaser after commissioning of CT. The values of tan delta and capacitance measured at 5 kV, 10 kV & $U_m/\sqrt{3}$ for

all CTs should be mentioned in the routine test report. In this regard, following may be noted by the tenderers:-

- a. If the value of tan delta, measured at 10 kV, during performance guarantee period of CT is found to be more than 0.7%, the supplier shall replace the CT free of cost.
- b. If the value of capacitance, measured at 10 kV, during performance guarantee period of CT is found to have increased by more than 3% in comparison to the factory test value, the supplier shall replace the CT free of cost.

6.0 TESTS :

6.1 TYPE TEST :

All the equipments offered, shall be fully type tested as per relevant Indian Standards or any equivalent International Standard during the last **five** years from the date of bid opening. Copy of type test reports shall be enclosed with the bid. For any change in the design/ type already type tested and the design/ type offered against this bid, the Purchaser reserves the right to demand repetition of same or all type tests without any extra cost.

For 220 kV & 132 kV CTs, the supplier has to furnish type test reports for the following tests :-

- i. Chopped Impulse Test
- ii. Multiple Chopped Impulse Test
- iii. Radio Interference Voltage Test
- iv. Mechanical Test on Terminals
- v. Seismic Test
- vi. Tan Delta Test at full Voltage
- vii. Thermal Stability Test
- viii. Temperature Coefficient Test

6.2 ACCEPTANCE AND ROUTINE TESTS :

6.2.1 The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards or equivalent International Standards in presence of Purchaser's representative.

6.2.2 In addition to other acceptance tests for 220 kV and 132 kV CTs, the following tests shall also be carried out :-

a/ Sealing test :

The sealing test shall be carried out on minimum one randomly selected CT of each ratio out of each offered lot of CTs. The procedure for sealing test is as under :-

- i. Test shall be performed on completely assembled unit.
- ii. Test shall be performed on proto-type as well as during acceptance test on minimum one randomly selected unit.
- iii. Temperature of CT under test will be elevated and maintained at 50⁰ C and simultaneously it shall be subjected to internal pressure of 103 kPa (@1.1 kg / sq.cm) for 12 hours.
- iv. Arrangement shall be made by manufacturer to maintain required pressure and temperature for 12 hours.
- v. During and after the test, there shall not be any oil leakage from any part or joint of CT.

- vi. Readings of temperature, internal pressure applied and duration of test along with observation of leakage, if any, shall be noted in inspection report.

b/ Temperature Coefficient Test:

This test will be carried out on minimum one randomly selected 220 kV and 132 kV CT of each ratio out of each offered lot of CTs.

c/ Thermal stability test:

This test will be carried out on minimum one randomly selected 220 kV and 132 kV CT out of each offered lot of CTs.

d/ Tests on Oil:

The following tests shall be carried out on minimum one randomly selected 220 kV and 132 kV CT out of each offered lot and shall be conducted after HV test:-

- i) BDV Test
- ii) Tan Delta Test
- iii) Water ppm Test
- iv) Specific Resistance at 75 Deg C & 90 deg C
- v) Viscosity
- vi) Total Acidity
- vii) Dissolved Gas Analysis Test

Copy of test report received from oil manufacturer will have to be submitted.

- e/ Measurement of tan delta and capacitance at 5 kV, 10 kV & $U_m/\sqrt{3}$ also shall be recorded in the acceptance and routine test report of 220 kV & 132 kV CTs.

6.2.3 Immediately after finalization of the programme of type/ acceptance/ routine testing, the manufacturer shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

6.2.4 During measurement of errors, the resistance of leads connecting the CT under test, the burden box and the standard CT to the measuring bridge should be kept minimum so that accuracy of measurement of CT errors is negligible

7.0 INSPECTION :

- i. 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 Bidder shall provide all facilities for unrestricted inspection of the Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.
- ii. The successful Bidder 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 arrangements could be made for inspection.
- iii. During final inspection of CTs & PTs, the purchaser reserves the right to carry out thorough internal inspection of two or three CTs & PTs randomly selected out of offered lot, during which the CTs & PTs will be completely opened to verify the dimensional and other details.
- iv. Besides above purchaser reserves the right to carry out type test at NABL accredited laboratory on one of the randomly selected CT & PT out of the supplied / offered CTs & PTs.
- v. No material shall be dispatched from the point of manufacture unless the material has been satisfactorily inspected and tested.

- vi. The acceptance of any quantity of the equipment shall in no way relieve the successful bidder of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipment are later found to be defective.

8.0 QUALITY ASSURANCE PLAN & STAGE INSPECTION :

QAP & stage inspection shall be as per Volume-II, Part-6, Book-I.

9.0 DOCUMENTATION :

9.1 All drawings shall conform to latest version of international standards organization (ISO) 'A' series of drawing sheet/ Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I.Units.

9.2 LIST OF DRAWINGS AND DOCUMENTS :

The Bidder shall furnish four sets of following details and drawings along with his bid.

- a. General outline and assembly drawings of the equipment.
- b. Graphs showing the performance of equipments in regard to magnetization characteristics.
- c. Sectional views showing:
 - i. General Constructional Features.
 - ii. Materials/ Gaskets/ Sealings used.
 - iii. The insulation of the winding arrangements, method of connection of the primary/ secondary winding to the primary/ secondary terminals etc.
 - iv. Porcelain used and its dimensions alongwith the mechanical and electrical characteristics
- d. Complete primary terminal assembly which should include the following :-
 - i. Complete primary terminal.
 - ii. All sub-assemblies with the help of which the primary terminal shall be brought out from the top tank including washers/ locking arrangements, check nut, main nut etc.
 - iii. Sub-assembly to demonstrate the arrangement of connection of primary winding to primary terminal inside the tank.
 - iv. Ratio changing strip and terminal connectors suitable for twin moose / twin zebra ACSR Conductor.
- e. Details of rupture type pressure relief device with diaphragm, specifying size of diaphragm and it's thickness etc.
- f. Name plate.
- g. Schematic drawing.
- h. Type Test reports in case the equipment has already been type tested.
- i. Test reports, literature, pamphlets of the bought out items and raw material.

9.3 The successful Bidder shall within two weeks of placement of order, submit four sets of final versions of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/approval on the drawings to the Bidder within reasonable time. The Bidder 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 Purchaser's comments. After receipt of Purchaser's approval, the Bidder

shall within three weeks submit 20 prints and two good quality reproducible of the approved drawings for Purchaser's use.

- 9.4 The Bidder for distribution, before commencement of supply, shall submit six sets of the type test reports, duly approved by the Purchaser. Adequate copies of acceptance and routine tests certificates, duly approved by the Purchaser shall accompany the dispatched consignment.
- 9.5 The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Bidder's risk.
- 9.6 Twenty (20) copies of nicely printed and bound volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment supplied shall be submitted by the Bidder for distribution, prior to the dispatch of the equipment. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. The manual shall also contain a set of all the approved drawings, type test reports etc.
- 9.7 Approval of drawings/ work by Purchaser shall not relieve the Bidder of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material, which in his judgment is not in full accordance therewith.

10.0 Important Requirements for ensuring quality of manufacture and processing of equipments.

- 10.1 For processing and vacuum treatment of core / coil assembly, it is desired that a separate heating chamber and a separate vacuum chamber should have been installed for vacuum treatment of core / coil assembly. Facility should be available to measure quantum of water released during vacuum treatment of core/coil assembly. Make, quality and capacity of vacuum chamber alongwith vacuum level may be brought out.
- 10.2 Completely dust free shop should be available for preparation of winding. This should be confirmed.
- 10.3 What is the process employed for wrapping of insulation on primary winding. Is it being done manually or through suitable wrapping machine.
- 10.4 Various stages of quality checks during manufacture should be highlighted.

11.0 PACKING AND FORWARDING :

Bidder shall ensure that 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.

12.0 DEVIATION FROM TECHNICAL PARTICULARS :

No deviation from technical particulars of equipment and materials will be allowed, which may please be noted.

APPENDIX – C1
I) PRINCIPAL TECHNICAL PARAMETERS OF
CURRENT TRANSFORMERS

SNo.	Item	220 kV	132 kV	33 kV
1	Type of CT/ Installation	Single phase, dead tank hair pin OR Live Tank, oil filled, hermetically sealed, outdoor type	Single phase, dead tank hair pin OR Live tank, oil filled, hermetically sealed, outdoor type	Single phase, dead tank, oil filled, hermetically sealed, outdoor type
2	Type of mounting	Pedestal Type		
3	Suitable for :-			
a.	System Frequency	50 Hz		
b.	Rated Voltage (kV rms)	245	145	36
4	Nominal System Voltage (kV rms)	220	132	33
5	Highest System Voltage (kV rms)	245	145	36
6	Current Ratio	i) 800-400/1-1-1 A 1-1-1 A	i) 800/1-1-1 A ii) 400/1-1-1 A iii) 200/1-1-1 A	i) 2000/1-1-1-1 A ii) 800/1-1 A
7	No. of Secondary Cores	5	3	5 (for 2000 A CT), 2 (for 800 A CT)
8	Ratio taps	Dual ratio CT	Single ratio CT	Single ratio CT
9	Method of earthing of the system to be connected to	Effectively earthed		
10	Rated continuous thermal current	125% of rated current.		
11	Acceptable limit of temperature rise above the specified ambient temperature for continuous operation at rated current	5 Degree Centigrade less than the limit specified in latest version of IS 2705 or equivalent international standard taking ambient temperature as 50 Degree Centigrade		
12	Acceptable partial discharge level at 1.1 times the rated voltage	Less than 10 pico coulombs		-
13	Radio interference voltage at 1.1 times the rated voltage	Less than 500 micro volts		-
14	250 / 2500 micro second switching impulse withstand voltage (kVp) (dry & wet)	-	-	-
15	1.2/50 microsecond lightning impulse withstand voltage (kVp)	1050	650	170

SNo.	Item	220 kV	132 kV	33 kV
16	1 minute dry/wet power frequency withstand voltage primary winding (kV rms)	460	275	70
17	Power frequency overvoltage withstand requirements for secondary winding (kV rms)	5	5	5
18	Min. creepage distance of porcelain housing (mm)	6125	3625	900
19	Rated short time withstand current with duration (KA rms for seconds)	40 KA for 1 sec.	40 KA for 1 sec.	26.2 KA for 2 sec.
20	Rated dynamic withstand current (KAp)	100	100	65.5
21	Visual corona extinction voltage (kV rms)	176	106	-
22	Seismic acceleration (horizontal)	0.3g	0.3g	0.3g
23	Tan Delta at 90 ⁰ C (max)	0.005	0.005	-
24	Material for Primary Winding	Copper/ Al	Copper/ Al	Copper
25	Terminal Connector			
a.	Type	Rigid Type (One clamp shall be through clamp type)	Rigid Type (One clamp shall be through clamp type)	Rigid Type
b.	Quantity	2 No	2 No	2 No
c.	Conductor	Twin Zebra ACSR	Twin /Single Zebra ACSR	4" IPS Aluminium tube for 2000 Amp CT and Twin Zebra for 800 Amp CT
d.	Arrangement for current take off	Horizontal (for 33 kV 2000 Amp CT), Horizontal & Vertical takeoff (for other rating of CTs).		
26	Mounting details (mm)	400x750 (As per drg. 220 kV CT&PT Base Plate)	450x450 (As per drg. 132 kV CT Base Plate)	200x350 (As per drg. 33 kV CT,PT,LA,PI Base plate)

II) DETAILS OF CT RATIO AND CORE PARTICULARS

i. **220 kV CT**

No. of cores	Core no.	Application	Current ratio	Output burden (VA)	Accuracy Class as per IEC 60044(1)	Min. knee point voltage (Volts)	Max. CT Sec. Winding resistance (Ohms)	Max. Exciting current at knee point voltage (mA)	Instrument Security factor
1	2	3	4	5	6	7	8	9	10
5	1	Main Protection	800-400/ 1-1-1-1-1A	N.A.	PS	1100	6	50	-
	2	Main Protection	800-400/ 1-1-1-1-1A	N.A.	PS	1100.	6	50	-
	3	Main Protection	800-400/ 1-1-1-1-1A	N.A.	PS	1100.	6	50	-
	4	Metering	800-400/ 1-1-1-1-1A	15	0.2S	N.A.	N.A	N.A.	5 or less
	5	Back up	800-400/ 1-1-1-1-1A	30	5P10	300	6	50	-

ii **132 kV CT**

No. of cores	Core no.	Application	Current ratio	Out-put burden (VA)	Accuracy Class as per IEC 185	Min. knee point voltage (Volts)	Max. CT Sec. Winding resistance (Ohms)	Max. Exciting current at knee point voltage (mA)	Instrument Security factor
1	2	3	4	5	6	7	8	9	10
3	1	Main Protection	800/1-1-1A 400/1-1-1A 200/1-1-1A	N.A.	PS	1100	6	50	-
	2	Back up	800/1-1-1A 400/1-1-1A 200/1-1-1A	30	5P10	300	3	50	-
	3	Metering	800/1-1-1A 400/1-1-1A 200/1-1-1A	15	0.2S	N.A.	N.A	50	5 or less

iii) **33 kV CT**

(a) CT ratio 2000/1-1-1-1-1 Amp.

No. Of cores	Core no.	Application	Current ratio (Amp)	Output burden (VA)	Accuracy Classs per IEC 185	Min. knee point voltage (Volts)	Max. CT Sec. Winding resistance (Ohms)	Max. Exciting current at knee point voltage (mA)	Instrument Security factor
1	2	3	4	5	6	7	8	9	10
5	1	Main Protection	2000/1	N.A.	PS	1100	6	50	-
	2	Main Protection	2000/1	N.A.	PS	1100	6	50	-
	3	Back-up Protection	2000/1	30	5P10	-	3	100	-
	4	Metering	2000/1	15	0.2S	N.A.	N.A.	N.A.	5 or Less
	5	Metering	2000/1	15	0.2S	N.A.	N.A.	N.A.	5 or Less

(b) CT ratio 800/1-1 Amp

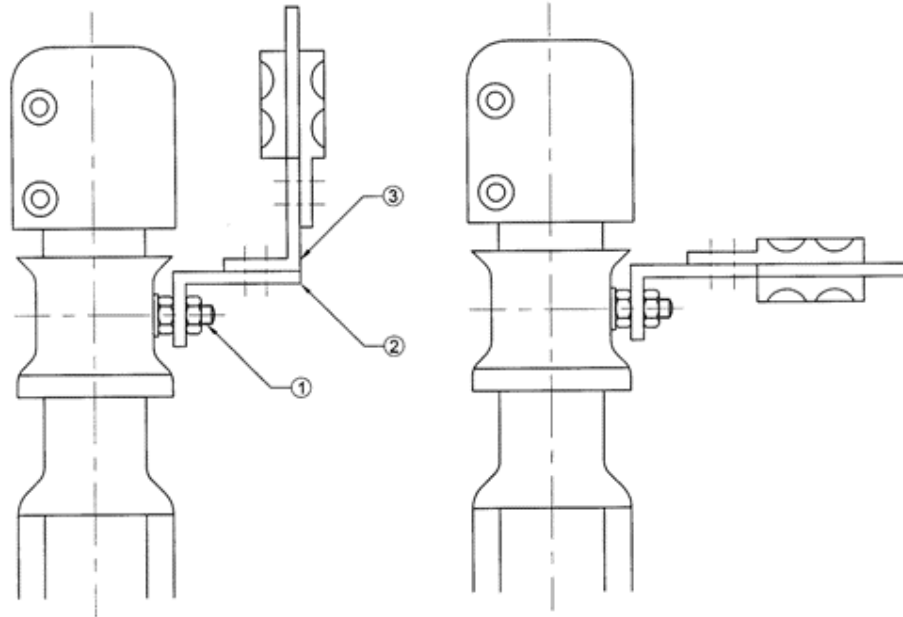
No. Of cores	Core no.	Application	Current ratio (Amp)	Output burden (VA)	Accuracy Classs per IEC 185	Min. knee point voltage (Volts)	Max. CT Sec. Winding resistance (Ohms)	Max. Exciting current at knee point voltage (mA)	Instrument Security factor
1	2	3	4	5	6	7	8	9	10
2	1	Back-up Protection	800/1	30	5P10	-	3	100	-
	2	Metering	800/1	15	0.2S	N.A.	N.A.	N.A.	5 or Less

APPENDIX- C2**DRAWING OF TERMINAL CONNECTOR & BASE PLATE DETAILS**

The following drawings showing mounting dimensions of structures and general requirement of terminal connectors are enclosed here with for general guidance:

SNo.	Description
1	Vertical / Horizontal take off Arrangement of Terminal Connector
2	Terminal connector suitable for single zebra conductor
3	Terminal connector suitable for twin zebra ACSR conductor
4	Base Plate details for mounting of 220 kV CT
5	Base Plate details for mounting of 132 kV CT Structure
6	Base Plate details for mounting of 33 kV CT Structure

VERTICAL / HORIZONTAL TAKE OFF ARRANGEMENT OF
TERMINAL CONNECTOR



VERTICAL TAKE OFF

HORIZONTAL TAKE OFF

1. COPPER STUD OF 32MM/ 40MM DIA.
2. COPPER 'L' CLAMP OF 8 MM THICKNESS
3. ALUMINIUM ALLOY 'L' CLAMP OF 12 MM THICKNESS

NOTES

1. BOTH THE NUTS IN THE COPPER STUD SHOULD BE FACTORY TIGHTENED & LOCKED
2. ALL 'L' CLAMPS SHALL BE FITTED ON COPPER STUD DURING TRANSPORTATION BY SUITABLE NUT
3. SUITABLE FOR 800 AMP. / 1200 AMP. C.T.
4. CURRENT DENSITY FOR COPPER 1.5 AMP/Sq MM & FOR ALUMINIUM 1.0 AMP/ Sq MM

ALL DIMENSION ARE IN MM

TENDER PURPOSE ONLY.

M. P. POWER TRANSMISSION Co. LTD. JABALPUR

TERMINAL CONNECTOR FOR CURRENT TRANSFORMER
(WITH SINGLE ZEBRA ACSR)

HORIZONTAL TAKE - OFF

VERTICAL TAKE - OFF

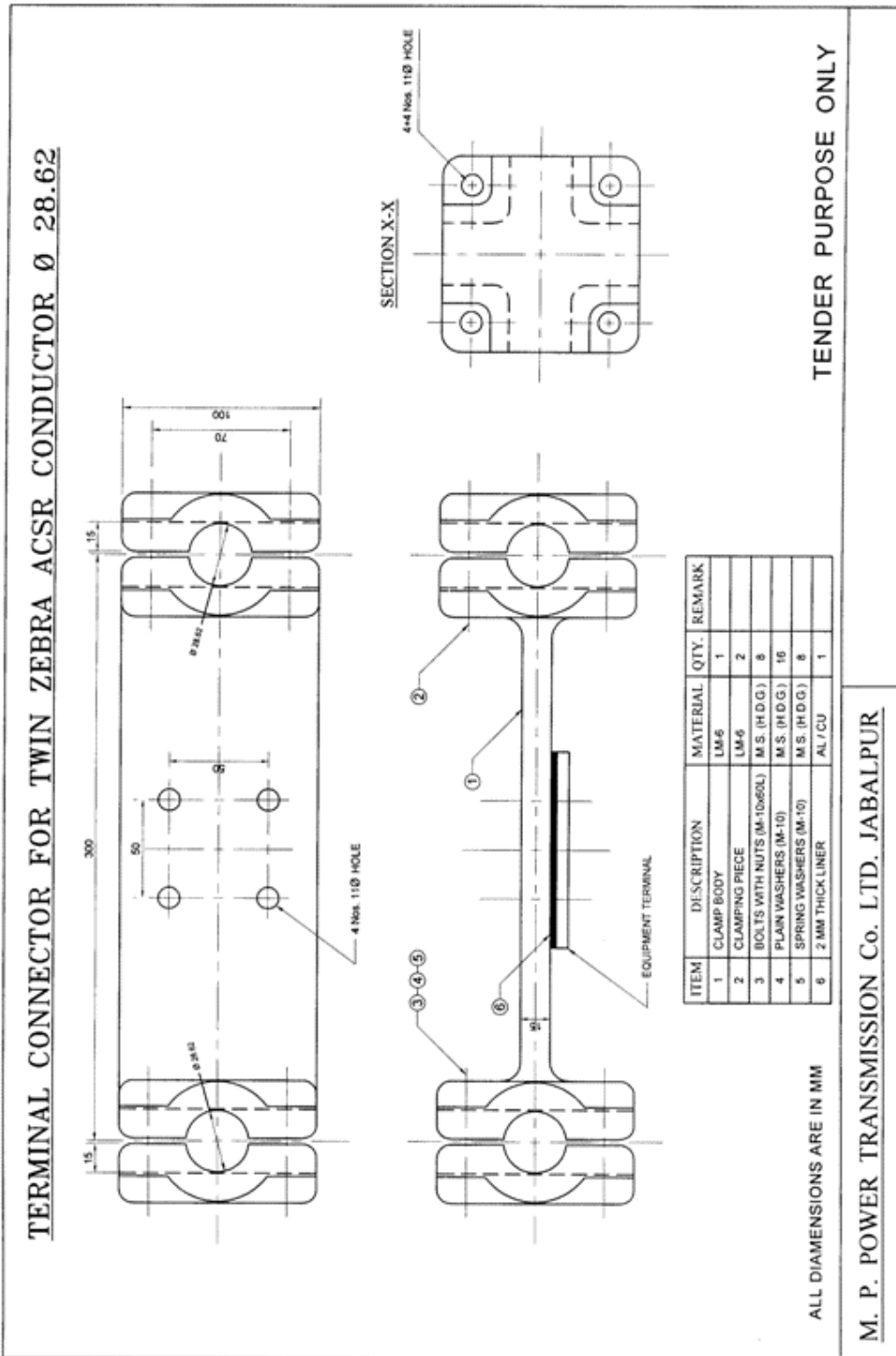
Sr.No.	DESCRIPTION	QTY.	MATERIAL	REMARKS
1	CLAMPING BODY	1	AL ALLOY	(A6)
2	CLAMPING PIECE	1	AL ALLOY	(A6)
3	CLAMPING PIECE	1	AL ALLOY	(A6)
4	HEX. BOLTS	8	M.S.	M-12 (H.D.G.)
5	HEX. NUTS	8	M.S.	M-12 (H.D.G.)
6	PLAIN WASHER	8	M.S.	M-12 (H.D.G.)
7	SPRING WASHER	8	SP. STEEL	M-12 (ELECTRO. GALV)
8	B-1 METALLIC SLEEVE	1	AL/CU	2mm THICK

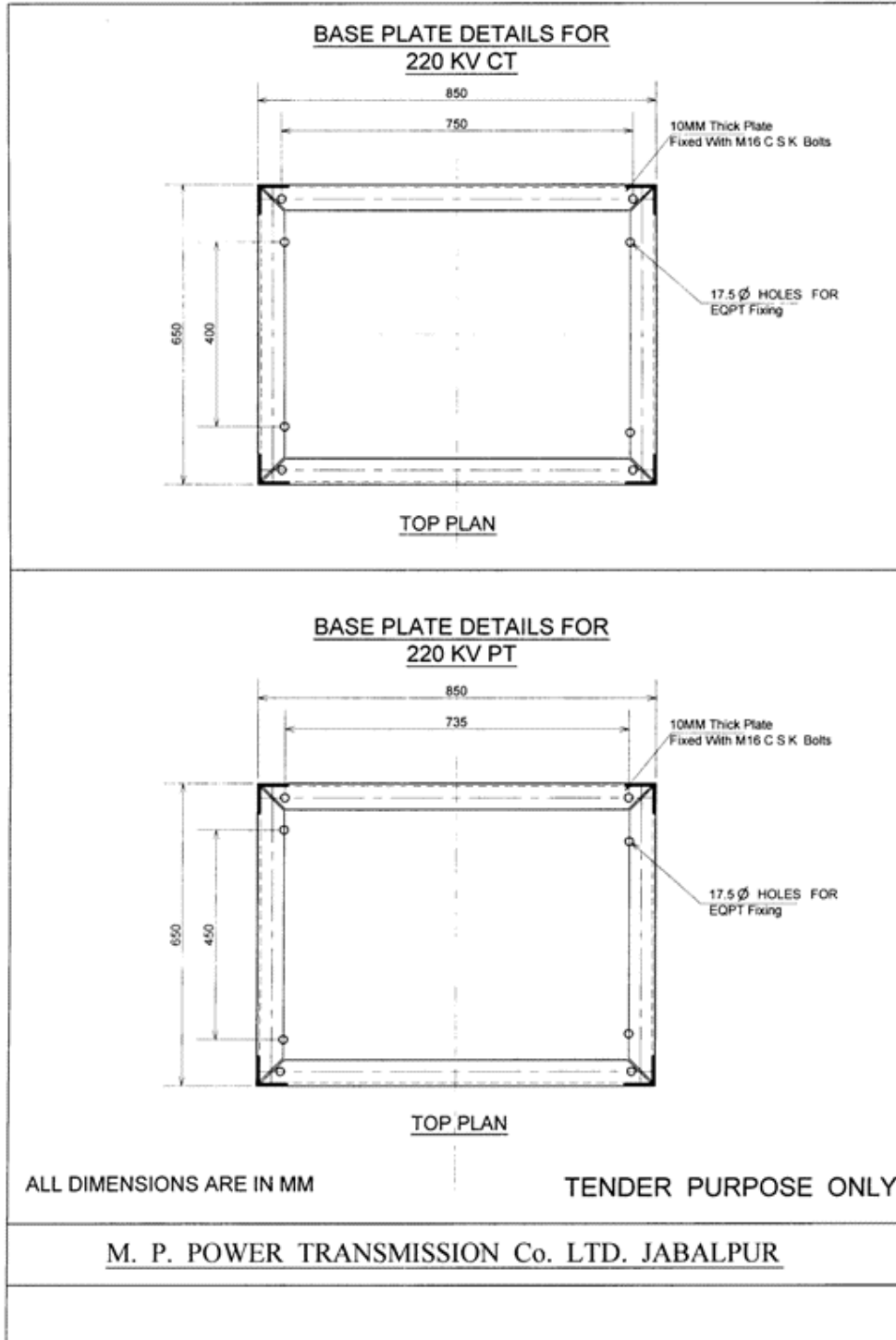
NOTE :-

1. DIMENSIONS INDICATED ARE SUBJECT TO MFG. TOLERANCE 5 mm.
2. ALL SHARP CORNERS SHALL BE ROUNDED OFF TO AVOID CORONA AND RADIO INTERFERENCE EFFECTS.
3. NO PART OF THE TERMINAL CONNECTOR LESS THAN 12 mm THICK.

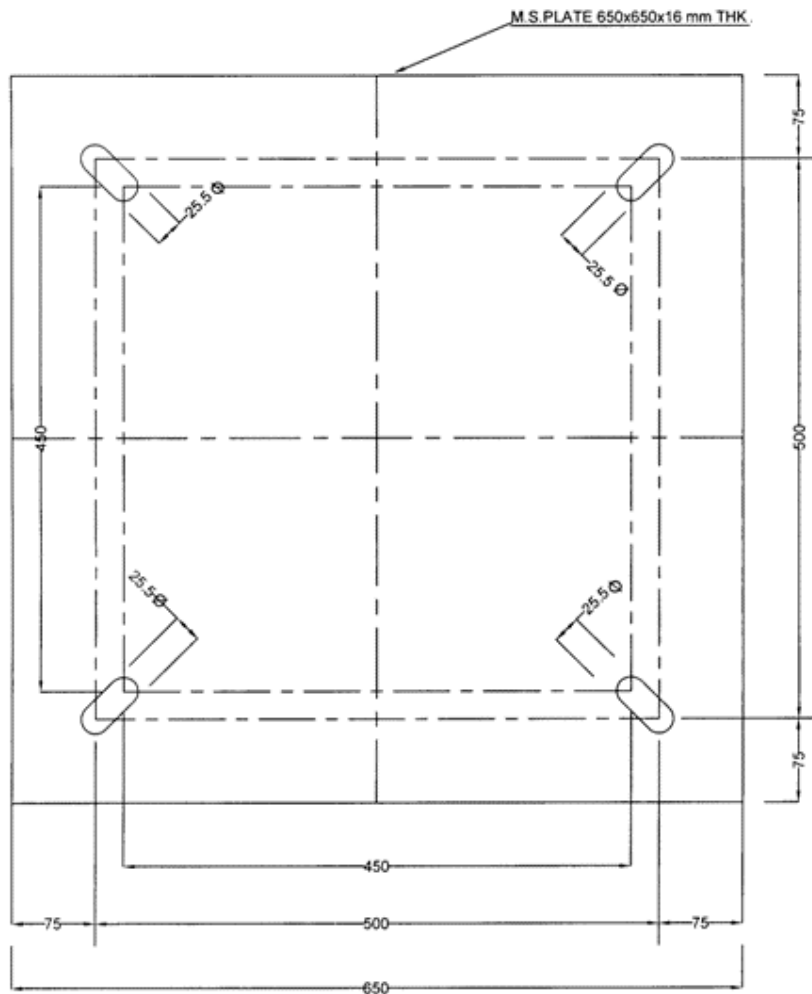
FOR TENDER PURPOSE ONLY

M. P. POWER TRANSMISSION Co. LTD. JABALPUR





**BASE PLATE DETAILS FOR
132 KV C.T. STRUCTURE (3CO5)**

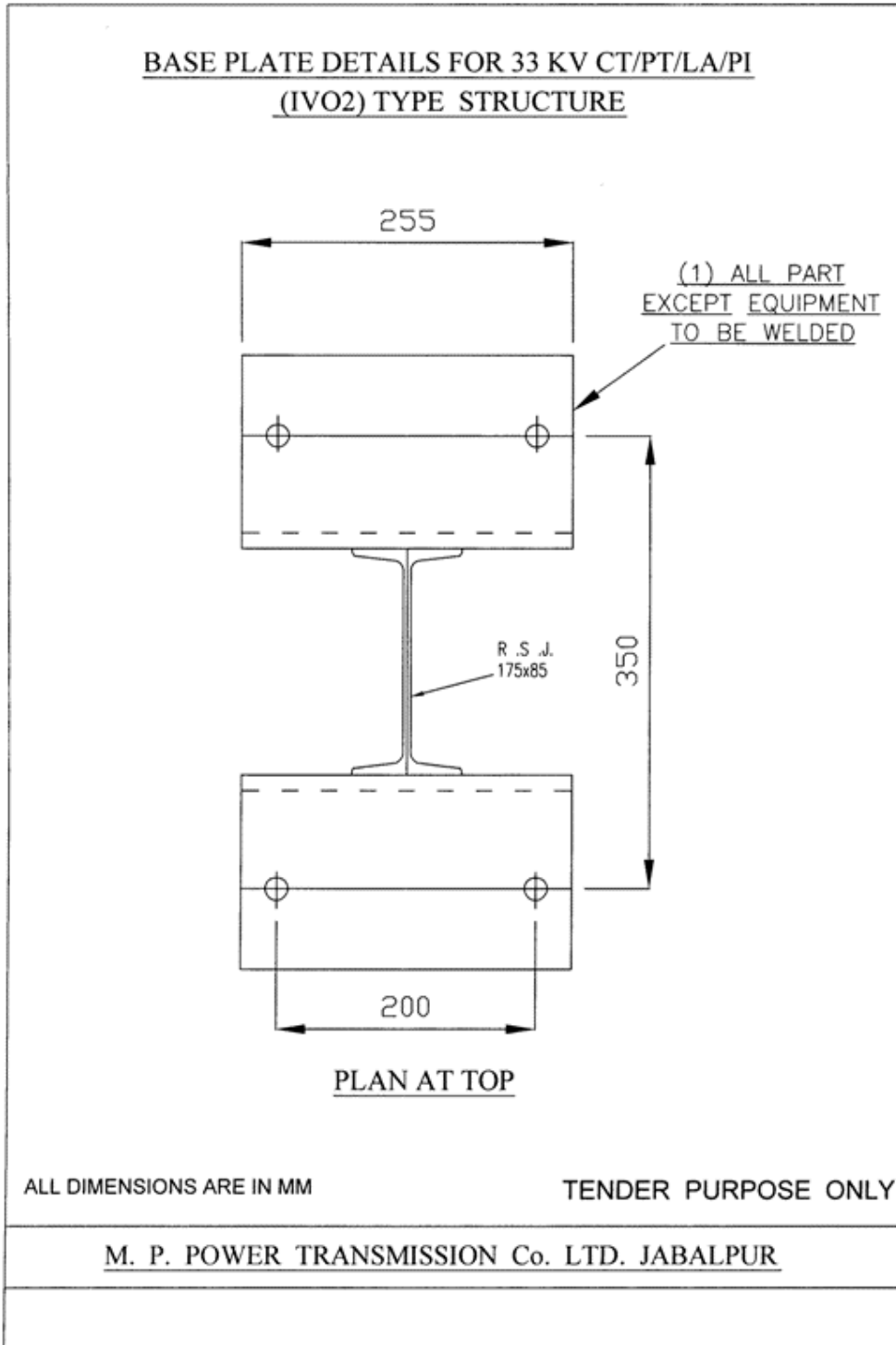


TOP PLAN

ALL DIMENSIONS ARE IN MM

TENDER PURPOSE ONLY

M. P. POWER TRANSMISSION Co. LTD. JABALPUR



SCHEDULE – I (A)**“DESCRIPTION OF EQUIPMENT FOR SCHEDULE FOR RATES AND PRICES TO BE FURNISHED IN VOLUME-VI”**

SNo.	Particulars of Equipment / Item	Qty.
A	400 kV Current Transformer	
1	400 kV Current Transformer ratio 2000-1000-500/1-1-1-1 Amp. complete with two Nos terminal connectors meeting all technical requirements of the specification	As per Price Schedule
B	220 kV Current Transformer	
2	220 kV Current Transformer ratio 800-400/1-1-1-1 Amp. complete with two No. terminal connectors, meeting all the technical requirements of tender specification	
C	132 kV Current Transformer	
3	132 kV Current Transformer ratio 800/1-1-1 Amp. complete with two No. terminal connectors, meeting all the technical requirements of tender specification	
4	132 kV Current Transformer ratio 400/1-1-1 Amp. complete with two No. terminal connectors, meeting all the technical requirements of tender specification.	
5	132 kV Current Transformer ratio 200/1-1-1 Amp. complete with two No. terminal connectors, meeting all the technical requirements of tender specification.	
D	33 kV Current Transformer	
6	33 kV Current Transformer ratio 2400/1-1-1-1 Amp. complete with two No. terminal connectors, meeting all the technical requirements of tender specification.	
7	33 kV Current Transformer ratio 800/1-1 Amp. complete with two No. terminal connectors, meeting all the technical requirements of tender specification.	

NOTE :

1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.
2. The quantity of above equipments has been mentioned in Volume VI

SECTION – II
2.1.3 - TECHNICAL SPECIFICATION FOR
POTENTIAL TRANSFORMERS

1.0 SCOPE :

The scope of this specification covers design, manufacturing and supply of equipment as per Section-I, Volume-II. The bidder mentioned in the Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The Purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment/material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS :

Applicable Standards for the offered equipments / items shall be as per Section-I.

3.0 CLIMATIC CONDITIONS :

Applicable climatic conditions shall be as per Section – I.

4.0 SYSTEM PARTICULARS :

Applicable System Particulars shall be as per Section – I.

5.0 BASIC DESIGN AND TECHNICAL REQUIREMENT FOR POTENTIAL TRANSFORMERS:

5.1 BASIC DESIGN :

- 5.1.1 The Potential Transformers will consist of a top dome /tank to accommodate primary terminal assembly, oil level gauge, pressure relief device (rupture type) etc. and a bottom tank to accommodate secondary core, terminal box etc. The equipment shall be outdoor, single phase oil immersed and self cooled type suitable for services indicated as above complete in all respect, conforming to modern practices of design and manufacture.

As stated, all potential transformers shall be paper insulated oil filled type. The potential transformers units after providing paper insulation shall be housed in the tank containing oil. Please note epoxy casting in primary & secondary cores is not acceptable. Manufacturers should briefly describe complete process of manufacturing

- 5.1.2 The insulation as per the latest version of IS: 4800 or equivalent International Standard of the potential transformers shall be so designed that the internal insulation shall have higher electrical withstand capability than the external insulation. The designed dielectric withstand values of external and internal insulations shall be clearly brought out in the guaranteed technical particulars. The dielectric withstand values specified in this specification are meant for fully assembled potential transformers.

5.1.3 The Potential Transformers covered under this specification shall meet the technical requirement indicated in Appendix-A enclosed with the specification.

5.2 PORCELAIN HOUSING :

5.2.1 The equipments should be designed using single porcelain housing. No metallic joints shall be provided in the porcelain. The housing shall be made of homogeneous, vitreous porcelain of high mechanical and electric 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 profile of porcelain shall be aerodynamic type as per the latest version of IEC-815.

5.2.2 Details of attachment of metallic flanges to the porcelain shall be brought out in the bid.

5.3 METAL TANK :

Special precaution will have to be taken towards selection of material for the metal tank and the following will have to be ensured.

- i. Material for metal tank which should be minimum 3 mm. thick. (i. e. mild steel / stainless steel / aluminium alloy) shall be carefully selected depending upon the primary current and the material should be clearly mentioned against technical questionnaire.
- ii. The practice of providing inserts of non-magnetic material in the body of the tank with suitable welding to reduce eddy current shall not be acceptable. This problem should be avoided by selection of tank of suitable material.
- iii. Welded joints have to be minimised to avoid possibility of oil leakage. In any case welding in horizontal plane shall be avoided. The material selected for the tank shall be justified with suitable explanation.
- iv. The slot / hole cutting in the bottom tank should be done smoothly to avoid any sharp edges within the tank. All welded surfaces need to be smoothen and shall be covered with pressboard or other insulating material of good mechanical properties.
- v. The bottom tank should not have any dents and pittings to ensure proper tightening of gasket and to avoid any oil leakage. Fabrication of bottom tank shall be done by utilizing fresh sheet steel only.

5.4 PREVENTION OF OIL LEAKAGES AND ENTRY OF MOISTURE :

5.4.1 The sealing of potential transformers units shall be properly achieved. The following should be properly taken care of & arrangement provided by the Bidder shall be described.

- a) Locations of emergence of primary and secondary terminals.
- b) Interface between porcelain housing and metal tank.
- c) Cover of the secondary terminal box.

5.4.2 For gasketed joints, wherever used, nitrile butyl rubber gaskets, neoprene or any other improved material shall be used. No cork gasket shall be used. The nitrile butyl rubber 'O' Ring should be fitted in properly machined groove with

adequate space for accommodating the gasket under compression at interface between main porcelain bottom flange and metal tank. You have to submit complete details and justify that the quality of gaskets which will be used between the joints and also for mounting of oil level indicator will be of best quality to avoid leakage of oil. The quality of gasket should be selected keeping in mind that the ambient temperature in MP now touches 50 deg. centigrade

- 5.4.3 The potential transformers shall be so constructed that it can be easily transported to site within the allowable transport limitation and in horizontal position if the transport limitations so demand. The equipment shall be hermetically sealed and method of such sealing shall be detailed out in the bid.

5.5 TERMINAL CONNECTORS :

The terminal connectors required for connection of the potential transformers to Owner's bus bar, shall be in bidder's scope. The terminal connectors shall be suitable for Zebra ACSR Conductor with arrangement for both vertical and horizontal take off. The terminal connector shall conform to the latest version of IS: 5561 or equivalent International Standard. The drawing for terminal connector is enclosed with the specification for guidance.

The design of clamp shall be to our approval. The details of current take off as required by us should be detailed out in drawing and should be submitted along with the bid. In respect of the terminal connectors following should be ensured:-

- a) The terminal connector should be made of A6 Aluminium Alloy and by gravity diecast only. Sand casted terminal connectors are not acceptable.
- b) All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges should be rounded off.
- c) No part of clamp shall be less than 12 mm thick.
- d) The bimetallic strips/sleeve shall be 2 mm thick.
- e) All nuts/bolts/washers shall be made of HDG Mild Steel with minimum diameter of 12 mm.
- e) All current carrying parts shall be designed and manufactured to have minimum contact resistance. The bimetallic strips/sleeve shall be 2 mm thick.
- f) Size of terminal connector for which the clamp is designed and also rated current under site conditions shall be embossed / punched on each part of clamp except hardware.
- g) The conductor should be tightened by six bolts. Conductor hold length must not be less than 100 mm.
- h) The surface of clamps to be tightened by six bolts should be flat in shape so that it may be possible to open the nuts and bolts by normal spanners.

Therefore, any type of groove in the clamp body for fixing of nuts should be avoided.

- i) The portion of clamp to hold the conductor should be flat and straight and not zig-zag in construction, at both the sides, so that holding of clamp by throttling action of current may be avoided.
- j) Space of at least 50% of diameter of nuts should be available after the hole at both the sides of conductor holding portion for better mechanical strength.

5.6 MOUNTING :

The potential transformers shall be suitable for mounting on our steel structure, which shall be arranged by the purchaser. The mounting dimensions of equipment shall match with the mounting dimensions of structure indicated in enclosed Appendix-B.

5.7 INSULATING OIL :

The insulating oil for first filling of oil in each transformer shall be in the scope of bidder. Only best quality new EHV Grade transformer oil should be used with the equipments with minimum BDV of 70KV. The BDV of oil will have to be recorded in the test certificate. The oil shall comply in all respect with the provisions of the latest version of IS: 335 or IEC publication no. 296 (as amended up to date)

5.8 SURFACE FINISH :

The metal tanks shall be coated with at least two coats of zinc rich epoxy painting or hot dip galvanised. All the ferrous hardware, exposed to atmosphere, shall be hot dip galvanised conforming to the latest version of IS: 2629 or equivalent International Standard. All other fixing nuts, bolts, washers shall be made of HDG Mild steel.

It has been observed that certain PTs received by us in the past did not have good quality painting and with passage of time flakes of paint got peeled off. The internal and external surfaces of metal tanks to be painted shall be shot or sand blasted to remove all rust and scale of foreign adhering matter or grease. All steel surfaces in contact with insulating oil shall be hot dip galvanized or painted with two coats of heat resistant, oil insulating varnish. All paints shall be carefully selected to withstand extremes of weather. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

5.9 ARRANGEMENT FOR COMPENSATION OF OIL VOLUME :

For compensation of variation in the oil volume due to variation in ambient temperature, stainless steel bellows or any other suitable arrangement which may be equal or superior shall be used. Rubber diaphragms shall not be permitted for this purpose. For indication of oil level, a ground glass window shall be provided to monitor the position of metal bellow.

5.10 SECONDARY TERMINALS TERMINATION :

The following may please be noted for strict compliance:-

- (a) The secondary terminals shall be terminated to stud type non-disconnecting terminal blocks inside the terminal box.
- (b) The outer secondary terminal box should have two separate compartments with separate covers for the purpose of sealing. Each compartment will have the terminals of each metering core. Suitable gland plates for both the compartments will have to be provided. This is required because covers of metering cores compartment will be provided with suitable seals to be operated by separate agencies who will verify the cover periodically for metering purpose.
- (C) 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 cable.
- (d) The terminal box shall be dust and vermin proof. Suitable arrangement shall be made for drying of air inside the secondary terminal box.
- (e) The dimensions of the terminal box and its openings shall be adequate to enable easy access and working space with use of normal tools.
- (f) The outer cover of secondary terminal box shall have provision for sealing by way of insertion of wire in the bolt hole. A drawing indicating above arrangement may please be furnished alongwith the bid.

5.11 RATING PLATE :

The P.T. shall be provided with a rating plate with dimensions and markings as per the latest version of IS:3156 or equivalent international standard. The markings shall be punched / engraved and not painted. This rating plate shall also contain our purchase order no. and date and guarantee period of equipment..

5.12 OIL FILLING AND SEALING :

The potential 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 sampling valve provided at the bottom of CT should be protected by providing metallic cover or blanking plug/plate. Valve should be welded to avoid any leakage. Nitrogen filling valve should be fitted with an indicator or cap to prevent leakage of nitrogen. The method adopted for hermetic sealing shall be described in the bid.

5.13 CASTING :

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

5.14 EARTHING :

Potential transformer shall be provided with two separate earthing terminals for bolted connection to 50 x 8 mm MS flat to be provided by the Purchaser for connection to station earth-mat.

5.15 LIFTING ARRANGEMENT :

Potential 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 as to avoid any damage to the porcelain housing or the tanks during lifting for installation/transport. Necessary sling guides shall be offered which shall be of removable type.

5.16 PRIMARY WINDING :

- a. Primary winding shall be made out of electrolytic grade 99.9% conductivity copper. Joints in the primary winding shall not be provided.
- b. It is desired that from the point of view of adequate mechanical strength in the normal course and also during short circuit, proper precaution should be taken. The primary conductor should be held firmly and for this purpose suitable clamping arrangement at the bottom shall be provided and explained through suitable sketch. Firm clamping arrangement is a must and holding of winding using nylon rope etc. shall not be acceptable.
- c. All primaries of PTs will be connected in phase to neutral with neutral point solidly earthed. The neutral of the system is also solidly earthed.

5.17 SECONDARY WINDINGS :

All PTs for phase to ground connection shall be provided, with separate windings. The star winding to be used for metering & relaying shall be of accuracy class as specified for appropriate class. The rated burden of the winding shall not be less than specified value. Suitably insulated copper wire of 99.9% conductivity electrolytic grade shall be used for secondary windings.

Enamel, if used for conductor insulation, shall be either polyvinyl acetate type or amide type and shall meet the requirements of the latest version of IS:4800 or equivalent international standard.

5.18 PRIMARY TERMINALS :

Selection of primary terminal only of copper material shall be made carefully. Primary terminal on either side of tank should be of minimum 100 mm long and 30 mm dia. to accommodate terminal connector. The primary terminals shall be of heavily tinned electrolytic copper. The minimum thickness of tinning shall be 15 microns.

5.19 SECONDARY TERMINALS :

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 out side diameter of the studs shall be of proper size preferably not less than 8 mm. The length of at least 15 mm shall be available on the studs for inserting the leads. The horizontal spacing between centres of the adjacent studs shall be at least 1.5 times the outside circum dia of the nuts. The arrangement should be shown through suitable sketch.

5.20 CORE :

The grade M4 toroidal core shall be of high grade non- ageing electrical silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy. The potential transformer core to be used for metering shall be of accuracy class specified.

5.21 SPECIAL REQUIREMENT FOR POTENTIAL TRANSFORMERS :

a) MAXIMUM CONTINUOUS OPERATING VOLTAGE :

The PTs shall be suitable for continuous over voltage up to 125% of rated voltage. The following requirement therefore should be noted:

- i) It should be specifically confirmed that all potential transformers offered against the tender specification are suitable for continuous over voltage of 25% above rated voltage. For this purpose, precaution taken in design of equipment may be suitably explained.
- ii) For all the potential transformers which are to be designed for 25% overvoltage, the permissible temperature rise of Potential Transformer windings over the reference ambient temperature of 50° C at 125% rated voltage rated frequency and at rated burden at any power factor between 0.8 lagging and unity shall not exceed 45° C, i.e. 5 deg. less than the permissible value as specified in IS/IEC.

b) CONSISTENCY OF ACCURACY :

It should be specifically confirmed that with 25% continuous overvoltage above rated voltage, the ratio/phase angle errors of the potential transformer shall be maintained strictly within specified limits without any drift and no variation shall take place due to over voltage of Potential Transformers.

6.0 TESTS :

6.1 TYPE TEST :

All the equipments offered, shall be fully type tested as per relevant Indian Standards or any equivalent International Standard during the last **five** years from the date of bid opening. Copy of type test reports shall be enclosed with the bid. For any change in the design/ type already type tested and the design/

type offered against this bid, the Purchaser reserves the right to demand repetition of same or all type tests without any extra cost.

6.2 ACCEPTANCE AND ROUTINE TESTS :

6.2.1 The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards or equivalent International Standards in presence of purchaser's representative.

6.2.2 In addition to other acceptance tests for CTs, the following tests shall also be carried out:-

a/ Sealing test :

The sealing test shall be carried out on minimum one randomly selected of 220 KV/ 132 KV PT out of each offered lot of 220 KV/ 132 KV PTs. The procedure for sealing test is as under:-

- i. Test shall be performed on completely assembled unit.
- ii. Test shall be performed on proto-type as well as during acceptance test on minimum one randomly selected unit.
- iii. Temperature of CT under test will be elevated and maintained at 50°C and simultaneously it shall be subjected to internal pressure of 103 kPa (@1.1 kg / sq.cm) for 12 hours.
- iv. Arrangement shall be made by manufacturer to maintain required pressure and temperature for 12 hours.
- v. During and after the test, there shall not be any oil leakage from any part or joint of CT.
- vi. Readings of temperature, internal pressure applied and duration of test along with observation of leakage, if any, shall be noted in inspection report.

b/ Tests on Oil:

The following tests shall be carried out on oil sample of minimum one randomly selected of 220 KV/ 132 KV PT out of each offered lot and shall be conducted after HV test:-

- i. BDV Test
- ii. Tan Delta Test
- iii. Water ppm Test
- iv. Specific Resistance at 75 Deg C & 90 deg C
- v. Viscosity
- vi. Total Acidity
- vii. Dissolved Gas Analysis Test

Copy of test report received from oil manufacturer will have to be submitted.

6.2.3 Immediately after finalization of the programme of type/ acceptance/ routine testing, the manufacturer shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

7.0 INSPECTION :

- i. The Purchaser shall have access at all times to the works and all other places of manufacture, where the potential transformers are being manufactured and the bidder shall provide all facilities for unrestricted inspection of the bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.
- ii. The successful bidder 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 arrangements could be made for inspection.
- iii. The Purchaser reserves the right to carry out thorough internal inspection of one or two randomly selected PTs out of offered lot, at the time of final inspection of PTs, during which the PTs will be completely opened to verify the dimensional and other details.
- iv. Besides above, the Purchaser reserves the right to carry out type test at NABL accredited laboratory on one of the randomly selected PT out of the supplied / offered PTs. The supplier shall extend co-operation for organizing the type tests in the presence of Purchaser's representative.
- v. For the purpose of inspection, it will be duty of the supplier to provide, to the inspecting officer, the detailed order, approved drawings, comments, if any, on the drawings and all amendments(if any) made in any term/condition/specification/ GTP of the order and all relevant IS, IEC, standards. Failure to provide documents demanded by the inspector shall render the inspection as "Fake Inspection Call" and relevant penalty may be imposed on the supplier on this account
- vi. No material shall be dispatched from the point of manufacture unless the material has been satisfactorily inspected and tested.
- vii. The acceptance of any quantity of the equipments shall in no way relieve the successful bidder 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.

8.0 QUALITY ASSURANCE PLAN & STAGE INSPECTION :

QAP & stage inspection shall be as per Section – I Volume – II.

9.0 DOCUMENTATION :

- 9.1 All drawings shall conform to the latest version of international standards organization (ISO) 'A' series of drawing sheet/ Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. Units.

9.2 LIST OF DRAWINGS AND DOCUMENTS :

The Bidder shall furnish four sets of following details and drawings along with his bid :-

- a. General outline and assembly drawings of the equipments.

- b. Graphs showing the performance of equipments in regard to magnetization characteristics.
 - c. Sectional views showing:
 - i) General Constructional Features.
 - ii) Materials/ Gaskets/ Sealings used.
 - iii) The insulation of the winding arrangements, method of connection of the primary/ secondary winding to the primary/ secondary terminals etc.
 - iv) Porcelain used and its dimensions alongwith the mechanical and electrical characteristics.
 - d. Complete primary terminal assembly which should include the following:-
 - i. Complete primary terminal.
 - ii. All sub-assemblies with the help of which the primary terminal shall be brought out from the top tank including washers/ locking arrangements, check nut, main nut etc.
 - iii. Sub-assembly to demonstrate the arrangement of connection of primary winding to primary terminal inside the tank.
 - e. Details of rupture type pressure relief device with diaphragm, specifying size of diaphragm and it's thickness.
 - f. Name plate.
 - g. Schematic drawing.
 - h. Type Test reports in case the equipment has already been type tested.
 - i. Test reports, literature, pamphlets of the bought out items and raw material.
- 9.3 The successful Bidder shall within two weeks of placement of order, submit four sets of final versions of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/approval on the drawings to the Bidder within reasonable time. The Bidder 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 Purchaser's comments. After receipt of Purchaser's approval, the Bidder shall within three weeks submit 20 prints and two good qualities reproducible of the approved drawings for Purchaser's use.
- 9.4 The Bidder for distribution, before commencement of supply, shall submit six sets of the type test reports, duly approved by the Purchaser. Adequate copies of acceptance and routine tests certificates, duly approved by the Purchaser shall accompany the dispatched consignment.
- 9.5 The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Purchaser. All manufacturing and fabrication work in

connection with the equipment prior to the approval of the drawing shall be at the Bidder's risk.

9.6 Twenty (20) copies of nicely printed and bound volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment supplied shall be submitted by the Bidder for distribution, prior to the dispatch of the equipments. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. The manual shall also contain a set of all the approved drawings, type test reports etc.

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

10.0 Important Requirements for ensuring quality of manufacture and processing of equipments.

10.1 For processing and vacuum treatment of core / coil assembly, it is desired that a separate heating chamber and a separate vacuum chamber should have been installed for vacuum treatment of core / coil assembly. Facility should be available to measure quantum of water released during vacuum treatment of core/coil assembly. Make, quality and capacity of vacuum chamber alongwith vacuum level may be brought out.

10.2 Completely dust free shop should be available for preparation of winding. This should be confirmed.

10.3 What is the process employed for wrapping of insulation on primary winding. Is it being done manually or through suitable wrapping machine.

10.4 Various stages of quality checks during manufacture should be highlighted.

11.0 PACKING AND FORWARDING :

Bidder shall ensure that 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.

12.0 DISCREPANCY IN TECHNICAL PARTICULARS :

Regarding discrepancy in technical particulars, stipulation under Section-I, .

13.0 Calculations and other important details to be furnished as a separate schedule along with technical bid.

- 13.1 The bidders may please note that for the purpose of evaluation of offers from technical angle, the Board, apart from other technical details asked for in the tender document, will carefully scrutinize certain important calculations and technical details and therefore in schedule III the following should be furnished by the bidders: -
- i Arrangement for clamping/ fixing of bushing shell to the top and bottom tank.
 - ii The details regarding type of material/ thickness of tank which will be utilized for manufacture of Potential transformer, of various ratios / types as per clause 5.3 of the specification.
 - iii The arrangement for housing the primary conductor and clamping of primary winding should be furnished duly demonstrated in suitable sketch.
 - iv Calculation should be furnished to arrive at the size of primary terminal which will be utilized for the manufacture of PTs of various ratings. The details of material, diameter, length and current rating of the primary terminal should also be furnished.
 - v Specific confirmation for PTs regarding maximum continuous over voltage and consistency of accuracy should be furnished as per clause 5.21 of the specification

APPENDIX - A**I) PRINCIPAL TECHNICAL PARAMETERS OF POTENTIAL TRANSFORMERS**

SNo.	Item	220 KV	132 KV	33 KV
1.	Type/ Installation	Single phase, oil filled, hermetically sealed, outdoor type		
2.	Type of mounting	Pedestal Type		
3.	Suitable for : -			
a.	System Frequency	50 Hz		
b.	Rated Voltage (KV rms)	245	145	36
4.	Nominal System Voltage (KV rms)	220	132	33
5.	Highest System voltage (KV rms)	245	145	36
6.	Number of secondary cores	Three	Two	Two
7.	Voltage Ratio			
	i) Rated primary voltage (KV rms)	$220/\sqrt{3}$	$132/\sqrt{3}$	$33/\sqrt{3}$
	ii) Secondary voltage (volts)	$110/\sqrt{3}$ V		
8.	Method of earthing of the system to be connected to	Effectively earthed		
9.	Lightning impulse withstand voltage (KVp)	1050	650	170
10.	1 minute dry power frequency withstand voltage primary winding (KV rms)	460	275	70
11.	1 minute power frequency withstand voltage for secondary winding (KV rms)	5		
12.	Min. creepage distance of porcelain housing (mm)	6125	3625	900
13.	Rated voltage factor	1.25 continuous 1.5 for 30 seconds		
14.	Visual corona extinction voltage (KV rms)	176	106	-
15.	Partial discharge level at rated voltage (pico coloumbs)	Less than 10		-
16.	Max. temperature rise over ambient of 50 deg.C	5 Deg. Cent. less than the limit specified in IS 3156 / IEC 185 taking ambient temp. as 50 Deg. C.		

SNo.	Item	220 KV	132 KV	33 KV
17.	Seismic acceleration (horizontal)	0.3 g		
18.	Mounting Details (mm)	450 x 735 (As per drawing No. JICA/MPPTCL / TR 101-107/220 KV CT& PT Base plate)	660 x 910 (As per drawing No. JICA/MPPTCL/TR 101-107/132 KV PT Base plate)	200 x 350 (As per drawing No. JICA/MPPTCL/TR 101-107/33 KV CT,PT,LA,PI Base plate)

II) DETAILS OF RATIO AND CORE PARTICULARS

(i) 220 KV PT

S.No.	Particulars	Requirements		
1	Rated primary voltage	220/ $\sqrt{3}$ KV		
2	Type	Single phase PT		
3	No. of cores	Three		
4	Rated voltage factor	1.25 continuous		
		1.5 for 30 seconds		
		Core I	Core II	Core III
5	Rated secondary voltage (Volts)	110/ $\sqrt{3}$	110/ $\sqrt{3}$	110/ $\sqrt{3}$
6	Application	Protection	Metering	Metering
7	Accuracy	3 P	0.2	0.2
8	Output Burden (VA)	200	100	100

(ii) 132 KV PT

S.No.	Particulars	Requirements	
1	Rated primary voltage	132/ $\sqrt{3}$ KV	
2	Type	Single phase PT	
3	No. of cores	Two	
4	Rated voltage factor	1.25 continuous	
		1.5 for 30 seconds	
		Core I	Core II
5	Rated secondary voltage (Volts)	110/ $\sqrt{3}$	110/ $\sqrt{3}$
6	Application	Protection	Metering
7	Accuracy	3 P	0.2
8	Output Burden (VA)	100	100

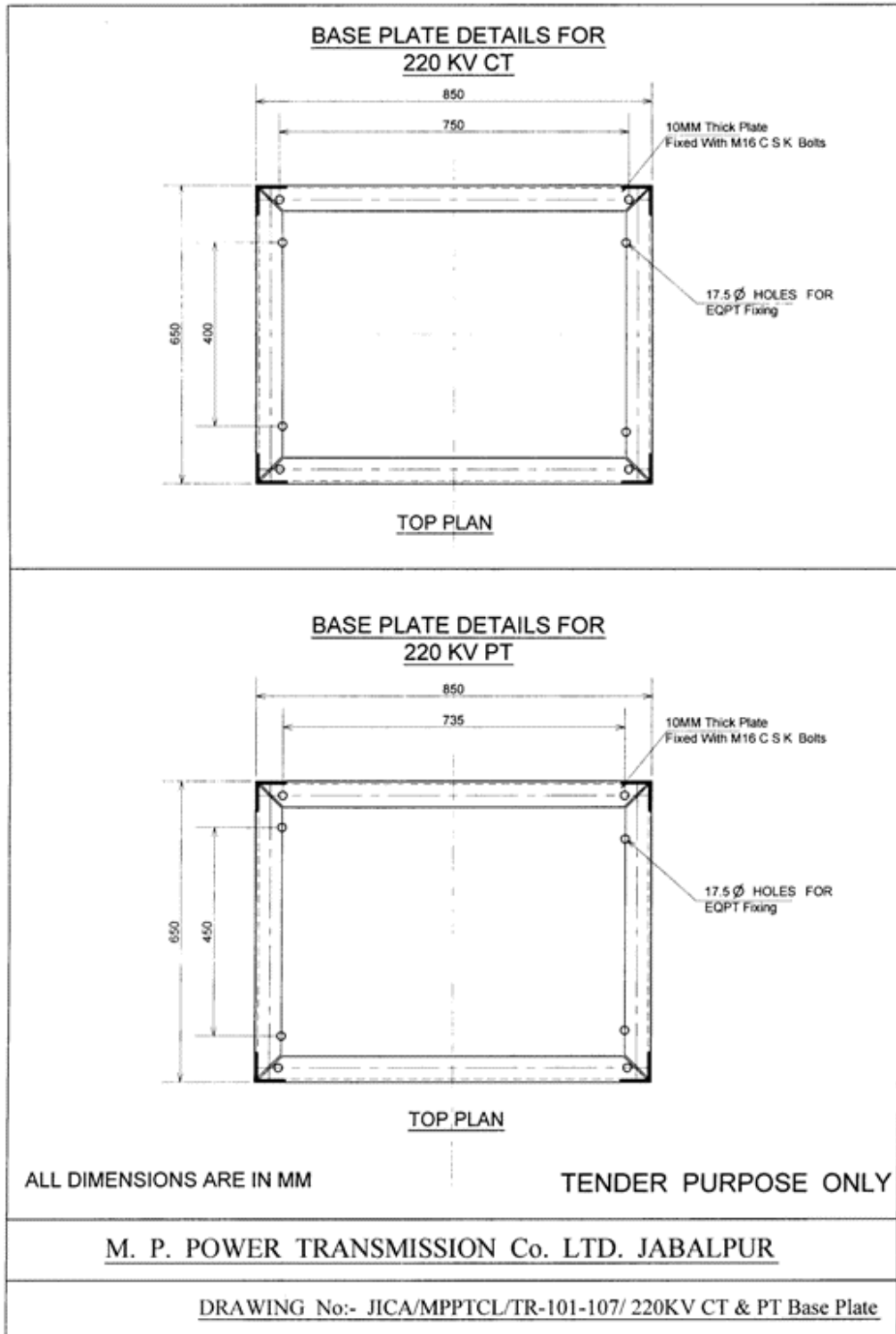
(iii) 33 KV PT

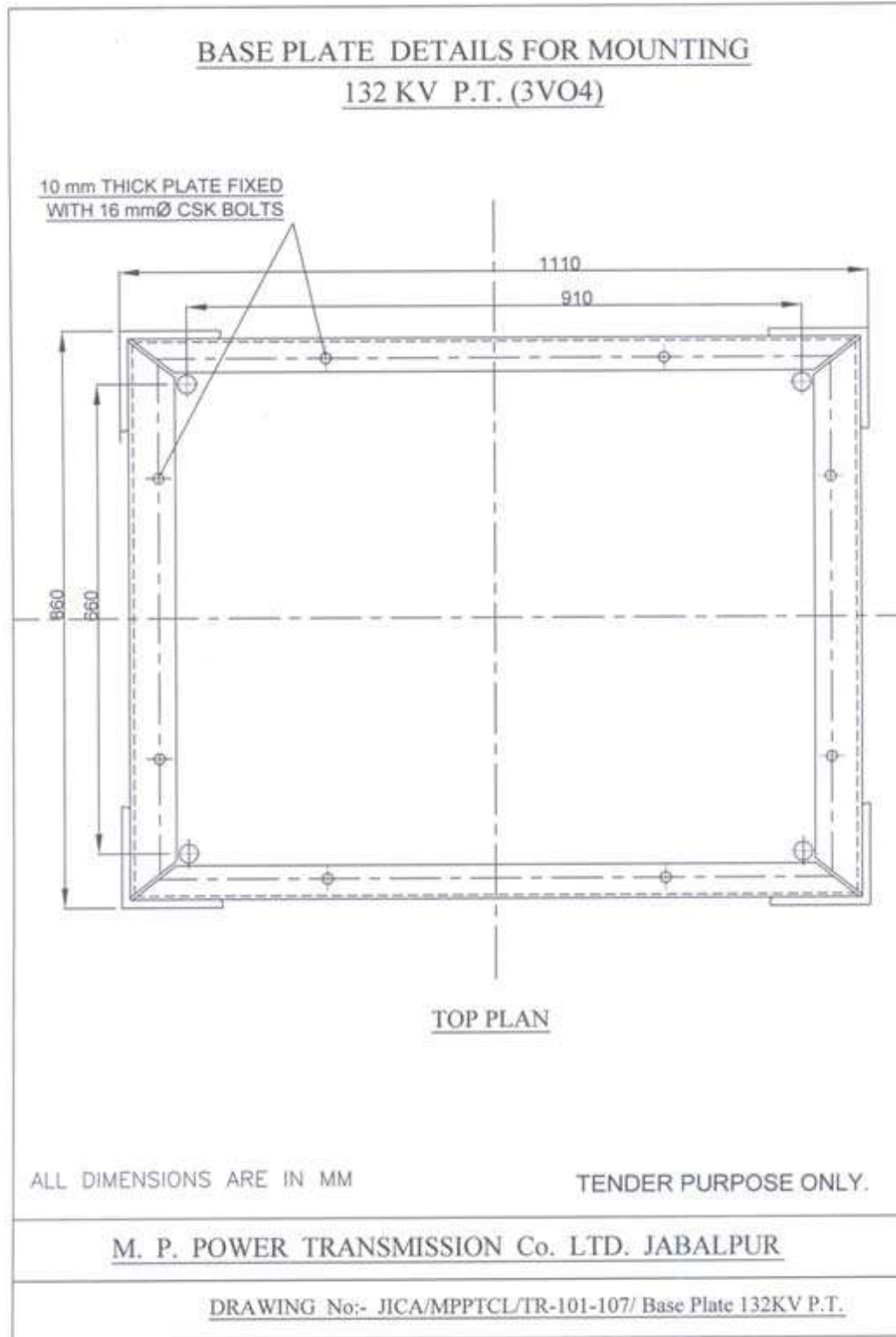
S.No.	Particulars	Requirements	
1	Rated primary voltage	33/ $\sqrt{3}$ KV	
2	Type	Single phase PT	
3	No. of cores	Two	
4	Rated voltage factor	1.25 continuous	
		1.5 for 30 seconds	
		Core I	Core II
5	Rated secondary voltage (Volts)	110/ $\sqrt{3}$	110/ $\sqrt{3}$
6	Application	Protection	Metering
7	Accuracy	3 P	0.2
8	Output Burden (VA)	100	100

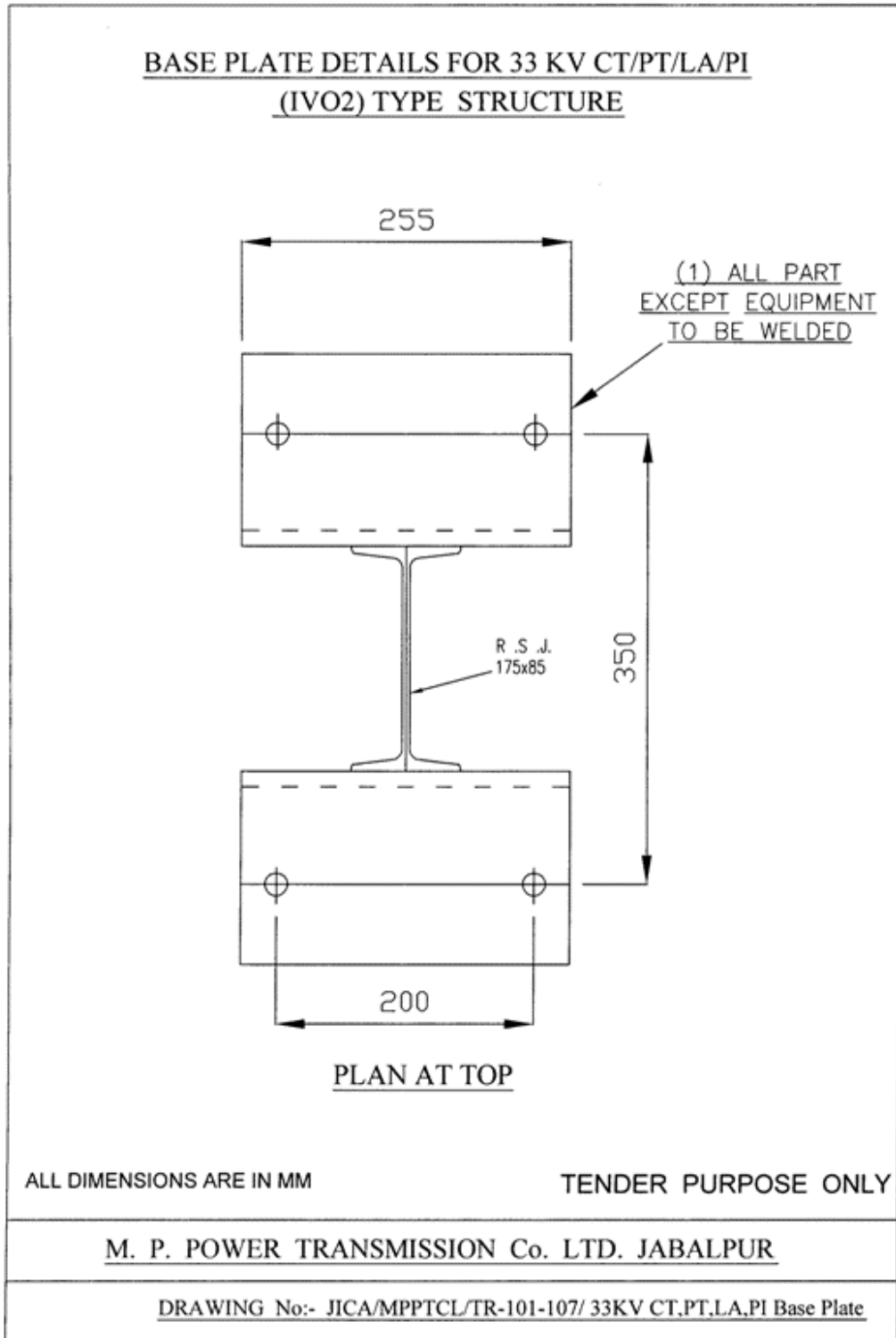
APPENDIX - B

The following drawings showing mounting dimensions of structure for Potential Transformer and general requirement of terminal connector are enclosed herewith for general guidance:

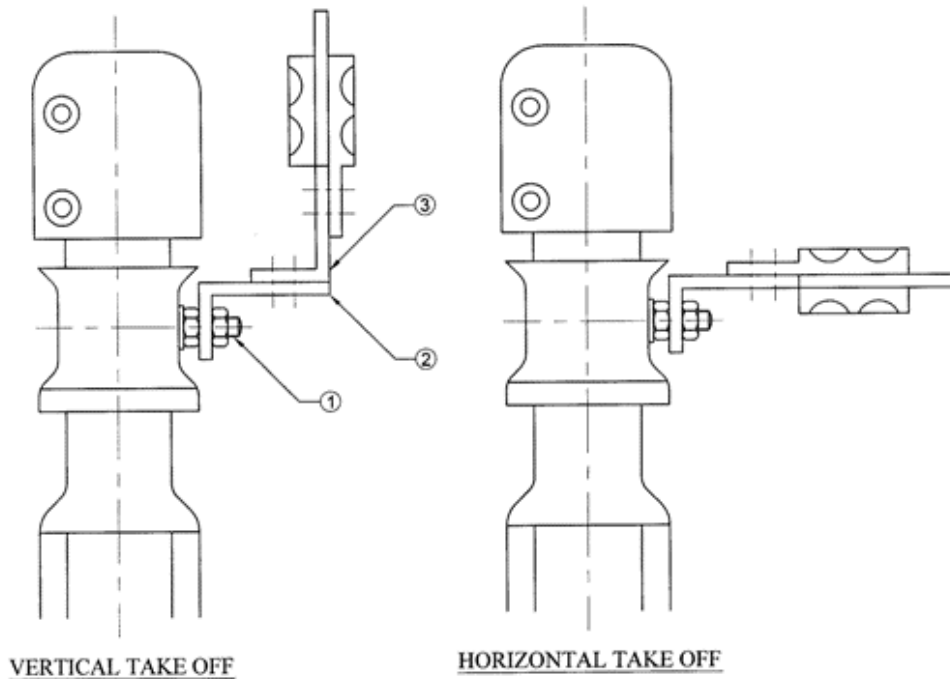
SNo	Description	Drawing No.
1.	Base Plate details for mounting of 220 KV PT	JICA/MPPTCL/TR-101 - 107/220 KV CT&PT Base Plate
2.	Base Plate details for mounting of 132 KV PT	JICA/MPPTCL/TR-101 - 107/132 KV PT Base Plate
3.	Base Plate details for mounting of 33 KV PT	JICA/MPPTCL/TR-101 - 107/33 KV CT,PT,LA,PI Base Plate
4.	Vertical/ Horizontal take off arrangement of terminal connector	JICA/MPPTCL/TR-101 to 107/ V/H Take off Arrangement
5.	Terminal connector suitable for single zebra conductor	JICA/MPPTCL/TR-101 -107/Term. Connector for CT







VERTICAL / HORIZONTAL TAKE OFF ARRANGEMENT OF
TERMINAL CONNECTOR



1. COPPER STUD OF 32MM/ 40MM DIA.
2. COPPER 'L' CLAMP OF 8 MM THICKNESS
3. ALUMINIUM ALLOY 'L' CLAMP OF 12 MM THICKNESS

NOTES

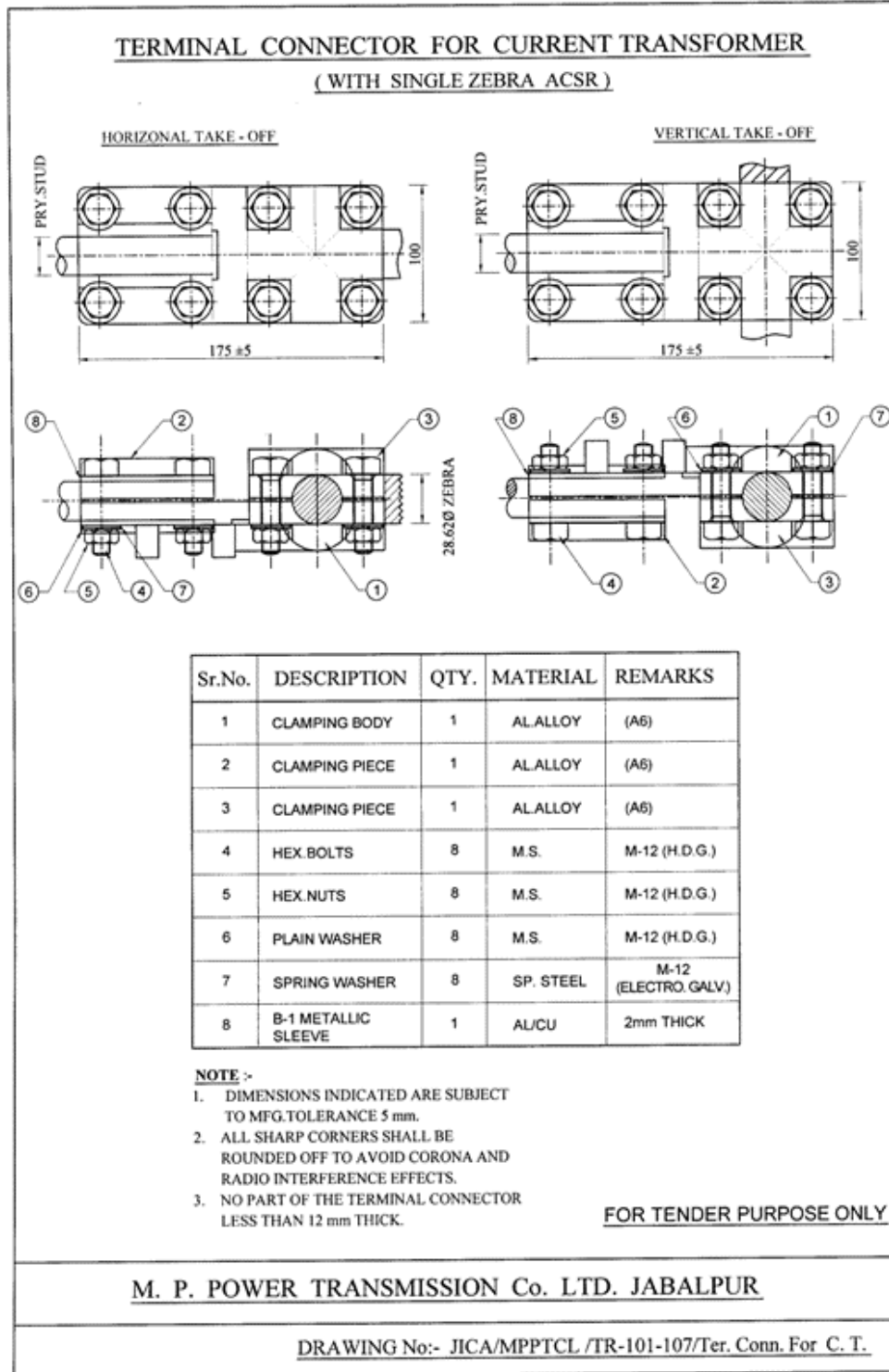
1. BOTH THE NUTS IN THE COPPER STUD SHOULD BE FACTORY TIGHTENED & LOCKED
2. ALL 'L' CLAMPS SHALL BE FITTED ON COPPER STUD DURING TRANSPORTATION BY SUITABLE NUT
3. SUITABLE FOR 800 AMP. / 1200 AMP. C.T.
4. CURRENT DENSITY FOR COPPER 1.5 AMP/Sq MM & FOR ALUMINIUM 1.0 AMP/ Sq MM

ALL DIMENSION ARE IN MM

TENDER PURPOSE ONLY.

M. P. POWER TRANSMISSION Co. LTD. JABALPUR

DRAWING No:- JICA/MPPTCL/TR-101-107/V/H Take off Arrangemnt.



APPENDIX - C**CALCULATIONS AND OTHER IMPORTANT
DETAILS TO BE FURNISHED**

The bidders may please note that for the purpose of evaluation of bids from technical angle the Purchaser, apart from other technical details asked for in the specification, will carefully scrutinize certain important calculations and technical details indicated in clause No. 13 and therefore the following should be furnished by the bidders :-

SNo.	Clause No. of specification	Requirement	Details to be furnished by the Bidder
1	Clause-5.21	Specific confirmation for PTs regarding continuous over voltage and consistency of accuracy.	
2	Clause-5.3	Details regarding type of material/ thickness of metal tank.	
3	Clause-5.18	Calculation to arrive at size of primary terminal. Also to furnish details like material, diameter, length and current rating etc.	

SCHEDULE – I(A)**“DESCRIPTION OF EQUIPMENT FOR SCHEDULE FOR RATES AND PRICES TO BE FURNISHED IN VOLUME-VI”**

SNo.	Particulars of Equipment / Item	Qty.
A	220 KV Potential Transformer	
1	220 KV Potential Transformer complete with one No. terminal connector, meeting all the technical requirements of tender specification .	As per Price schedule
B	132 KV Potential Transformer	
2	132 KV Potential Transformer complete with one No. terminal connectors, meeting all the technical requirements of tender specification .	
C	33 KV Potential Transformer	
3	33 KV Potential Transformer complete with one No. terminal connector, meeting all the technical requirements of tender specification .	

NOTE :

1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.
2. The quantity of above equipments has been mentioned in Volume VI

SECTION – II
2.1.4 - TECHNICAL SPECIFICATION FOR
LIGHTNING ARRESTERS

1.0 SCOPE :

The scope of this specification covers design, manufacturing and supply of equipment as per Section-I, Volume-II. The bidder mentioned in the Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The Purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment/material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS :

Applicable Standards for the offered equipments / items shall be as per Section-I.

3.0 CLIMATIC CONDITIONS :

Applicable climatic conditions shall be as per Section - I.

4.0 SYSTEM PARTICULARS :

Applicable System Particulars shall be as per Section - I.

5.0 GENERAL TECHNICAL REQUIREMENT :

- 5.1 The 400 KV, 220 KV, 132 KV, 36 KV and 33 KV Lightning Arresters covered under this specification shall meet the technical requirement indicated in Annexure-I enclosed with the specification.
- 5.2 The materials and components not specifically stated in this specification but which are necessary for satisfactory operation of the equipment are deemed to be included in the scope of supply unless specifically excluded.
- 5.3 The supplier should offer nearest rating of surge arresters & maximum residual voltage shall comply with the requirement indicated in Appendix-A.
- 5.4 The transformer, which is to be protected, has BIL 1300 KVp, 900 KVp, 550 KVp & 170 KVp for 400 KV, 220 KV, 132 KV & 33 KV system respectively. Considering 20% safe margin as per IEC the impulse voltage of more than 1040 KVp, 720 KVp, 440 KVp & 136 KVp respectively for 400 KV, 220 KV, 132 KV & 33 KV systems, should not appear across the transformer. The Lightning Arresters will be installed at a distance of 5/10 metres from transformer (another 5 metres be added towards height of Lightning Arresters lead length and bushing of transformers). It should be explained with suitable graphs and calculations that the voltage more that specified above will not appear on transformer.

5.5 The graph for Temporary Over Voltage (TOV) capability should be submitted along with the bid.

5.6 ENERGY HANDLING CAPABILITY :

Calculation for energy handling capability should essentially be submitted along with the bid. The calculations should be as per latest version of IEC-99-4. The energy handling capability for single shot of wave and multiple shots of wave as per IEC should be submitted alongwith the bid.

5.7 SEPARATING DISTANCE :

The minimum permissible separation between the surge arresters and any earthed object shall be indicated in the bid.

5.8 SEALING :

Each and every individual unit of surge arrester shall be hermetically sealed and fully protected against ingress of moisture. The hermetic seal shall be effective for entire lifetime of arresters and under the service conditions specified. The bidder shall furnish sectional view showing details of sealing employed. Complete details of sealing arrangement may please be furnished.

5.9 GRADING RING :

The grading ring on each complete arrester may be provided for proper stress distribution for attaining relevant technical particulars in case of 400 KV, 220 KV & 132 KV Lightning Arresters.

5.10 PRESSURE RELIEF DEVICE :

The surge arresters shall be fitted with pressure relief devices and arc diverting ports and shall be tested as per the requirements of IEC specification for minimum prospective symmetrical fault current as specified in clause 4(e) above.

5.11 INTERCHANGEABILITY :

All the units of arresters of same rating shall be interchangeable without adversely affecting the performance.

5.12 MOUNTING :

- a) The lightning (surge) arresters shall be suitable for pedestal type mounting which will be arranged by the purchaser. The drawing of mounting structure for Lightning Arresters is enclosed in Appendix-B.
- b) All necessary bolts, nuts, clamps etc., required for mounting of LAs on support structure to be supplied by the purchaser shall be included in the scope of supply.

5.13 TERMINAL CONNECTORS :

The terminal connectors required for connection of lightning arresters to the bus bar, shall be in the bidder's scope. The design of Terminal connectors

shall be to Purchaser's approval. Terminal connectors shall be manufactured and tested as per latest version of IS: 5561 or equivalent International Standard and should be type tested. In respect of terminal connectors following should be ensured:-

- a) All casting shall be free from blowholes, surface blisters, crakes and cavities. All sharp edges and corners shall be blurred and rounded off.
- b/ All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- c/ The contact surface must be machined smooth to obviate excessive current density.
- d/ The terminal connectors for connection of conductor should be suitable for Moose / Zebra ACSR conductor with vertical as well as horizontal take off arrangement and should have adequate current carrying capacity.
- e/ The terminal connectors shall be manufactured out of aluminum alloy grade A6 as per latest version of IS 5561 or equivalent grade specified in relevant International Standard and by gravity die casting process only.
- f/ Terminal connector should have six bolts to hold the conductors. The conductor hold length shall not be less than 100 mm. All nuts, bolts, washers etc. shall be made of HDG mild steel Steel with minimum diameter of 12 mm.
- g/ The minimum thickness of any part of clamps body should not be less than 12 mm.
- h/ The surface of clamps to be tightened by six bolts should be flat in shape so that it may be possible to open the nuts and bolts by normal spanners. Therefore, any type of groove in the clamp body for fixing of nuts should be avoided.
- i/ The portion of clamp to hold the conductor should be flat and straight and not zig-zag in construction, at both the sides, so that holding of clamp by throttling action of current may be avoided.
- j/ Spacer of at least 50% of diameter of nuts should be available after the hole at both the sides of conductor holding portion for better mechanical strength.

5.14 PORCELAIN BUSHING :

- a/ All porcelain housing shall be free from lamination cavities and other flaws affecting the maximum level of mechanical and electrical strength.
- b/ The porcelain shall be well vitrified and non -porous.
- c/ The creepage distance of the arrester housing shall comply with the requirement indicated in Annexure-I.
- d/ The porcelain petticoats 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 the form of a detailed drawing.
- e/ The arrester housing shall conform to the requirements of IEC specification.

5.15 GALVANISATION, NICKEL PLATING ETC:

- i/ All ferrous parts exposed to atmosphere shall be hot dip galvanised as per latest version of IS:2629 or equivalent International Standard. 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 nickel-plated.
- ii/ Ground terminal pads and name plate brackets shall be hot dip galvanised.
- iii/ The material shall be galvanised only after completing all shop operations.

5.16 SURGE COUNTER:

- a) The surge discharge counter shall be provided only with each 400 KV and 220 KV lightning arrester. The discharge counter shall be provided with milli-ammeter for measuring the leakage current and shall not require any DC or AC Auxiliary supply. It shall be suitable for outdoor use. The installation of discharge counter shall not adversely affect the arrester performance.
- b) The discharge counter shall register operation whenever lightning or any other type of surge strikes the surge arrester.
- c) All necessary accessories and earthing connection leads between the bottom of the Arrester and the discharge counter shall be in the supplier's scope of supply. The discharge counter shall be so designed that the readings of discharges recorded by the counter and the readings of milli-ammeter shall be clearly visible through an inspection window to a person standing on ground. The minimum height of Purchaser's support shall be 2.5 metres.
- d) Each surge counters shall have terminals of robust construction for connection to earthing lead and these shall be suitably arranged so as to enable the incoming and outgoing connections to be made with minimum bends.

5.17 MANUFACTURE OF ZINC OXIDE (ZnO) ELEMENTS :

- a) It is desired that the bidder should have all modern facilities to manufacture zinc oxide discs, with special emphasis on automation of each element of processing of raw materials, mixing of ingredients employed for manufacture of discs, verification of homogeneity of powder mixture, preparation and compression of disc element and stage verification/ testing of disc elements. The bidder must confirm that the process employed for the purpose is fully automatic and should describe all critical stages of manufacture, including the following:
 - i. Batch Mixing
 - ii. Batch Grinding
 - iii. Batch Homogenising
 - iv. Spray Drying
 - v. Sieving or Sizing
 - vi. Sintering

- b) The bidder should also briefly describe the methods adopted and instruments used for measurements to check the quality in following areas as also other important areas during manufacturing process:
- i. The fineness of material having sub micron size of particles.
 - ii. To measure the particle sizes of input and process materials.
 - iii. Determination of trace impurities in all the metallic oxides.
 - iv. The determination of viscosities of the metal oxide slips during powder preparation.
 - v. To determine the impurity levels of Chlorides, Nitrates and Sulphates as a spot check.
 - vi. To check the porosity and the grain sizes of pressed metal oxide elements.
 - vii. Process of testing of each disc after final finishing.

5.18 EARTHING :

The Lightning Arrester shall be provided with two separate earthing terminals for bolted connection to 65 x 10 and 50 x 8 mm MS flat to be provided by the Purchaser for connection to station earth-mat.

5.19 NAME PLATE :

The arresters shall be provided with non-corrosive legible nameplate indelibly marked with the following information:

- i. Madhya Pradesh Power Transmission Co. Ltd.
- ii. Order No. & Date
- iii. Manufacturer's name or trademark, type and identification no. of the arresters being supplied.
- iv. Rated voltage
- v. Maximum continuous operating voltage
- vi. Type
- vii. Rated frequency
- viii. Nominal discharge current
- ix. Long duration discharge class
- x. Pressure relief rated current in kA rms.
- xi. B.I.L. of the equipment to be protected.
- xii. Year of manufacture
- xiii. Identification of the assembly positions of the unit (for multi unit arresters only).

5.20 MOUNTING STRUCTURE:

The drawing of standard mounting structure of Lightning Arresters is enclosed. The suppliers should confirm specifically the Lightning Arresters shall be suitable for mounting on our structures.

6.0 TESTS :

6.1 TYPE TEST

All the equipment offered, shall be fully type tested as per relevant Indian Standards or any equivalent International Standard (as specified in clause-2) during the last **five** years from the date of BID opening. Copy of test reports

shall be enclosed with the bid. For any change in the design / type already type tested and the design/type offered against this bid, the Purchaser reserves the right to demand repetition of same or all type tests without any extra cost.

6.2. ACCEPTANCE AND ROUTINE TESTS:

- 6.2.1 The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards or equivalent International Standards in presence of Purchaser's representative.
- 6.2.2 Immediately after finalisation of the programme of type/ acceptance/ routine testing, the manufacturer shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.
- 6.2.3 Acceptance tests, whenever possible shall be conducted on the complete arrester unit. The number of samples to be subjected to acceptance tests shall be decided by the purchaser at the time of actual testing.
- 6.2.4 The special thermal stability test shall be carried out as acceptance test. The acceptance tests shall include the galvanisation test on metal parts.
- 6.2.5 The functional (operational) acceptance tests shall be carried out on the surge counter by way of checking its operation at following nominal discharge currents ;
 - a) 100 Amps with 8/20 microsecond wave shape
 - b) 10 kA with 8/20 microsecond wave shape.

7.0 INSPECTION :

- i. The Purchaser shall have access at all times to the works and all other places of manufacture, where the isolators are being manufactured and the Bidder shall provide all facilities for unrestricted inspection of the Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.
- ii. The successful Bidder 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 arrangements could be made for inspection.
- iii. For the purpose of inspection, it will be duty of the supplier to provide, to the inspecting officer, the detailed order, approved drawings, comments, if any, on the drawings and all amendments(if any) made in any term/ condition/specification/ GTP of the order and all relevant IS, IEC, standards. Failure to provide documents demanded by the inspector shall render the inspection as "Fake Inspection Call" and relevant penalty may be imposed on the supplier on this account

- iv. No material shall be dispatched from the point of manufacture unless the material has been satisfactorily inspected and tested.
- v. The acceptance of any quantity of the equipment shall in no way relieve the successful bidder of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipment are later found to be defective.

8.0 QUALITY ASSURANCE PLAN & STAGE INSPECTION :

QAP & stage inspection shall be as per Section – I Volume – II.

9.0 DOCUMENTATION :-

9.1 All drawings shall conform to latest version of international standards organization (ISO) 'A' series of drawing sheet/ Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for microfilming. All dimensions and data shall be in S.I. Units.

9.2 LIST OF DRAWINGS AND DOCUMENTS:

The Bidder shall furnish four sets of following details and drawings along with the bid:-

- i. General outline drawings of complete Lightning Arrester with technical parameters.
- ii. Drawings showing clearance from grounded and other live objects and between adjacent poles of Lightning Arresters required at various heights of Lightning Arresters.
- iii. Drawing showing details of pressure relief device.
- iv. Sectional view to explain pressure relief arrangement.
- v. Detailed drawing of discharge counters along with the wiring and schematic drawing of discharge counters & meters.
- vi. Details of grading rings if used.
- vii. Outline drawing of insulating base.
- viii. Mounting details of Lightning Arresters.
- ix. Details of the line terminal connector and ground terminals.
- x. Volt time characteristics of Lightning Arresters.
- xi. Details of galvanising being provided on different ferrous parts.
- xii. The detailed dimensional drawing of porcelain housing such as ID, OD, thickness and insulator details such as height, profile of petticoats, angle of inclination & gap between successive petticoats, total creepage distance etc.
- xiii. Name plate drawing.
- xiv. Sectional view of sealing arrangement and pressure relief device.
- xv. Type test reports in case the equipment has already been type tested.
- xvi. Test reports, literature, pamphlets of the bought out item and raw material.

9.3 The successful Bidder shall within two weeks of placement of order, submit four sets of final version of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/approval on the drawings to the Bidder within reasonable time. The Bidder 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 Purchaser's comments. After receipt of Purchaser's approval, the Bidder shall within three weeks submit 20 prints and two good quality reproducible of the approved drawings for Purchaser's use.

- 9.4 The Bidder before commencement of supply shall submit six sets of the type test reports, duly approved by the Purchaser. Two copies of acceptance and routine tests certificates, duly approved by the Purchaser shall accompany each dispatched consignment.
- 9.5 The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Bidder's risk.
- 9.6 Twenty (20) copies of nicely printed and bound volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment supplied shall be submitted by the Bidder for distribution to field officers, prior to the dispatch of the equipment. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. The manual shall also contain a set of all the approved drawings, type test reports etc.
- 9.7 Approval of drawings/work by Purchaser shall not relieve the Bidder of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material, which in his judgment is not in full accordance therewith.

10. PACKING AND FORWARDING :

Bidder shall ensure that 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..

11. DISCREPANCY IN TECHNICAL PARTICULARS :

Regarding discrepancy in technical particulars, stipulation under Section-I, Volume-II shall be applicable.

APPENDIX – A

PRINCIPAL TECHNICAL PARAMETERS OF LIGHTNING ARRESTERS

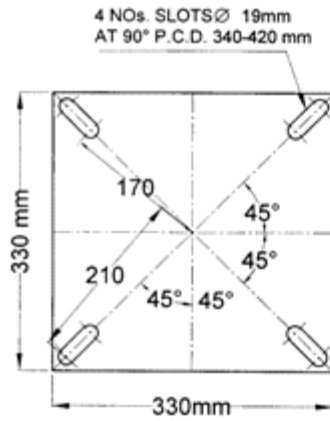
S. No.	Particulars	400 KV	220 KV	132 KV	36 KV	33 KV
1	Nominal system voltage	400 KV	220 KV	132 KV	33 KV	
2	Rated arrester voltage	390 KV	198 KV	120 KV	36 KV	30 KV
3	Highest system voltage	420 KV	245 KV	145 KV	36 KV	
4	Maximum continuous operating voltage(KV rms)	290	168	96	30	24
5	Temporary over voltage capability (KV Rms) a/ 0.1 sec. b/ 1.0 sec. c/ 10 sec.	410 400 390	237 218 198	139 132 120	44 42 39	36 34 32
6	Nominal discharge current corresponding to 8/20 micro second wave shape (KA)	20	10	10	10	10
7	Minimum energy discharge capability (as per long duration discharge class of IEC- 99-4) in KJ/KV	8	4.7	4.7	4.7	2.83
8	Long duration discharge class.	4	3	3	3	2
9	Maximum residual voltage at nominal discharge current of 8/20 micro sec. wave for 10 KA (KV peak)	900	480	300	110	90
10	Minimum prospective symmetrical fault current for pressure relief test	40 KA for one sec.			26.2 KA for two sec.	
11	High current Impulse withstand (KA)	100	100	100	100	100
12	Creepage distance of porcelain housing (mm)	10500	6125	3625	950	900
13	Pressure relief device.	-- Class A --				
14	Insulation level of housing (Lightning Impulse withstand voltage) (KVp)	1425	1050	650	250	170
15	Cantilever strength (Kgm)	1000				300
16	Terminal connector					
a.	Quantity	1 No.	1 No.	1 No.	1 No.	1 No.
b.	Conductor	Moose	Zebra			
c.	Arrangement of current take off	Horizontal & Vertical				

APPENDIX - B

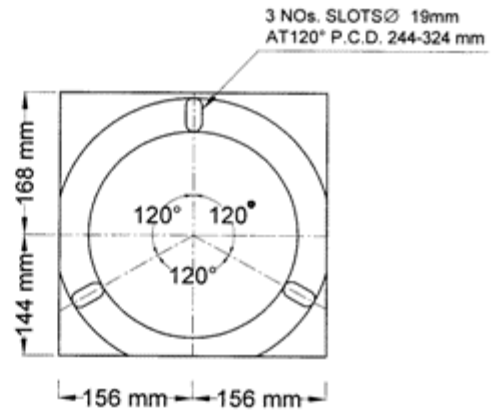
The following drawings showing mounting dimensions of structure & general requirement of surge counter are enclosed here with for guidance:

SNo.	Description	Drawing No.
1.	Mounting Details for 400 KV Lightning Arresters.	JICA/MPPTCL/TR.101-107/ Mounting Details
2.	Base plate details for mounting of 220 KV, 132 KV & 33 KV Lightning Arresters	JICA/MPPTCL/TR.101-107/ Base Plate Details
3.	Surge monitor for Gapless Lightning Arresters	JICA/MPPTCL/TR.101-107/ Surge Monitor
4.	Pad Clamp for Zebra ACSR Conductor	JICA/MPPTCL/TR.101-107/ Pad Clamp ZEBRA

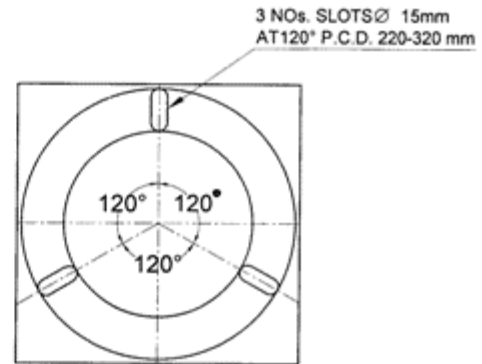
BASE PLATE DETAILS
FOR MOUNTING OF 220 , 132 , & 33KV LAs



DETAILS OF STRUCTURE FOR
MOUNTING OF 220KV SYSTEM
VOLTAGE L.A.



DETAILS OF STRUCTURE FOR
MOUNTING OF 132KV SYSTEM
VOLTAGE L.A.



DETAILS OF STRUCTURE FOR
MOUNTING OF 33 KV SYSTEM
VOLTAGE L.A.

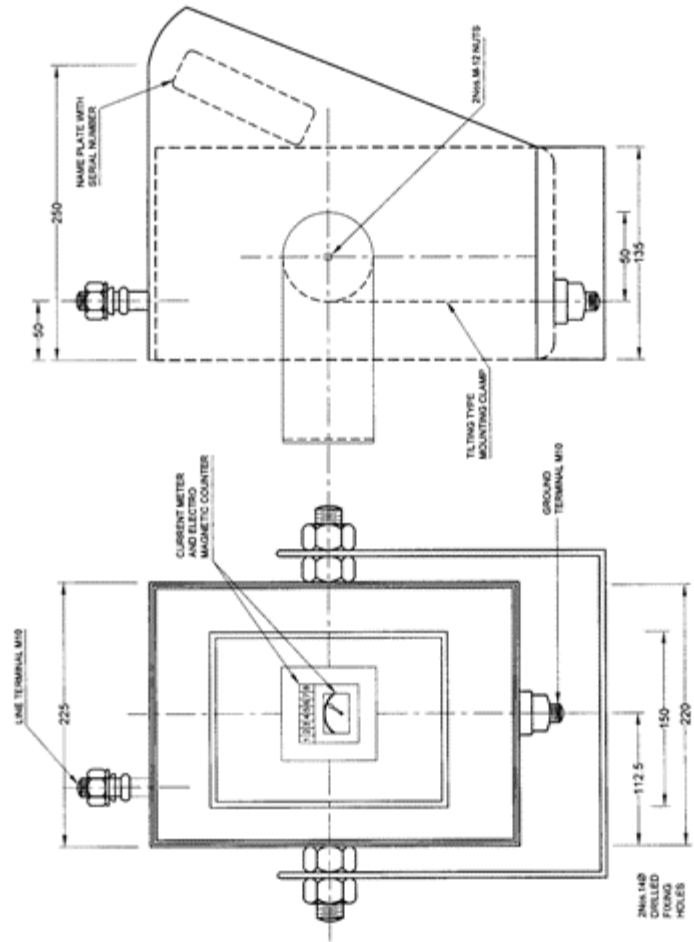
ALL DIMENSIONS ARE IN MM

TENDER PURPOSE ONLY

M. P. POWER TRANSMISSION Co. LTD. JABALPUR

DRAWING No:- JICA/MPPTCL/TR-101-107/ Base Plate Details

SURGE MONITOR FOR GAPLESS SURGE ARRESTER



NOTE:-

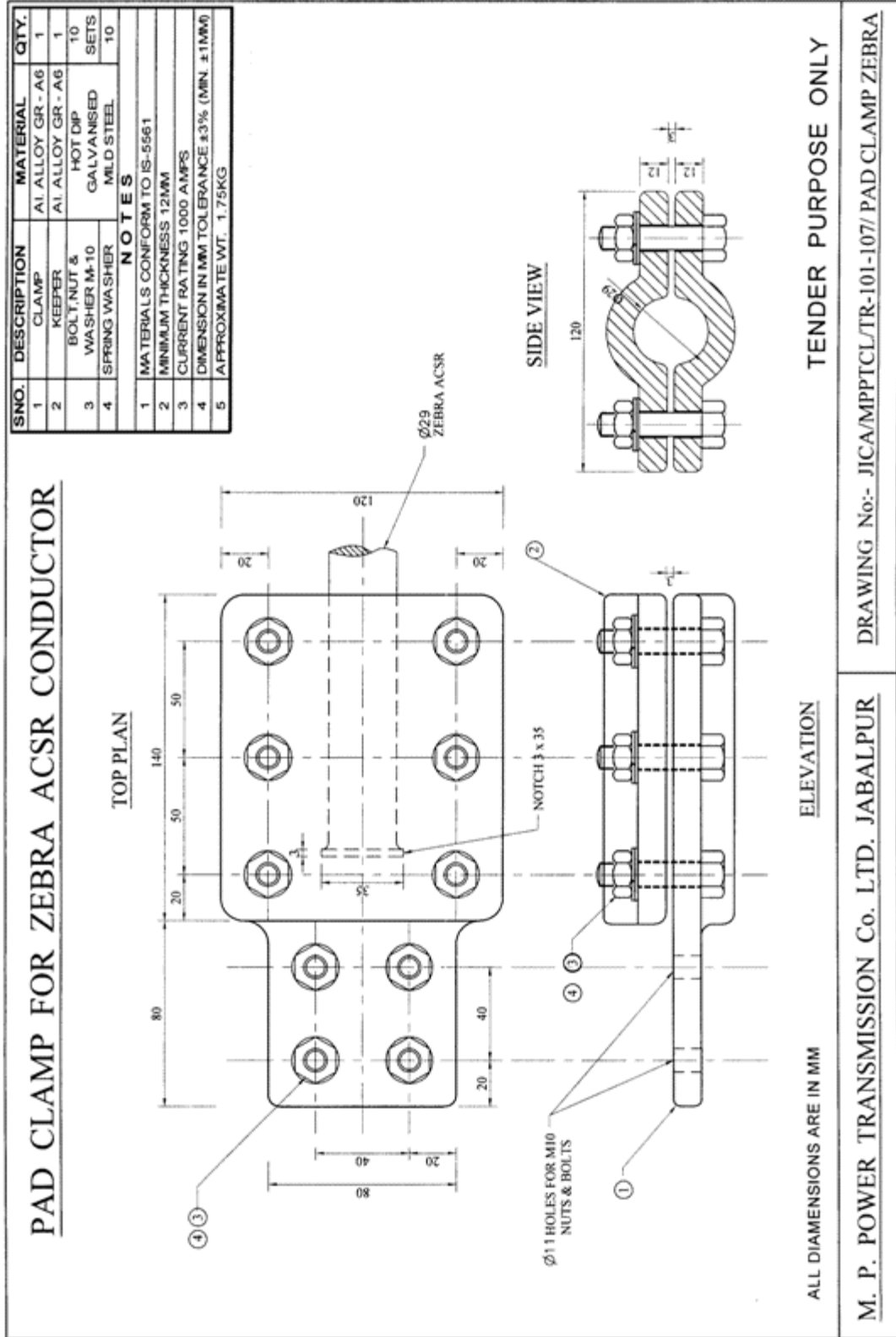
1. ALL DIMENSIONS ARE IN mm
2. GENERAL TOLERANCES ± 3 mm
3. CURRENT METER
 - a. GREEN BAND INDICATES A HEALTHY ARRESTER.
 - b. RED BAND INDICATES A DEFECTIVE ARRESTER. THE CURRENT METER INDICATES THE SUM OF THE EXTERNAL SURFACE LEAKAGE AND INTERNAL GRADING CURRENT OF THE ARRESTER.
 - c. IF THE POINTER LIES IN THE RED BAND DE-ENERGISE ARRESTER, CLEAN THE SURFACE OF THE ARRESTER COMPLETELY.
 - d. RE-ENERGISE AND RECHECK IF POINTER REMAINS IN RED BAND THE ARRESTER IS DEFECTIVE REMOVE FROM SERVICE IMMEDIATELY
4. COUNTER. THE COUNTER MAINTAINS COUNTS OF OPERATION UNDERGONE BY THE ARRESTER.
5. NOTE THE INITIAL METER AND COUNTER READINGS FROM THE FIRST ENERGISATION AND MAINTAIN A REGULAR LOSS OF THESE READINGS
6. FOR MOUNTING THE MONITOR.
 - a. LOOSEN THE M-12 NUTS OF THE MOUNTING CLAMP MOVE THE MOUNTING CLAMP TO THE BACK OF THE MONITOR AND TIGHTEN THE NUTS.
 - b. FASTEN THE MONITOR IN THE REQUIRED PLACE.
 - c. FOR VIEWING THE COUNTER AND THE METER, MONITOR CAN BE TILTED SUITABLY.
 - d. DO NOT EXERT EXCESSIVE PRESSURE WHILE FASTENING THE NUTS.
7. COMPLETE WEIGHT OF THE SURGE MONITOR 7.5 kgs.
8. ARRESTER IS HEALTHY TILL THE POINTER IN THE MILLIMETER GOES TO THE RED BAND.

THESE DIMENSIONS ARE NOT CRITICAL AND ARE FOR INFORMATION PURPOSE ONLY

M. P. POWER TRANSMISSION Co. Ltd. JABALPUR

DRAWING. No:- JICA /MPPTCL/TR. 101-107 / Surge Monitor

TENDER PURPOSE ONLY



SCHEDULE – I(A)**“DESCRIPTION OF EQUIPMENT FOR SCHEDULE FOR RATES AND PRICES TO BE FURNISHED IN, VOLUME-VI”**

SNo.	Particulars of Equipment / Item	Qty.
A	400 KV Lightning Arresters	As per Price schedule
1.	a. 400 KV metal oxide gapless type Lightning Arresters complete with terminal connector & grading ring etc. meeting all the technical requirements of tender specification b. Porcelain insulating base for above. c. Surge counter for above.	
B	220 KV Lightning Arresters	
2.	a. 220 KV metal oxide gapless type Lightning Arresters complete with terminal connector & grading ring etc. meeting all the technical requirements of tender specification b. Porcelain insulating base for above.. c. Surge counter for above.	
C	132 KV Lightning Arresters	
3.	a. 132 KV metal oxide gapless type Lightning Arresters complete with terminal connector & grading ring etc. meeting all the technical requirements of tender specification b. Porcelain insulating base for above	
D	36 KV Lightning Arresters	
4.	36 KV metal oxide gapless type Lightning Arresters complete with terminal connector etc. meeting all the technical requirements of tender specification	
E	33 KV Lightning Arresters	
5.	33 KV metal oxide gapless type Lightning Arresters complete with terminal connector etc. meeting all the technical requirements of tender specification	

NOTE :

1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.
2. The quantity of above equipments has been mentioned in Volume VI.

SECTION – II (A)
2.1.5 - TECHNICAL SPECIFICATION FOR
400 kV ISOLATORS

1.0 SCOPE :

The scope of this specification covers design, manufacturing and supply of equipment as per Section-I, Volume-II. The bidder mentioned in the Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The Purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment/material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS :

Applicable Standards for the offered equipments / items shall be as per Section-I.

3.0 CLIMATIC CONDITIONS :

Applicable climatic conditions shall be as per Section – I.

4.0 SYSTEM PARTICULARS :

Applicable system particulars shall be as per Section – I.

5.0 GENERAL TECHNICAL REQUIREMENTS FOR 400 kV ISOLATORS WITH / WITHOUT EARTH SWITCHES :

5.1 The 400 kV isolators shall be a set of three individual poles having individual drive for each pole of main disconnect/ earth switch supported on two insulator columns per pole in case of horizontal center break type and on single support insulator column and one rotary operating insulator per pole in case of pantograph. The pantograph isolator shall have one vertical break earth switch. The center break isolator shall have two/ without vertical break earthing blade/s per pole (phase) suitable for fixing on sides of the poles as per requirement.

5.2 It may please be noted that the all types of Isolators are to be supplied with matching structure and Solid core Insulator. Structure to be supplied shall be as per our specification for which drawing is available in the Tender document. As Civil foundation for structure will be as per our civil drawing, structure base should be suitable for civil foundation. The prices of isolators are to be quoted accordingly including the cost of structure and Solid core Insulator. Further one prototype Isolator assembly complete with structure and solid core insulator duly assembled as per MPPTCL drawings at the premises of Isolator manufacturer shall be offered for inspection of MPPTCL before taking up mass supply. The proto assembly shall be

checked for proper operation and fitting to avoid any mismatch during actual erection in the field.

5.3 The disconnects & earthing switches, when installed according to the manufacturer's instructions shall be able to bear on the terminals, the total forces (including wind loading and electro-dynamic forces on the attached conductors) related to the application and rating without impairing the reliability or current carrying capacity.

5.4 Disconnects and earthing switches, including their operating mechanism shall be so designed and constructed that these cannot come out of their open or closed positions by gravity, wind pressure vibrations reasonable shocks, or accidental touching of the connecting rods or their operating mechanisms.

5.5 The operating device shall be capable of closing and opening the disconnect at any value of supply voltage between 75% and 110% of the rated voltage and between 92% and 108% of the rated frequency.

5.6 Flexible copper connections between rotating shaft of the earthing switch and the frame shall have a cross-section suitable to withstand short time rated current.

5.7 AUXILIARY CONTACTS FOR SIGNALLING :

- i) Signaling of the closed position shall not take place unless it is certain that the moveable contacts will reach a position in which the rated normal current, the peak withstand current and the short-time withstand current can be carried safely.
- ii) Signaling of the open position shall not take place unless the movable contacts have reached a position such that the clearance between the contacts is atleast 80% of the isolating distance.

5.8 AUXILIARY EQUIPMENTS :

- i) Auxiliary contacts and auxiliary equipments shall be capable of carrying a current of atleast 10 Amps. continuously.
- ii) Auxiliary switches shall be capable of breaking atleast 2A in a 220 V D.C. circuit with a time constant of not less than 20 milli secs. Auxiliary switches shall be positively driven in both the directions.
- iii) Number of auxiliary contacts in each AC motor-operated mechanism box for main disconnects for purchaser's use.
 - a. 20 N.O. and 20 N.C. contacts.
 - b. 8 Make Before Break (MBB) contacts.
- iv) Number of auxiliary contacts in each manually operated mechanism box for earthing switches shall be 8 N.O. and 8 N.C. contacts.

5.9 TERMINAL CONNECTOR DESIGN :

- i) Current carrying capacity of the clamps shall not be less than the current rating of the isolators in an ambient temperature specified in this specification. The clamps shall be so designed that they shall be free from corona emission and the requirement of visual discharge voltage is satisfied. Special care shall be taken in the clamp design to account for Galvanic corrosion and Thermal Cycling.
- ii) Clamp body shall be of high conductivity and high strength aluminium or copper alloy. The aluminium alloy shall be copper free. Bolts and nuts shall be of high tensile, non-corrosive, fungus resistant material preferably made of stainless steel. Bolting pressure shall be well distributed, washers of the Beleville type or equivalent shall be used to provide constant pressure under thermal cycling conditions so as to maintain a low contact resistance. Braids for flexible clamps shall be of tinned copper. The use of stranded aluminium conductor like Tarantula with strong welding connections to assemblies instead of copper braids is acceptable. Contact surfaces shall be finished and protected against galvanic action and oxidation. The bidder shall indicate the jointing compound recommended to be applied to the aluminium contact surfaces before bolting the clamps.
- iii) Current density adopted for design of clamps for 420 kV isolators shall not exceed 1 Amp/sq.mm. for aluminium alloy clamp and 1.6 Amp./sq.mm. for copper clamps.
- iv) Wherever necessary bimetallic strips of standard quality shall be used to avoid galvanic corrosion.

5.10 REQUIREMENT OF TERMINAL CONNECTORS :

- i) Terminal connectors required for 400 kV pantograph/ center break type isolators shall have to be suitable for connecting them to either twin MOOSE ACSR conductor (with a sub-conductor spacing of 450 mm) or 4" IPS aluminium tube as the case may be, depending upon their position in the layout. The connectors for 4" IPS aluminium tube shall be of fixed type for some terminals and of the flexible or expansion type for others. The fixed contact of the pantograph isolators will be suspended from bus bars which would comprise of 4 conductors of MOOSE ACSR. This fixed contact with the suspension arrangement shall be such that it collects juice from each of the four bus bar conductors with equal effectiveness and shall simultaneously function as a spacer to keep the bus bar conductors at the vertices of a square of 450 mm. side.
- ii) In case terminal connectors are supplied through sub-suppliers, the bidder should guarantee for suitability of the terminal connectors in regard to the temperature rise being within limits, short time current

carrying capability of connectors being same as that of the associated isolator, and connector being corona free.

5.11 Live metal parts shall be non-rusting and non-corroding metal. Current carrying parts shall be provided with lock-washers, keys or equivalent locking facilities and shall be made of non-ferrous and non-corroding materials. The structure steel, operating pipes, phase coupling rods, tandem pipes, operating mechanism boxes, bolts, pins etc. used in other than current carrying parts shall be hot-dip galvanized. Galvanized current carrying parts shall be made of malleable cast iron or cast steel. No grey iron shall be used in the manufacture of any part of the isolator.

5.12 In case of 400 kV isolators the live parts shall be designed to eliminate sharp joints, edges and other corona producing surfaces. Where this is impracticable, adequate corona shields shall be provided.

5.13 The live parts shall be so constructed that the switch blade will not fall to the closed position if the operating shaft gets disconnected.

5.14 The switch shall be designed such that no lubrication of any part is required except at very infrequent intervals.

5.15 ACCESSORIES :

The accessories to be provided on the isolators shall include but not necessarily be limited to the following:

5.15.1 BASE :

Each single pole of the pantograph isolator shall be provided with complete galvanised steel base provided with holes and designed for mounting on steel tubular support structures. For pantograph the support structure shall be supplied by the Bidder. The support structure should be such as to match the strung bus at an height of 15.6 metres (with a maximum Sag upto 1900 mm) and equipment to equipment terminal connection at a height of 8.2 metres. (Height including 300 mm of plinth level). For center break isolators the structure will be arranged by the purchaser which will match the height of terminal connectors at 8.2 meters (including plinth level of 300 mm) from ground level. The base shall be rigid and self-supporting, requiring no guy, cross bracing between phases other than the supporting structures. The complete details of mounting channels for center break isolators included in the scope of supply shall be given by the bidder. The recommended design of mounting structures shall also be furnished enabling purchaser to procure structures accordingly.

5.15.2 POSITION INDICATOR :

A position indicator to show, whether the isolator is in 'ON' or 'OFF' position, shall be provided for each isolator. Auxiliary contacts for remote indication shall also be provided.

5.15.3 GROUNDING PADS :

Each pole of the isolator shall be provided with two grounding pads at the opposite ends. Also flexible grounding connectors complete with non-ferrous bolts shall be provided for connecting operating handle to the station grounding system. When grounding blades are provided in the isolators, two independent grounding terminals shall be provided for bolted connection to 75x10 mm. M.S. Flat to be provided by the purchaser for connection to station earth mat.

5.15.4 COUNTER BALANCE SPRINGS :

Counter-balance springs shall be provided for counter balancing the isolators to prevent impact at the end of travel both on opening and closing of the isolator. The springs shall be made of non-rusting type alloy.

5.15.5 NAME PLATES :

Isolators, earthing switches and their operating devices shall be provided with a Name plate. The name plate shall be weather-proof and corrosion-proof. The markings shall be punched/ engraved and not painted. The Name plates shall also contain our purchase order no. and date. 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:-

- i) **Earthing Switches:**
Name of manufacturer
Designation type
Serial Number
Rated voltage
Impulse withstand voltage to earth
Rated short time current
Rated maximum duration of short time current
Rated mechanical terminal load
Weight.
- ii) **Operating Device:**
Name of manufacturer
Designation type
Rated auxiliary voltage and Horse Power of AC Motor
Weight.
- iii) **Isolators:**
Name of manufacturer
Designation type
Serial Number
Rated voltage
Impulse withstand voltage to earth
Rated current
Rated short time current

Rated maximum duration of short time current

5.16 EARTHING SWITCHES :

- a) Isolators equipped with earthing switch shall have one or two grounding blades per pole as specified in Schedule-I. The grounding blades shall form integral part of the isolator. A flexible braid with a connector suitable for the specified copper stranded conductor shall be provided on the hinge end of the grounding blade for connection to the station ground grid.
- b) The grounding blades shall be manually operated by a separate mechanism but shall be constructionally (Mechanically) interlocked with the isolator so that the grounding blades can be closed only when the isolator is open and vice-versa.

5.17 OPERATING MECHANISM AND CONTROL:

- 5.17.1**
- a) 3 Phase AC motor operated type operating mechanism shall be provided for each pole of 400 kV Pantograph Isolator and Centre Break main switch for individual as well as simultaneous operation of all the three poles i.e. it should be possible to operate all the poles either individually or simultaneously through electrical operation. The operating mechanisms of three phases should be well synchronized and interlocked. There shall also be manual cranking in the event of power failure.
 - b) Manual operating mechanism through crank and reduction gear shall be provided for each pole of 00 kV Centre Break Isolator earth switch and pantograph earth switch. Individual mechanism box shall be provided for each earth blade.

5.17.2 The operating mechanism shall provide a quick, simple and effective operation. The design shall be such that one man shall be able to operate the isolator without undue efforts, with about twenty revolutions of the crank.

5.17.3 The mechanism shall be provided with sufficient adjustment to allow for final alignment of the isolator blades for simultaneous operation and adjustable stops shall be provided to prevent over-travel in either direction.

5.17.4 The isolator shall be provided with positive continuous control throughout the entire cycle of operation. The operating pipes and rods shall be sufficiently rigid to maintain positive control under the most adverse conditions and when operated in tension or compression for isolator closing. They shall also be capable of withstanding all torsional and bending stresses due to operation of the isolator.

5.17.5 It shall not be possible, after final adjustment has been made, for any part of the mechanism to be displaced at any point in the travel sufficiently to allow

improper functioning of the isolator when the isolator is opened or closed at any speed. All holes in cranks, linkages etc. having pins shall be drilled to accurate fit so as to maintain the minimum amount of slack and lost motion in the entire mechanism.

5.17.6 The operating handle shall be mounted on the base supporting structure. Guide bearings shall be provided if necessary. All brackets, angles or other members necessary for attaching the operating mechanism to the isolator supporting structure shall be supplied by the Bidder. Rust proof pins and bearings of the bronze bushing ball or roller type shall be furnished. All ball and roller bearings shall be protected from the weather by means of covers and grease retainers. Bearing pressures shall be kept low to ensure long life and ease of operation.

5.17.7 A weather proof steel cabinet shall be provided to house driving mechanism and auxiliary switches etc. The steel cabinet shall be fitted with 1100 Volt grade barrier type of porcelain terminal blocks. The terminal blocks shall be properly identified. Control wiring shall be carried out with minimum 2.5 sq mm copper wire of 1100 Volt grade insulation. The auxiliary wiring with auxiliary device shall be capable of withstanding a test voltage of 2000 Volts for 1 minute.

5.17.8 In addition to the limit switch contacts required for motor control of the isolator, other normally open and close contacts shall be provided as specified in clause 5.8 of this specification for other services. These switch contacts shall be actuated from the isolator shaft so as to provide true indication of the position of the isolator whether operated manually, or with power driven devices.

5.17.9 Control cabinet and component equipment shall otherwise be in accordance with the details given in clause 5.18 of this specification.

5.17.10 Power operated isolators shall be offered in accordance with this specification. Grounding switches provided with power driven isolators shall be manually operated. Power operation shall be by motor as specified in clause No. 3.2 and 5.17.1 of this specification.

5.17.11 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 from a local or a remote push buttons. The remote push button will be supplied by the purchaser.

5.17.12 An out of step relay for the three poles in case of pantograph and centre break isolators with proper stud shall be supplied with each isolator to give a remote discrepancy alarm.

5.17.13 The control shall be so arranged that the operation shall be completed, when corresponding push button is pressed even momentarily. The control circuit shall be so arranged that necessary interlocks with associated breakers and earthing switches can be incorporated in it.

5.17.14 A lever shall be provided to permit manual operation of the isolator when desired. The lever shall be so arranged that, when manual operation is in progress the power operation shall be made inoperative. Arrangement shall be provided to padlock this lever when not in use.

5.17.15 MOTOR DRIVE:

- i) Suitable reduction gearing shall be provided between the motor and the drive shaft to the isolator and a quick acting electro-mechanical brake shall be fitted on the higher speed shaft to provide rapid braking of the drive shaft.
- ii) Limit switches for motor control shall be fitted on the isolator shaft within the cabinet to sense the open and closed position of the isolators.
- iii) All drive motors shall conform to the requirements of IS:325.

5.18. CONTROL CABINETS

5.18.1. This specification covers the requirements of control cabinets and associated control and accessory equipment. Cabinets shall be of the well-mounting type of free standing floor mounting type.

5.18.2. Control cabinets shall be sheet-steel enclosed and shall be dust, weather and vermin proof. Sheet steel shall be at least 2.0 mm. thick when control cabinets shall be provided with a hinged door and padlocking arrangement. The door hinges shall be of union joint type to facilitate easy removal. Door shall be properly braced to prevent wobbling.

5.18.3. Equipment and devices shall be suitable for operation on a 415 V, 3 phase, 3/4 wire, 50 Hz. AC system.

5.18.4. Motors being controlled from the control cabinet, would be suitable for operation on a 415 V, 3 phase, 50 Hz system.

5.18.5. Isolating switches shall be group operated units, (three pole for use on 3 phase supply system) quick make, quick-break type, capable of breaking safely and without deterioration of the rated current of the associated circuit. Control cabinet on door shall be interlocked with the operating handle of the switch so as to prevent opening of the door when the switch is closed. A device for bypassing the door interlock shall also be provided. Switch handle shall have provisions for locking in both fully-open and fully closed positions.

5.18.6. Fuses shall be HRC cartridge link type having suitable current rating. They shall be provided with visible operation indicators to show when they have operated. One fuse pulling handle shall be supplied for every ten fuses or a part thereof.

5.18.7. Push button shall be rated for not less than 6 Amps. 415 Volts, AC or 1 Amp. 250 V DC and shall be flush mounted on the cabinet door and provided with appropriate name-plates. Red, Green and Amber indicating lamps shall be flush mounted and provided with series resistors to eliminate the possibility of short-circuiting of control supply in the event of fusing of lamps.

5.18.8. The contactors for motors shall be direct-on-line, air-break, single-throw type and shall be suitable for making and breaking the stalled current of the associated motor which shall be assumed equal to 6.5 times and the full load current of the motor at 0.2 p.f., 3 pole contactors shall be furnished for 3 phase motors and 2 pole contactors for single-phase motors. Reversing contactors shall be provided with electrical interlocks between forward and reverse contactors. If possible, mechanical interlock shall also be provided. Contactors shall be suitable for uninterrupted duty and shall be of duty category class AC4 as defined in latest version of IS-2959 or equivalent international standard. The main contacts of the contactors shall be silver plated the insulation and class for the coils shall be Class-E or better. The drop-out voltage of the contactors shall not exceed 70% of the rated value.

5.18.9. Contactors shall be provided with a three element, positioning acting, ambient temperature compensated, time lagged hand-reset type thermal overload relay with adjustable setting. Hand reset button shall be flush with the front door of the cabinet and suitable for resetting with starter compartment door closed. Relays shall be either direct connected or CT operated depending on the rated motor current.

5.18.10 Suitable relay/ device shall be provided to prevent overloading of the motor. Single phase preventer relay shall be provided to operate on open circuiting of any phase and shall trip off the motor. Complete details of the devices shall be furnished in the bid.

5.18.11. Mini starters shall be provided with no volt coils when required.

5.18.12. Purchaser's power cables will be 1100/ 650 Volt grade, aluminium conductor, PVC insulated PVC sheathed single steel wire armoured and PVC jacketed. All necessary cable terminating accessories such as packing glands, crimp type tinned copper lugs etc. for power as control cables shall be included in bidder's scope of supply. Suitable brass cable glands shall be provided for cable entry.

5.18.13. Wiring for all control circuits shall be carried out with 650 grade PVC insulated tinned copper conductors of sizes not smaller than 2.5 sq.mm. Atleast 10% spare terminal blocks for control wire terminations shall be provided for each panel. The terminal blocks shall be similar to ELEMEX type. All terminals shall be provided with ferrules indelibly marked or numbered and these identifications shall correspond to the designations on the relevant wiring diagram. The terminals shall be rated for 10 Amps.

5.18.14. Control cabinet shall be provided with a 240V, 1 phase 50 Hz., 240V, 20W fluorescent lighting fixture and a suitable rated 240V, 1 phase, 5 Amp. 3 Pin socket for hand lamps.

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

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

5.18.17. Two coats of zinc-chromate primer and two coats of light gray enamel paint shall be applied both inside and outside after steam cleaning and phosphating. Items inside the cabinet made of organic material and shall be treated with a fungus-resistant varnish.

5.18.18. All doors, panels, removable covers and breaker openings shall be gasketed all around. All louvers shall have screens and filters. Cabinets shall be dust, moisture and vermin proof.

5.19 GEAR :

The disconnecter may be required to operate occasionally, with considerably long idle intervals. Special care shall be taken for selection of material for gear and lubrication of gears to meet this requirement. The gears shall be made out of aluminium bronze or any other better material and lubricated for life with graphite or better quality non draining and non hardening type grease. Wherever necessary automatic relieving mechanism shall be provided. Complete details of components, material, grade, self lubricating arrangement, grade of lubricants, details of jig, fixtures and devices used for quality check shall be furnished by the bidder.

5.20 GLAND PLATES AND GLANDS :

A removable gland plate with double compression type brass cable glands shall be provided with each operating mechanism for terminating all cables.

5.21 CONTACTS :

Contacts shall be made out of hard drawn electrolytic grade copper. Arcing contacts wherever provided shall close first and open last. The contact surface shall be silver plated. Fabrication of contact shall be made with suitable jig to avoid deviations during production. Details of size and shape of contacts, springs, back plated, fixing arrangements design of contact pressure, life of contacts, limit of temperature rise etc. shall be furnished in the bid.

5.22 MOUNTING OF CONTACTS :

The contacts shall rest on a brass block and with initial tension. Suitable device shall be provided to prevent dashing. Fabrication, welding etc. shall be done in suitable jig to avoid deviations during production.

5.23 MOVING BLADE :

Contact surface of moving blade shall be heavily silver plated. The surface shall be wiped during closing and opening operations to remove any film, oxide coating etc. Wiping action shall not cause scouring or abrasion of surfaces.

5.24 ROTATING INSULATOR :

The rotating insulator shall be mounted on a housing with bearing housing. The housing shall be made of gravity die cast aluminium with smooth surfaces suitably machined for seating the bearings. Two Nos. of bearings, with adequate shaft diameter and distance between the bearings, shall be provided to avoid wobbling during operations. The bearings shall be of atleast 75 mm shaft diameter. The bearing shall be of reputed make e.g. SKF, HMT, NBC, TATA and lubricated for life. All other friction locations shall be provided with suitable bearings or stainless steel or brass bushes. The bearings, bushes, joints, springs etc. shall be so designed that no lubrication shall be required during service. Complete details of bearings, bushes, housing, greasing etc. shall be furnished in the bid.

5.25 OPERATING PIPE :

50 mm internal diameter class B pipe shall be provided for operating disconnects. The pipe shall be terminated into a suitable swivel or universal type joint between the insulator bottom bearing and the operating mechanism to take care of marginal angular misalignment at site.

5.26.0 MISCELLANEOUS :

5.26.1 In centre break isolators, it has been observed that the vertical alignment of support insulator column shifts due to the weight of conductor/ aluminium tube bus, resulting in mismatching of contact/aluminium blades. The bidder shall ensure manufacturing design to prevent this mishap.

5.26.2 The design of pantograph disconnect shall also permit manual cranking after the half-way operation of disconnect and subsequent power failure. It is our experience that the insertion of handle for manual drive becomes difficult when the blades are stuck-up in mid-position after the power failure.

5.27 LIMITS OF TEMPERATURE RISE :

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

S.no.	Nature of the part or of the liquid	Maximum values of	
		Temperature (Deg.C.)	Temperature rise at a maximum ambient air temperature not exceeding 50 Deg.C.
1.	Contacts in air: Silver-face, copper, copper alloy or aluminium alloy (See Notes i & ii).	105	55

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

NOTES :

- (i) When applying the temperature rise of 55 Deg. C., care should be taken to ensure that no damage is caused to the surrounding insulating materials,
- (ii) The quality of the silver facing shall be such that a layer of silver remains at the points of contact after the mechanical endurance test. Otherwise, the contacts shall be regarded as "bare".
- (iii) The values of temperature and temperature rise are valid whether or not, the conductor connected to the terminals is silver-faced.
- (iv) The temperature shall not reach a value where the elasticity of the materials is impaired. For pure copper, this implies a temperature limit of 75 Deg. C.

5.28.0 MANDATORY SPARE PARTS :

5.28.1 The Bidders may please note that the name of essential items required for operation and maintenance of Isolators may please be included while offering the prices for isolators covered under the package. The spares shall be interchangeable with the identical parts of similar isolators. These shall be of the same materials and workmanship and shall meet the same requirements.

5.29.0 SUPPORT STRUCTURES FOR PANTOGRAPH ISOLATORS :

5.29.1 The bidder shall furnish the detailed drawings of the structures along with relevant calculations. The mean height of the 400 kV strung bus is 15.6 metres and that of connectors for equipment to equipment connection should be 8.2 metres (Heights including plinth of 300 mm.)

5.29.2 The structures shall be made up of hot dip galvanized good quality structural steel tube.

6.0 TESTS :

6.1 TYPE TEST :

All the equipment offered, shall be fully type tested as per relevant Indian Standards or any equivalent International Standard (as specified in clause-2) during the last five years from the date of bid opening. Copy of test reports shall be enclosed with the bid. For any change in the design/ type already type tested and the design/ type offered against this bid, the MPPTCL reserves the right to demand repetition of same or all type tests without any extra cost.

6.2 ACCEPTANCE AND ROUTINE TESTS :

- a) The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards or equivalent International Standards in presence of Purchaser's representative.
- b) Immediately after finalization of the programme of type/ acceptance/ routine testing, the manufacturer shall give sufficient advance intimation MPPTCL, to enable him to depute his representative for witnessing the tests.

7.0 INSPECTION :

- i. MPPTCL shall have access at all times to the works and all other places of manufacture, where the isolators are being manufactured and the Bidder shall provide all facilities for unrestricted inspection, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.
- ii. The successful Bidder 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 arrangements could be made for inspection.
- iii. No material shall be dispatched from the 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 successful bidder of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipment are later found to be defective.

8.0 QUALITY ASSURANCE PLAN & STAGE INSPECTION :

QAP & stage inspection shall be as per Section – I Volume – II.

9.0 DOCUMENTATION :

9.1 All drawings shall conform to latest version of international standards organization (ISO) 'A' series of drawing sheet/Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. Units.

9.2 LIST OF DRAWINGS AND DOCUMENTS :

The Bidder shall furnish four sets of following details and drawings along with his bid.

- i. Complete assembly drawing showing plan and elevation views of the isolator, complete with details of operating mechanism, mounting dimensions etc.
- ii. Sketches and descriptive details of :
 - a. Bearings
 - b. Jaw contacts and main isolator blades.
 - c. Inter-locking device.
 - d. Ground blades.
 - e. Interrupting device for making and breaking magnetising current.
 - f. Operating mechanism.
 - g. Spring operation etc.
 - h. Control cabinet.
- i. Isolator mounting structure.
- iii. Drawings with details to substantiate the suitability of the jaw design.
- iv. Type Test reports in case the equipment has already been type tested.

9.3 The successful Bidder shall within two weeks of placement of order, submit four sets of final versions of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/ approval on the drawings to the Bidder within reasonable time. The Bidder 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 Purchaser's comments. After receipt of Purchaser's approval,

the Bidder shall within three weeks submit 20 prints and two good quality reproducible of the approved drawings for Purchaser's use.

9.4 The Bidder before commencement of supply, shall submit six sets of the type test reports, duly approved by the Purchaser. Two copies of acceptance and routine tests certificates, duly approved by the Purchaser shall accompany the dispatched consignment.

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

9.6 Twenty (20) copies of nicely printed and bound volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment supplied shall be submitted by the Bidder for distribution to field officers prior to the dispatch of the equipment. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. The manual shall also contain a set of all the approved drawings, type test reports etc.

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

10. PACKING AND FORWARDING :

10.1 Bidder shall ensure that 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.

11. DISCREPANCY IN TECHNICAL PARTICULARS :

Regarding discrepancy in technical particulars, stipulation under Section-I, Volume-II shall be applicable.

APPENDIX - A**PRINCIPAL TECHNICAL PARAMETERS OF
400 kV ISOLATORS**

SNo.	TECHNICAL PARAMETERS	SPECIFICATION
1	Rated Frequency (Hz)	50
2	System Neutral Earthing	Effectively Earthed
3	No. of Phases (Poles)	3
4	Temperature Rise	As per relevant IS/ IEC Publication
5	Safe Duration of overload: a) 150% of rated current. a) 120% of rated current.	5 minutes 30 minutes
6	Suitable for :- Rated voltage (kV rms) Frequency (Hz)	420 50
7	Type of disconnect (AB)	Pantograph/ Centre Break Horizontal
8	Rated normal current (Amp.rms)	2000
9	Rated short time withstand current of disconnects and earthing switches for one sec. duration (KA rms)	40
10	Rated dynamic withstand current (KA)	100
11	Rated short circuit current of Earth Break (KA peak).	100
12	Rated insulation level:	
12.1	1.2/50 micro second lightning impulse withstand voltage (+ve or -ve polarity) a) To earth (kVp) b) Across the open disconnect voltage applied to. i) One terminal, lightning impulse (kVp) ii) Opposite terminal, power frequency (kVp)	1425 1425 240
12.2	250/2500 micro seconds switching impulse with stand voltage a) To earth (kVp) b) Across terminals of open disconnect (kV rms) i) One terminal, switching impulse (kVp). ii) Opposite terminal subjected to power	1050 900 345

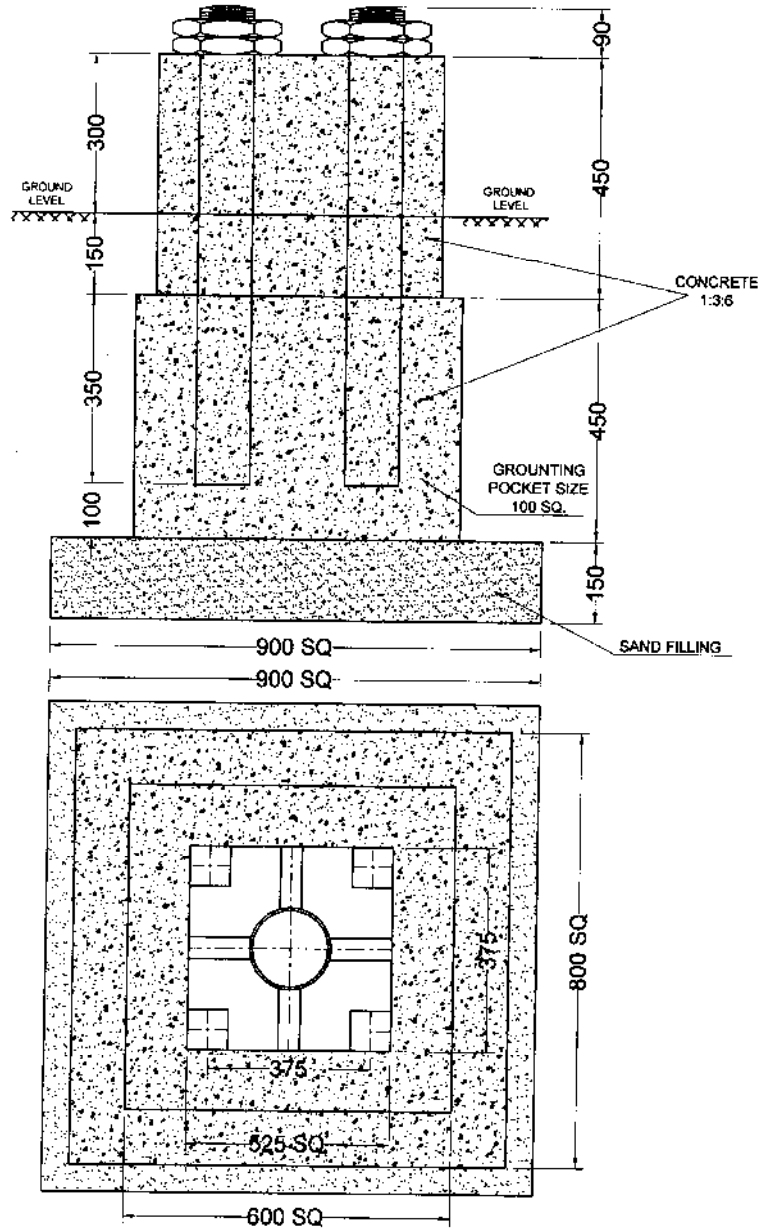
	frequency voltage (kV rms)	
12.3	Rated 1 minute power frequency with stand voltage (kV rms) a. To earth kV (rms) b. Across terminals of open disconnect	520 610
13	Minimum creepage distance of support and rotating insulator (mm)	10500
14	Rated Mechanical Terminal Load :	
14.1	For two column horizontal break disconnect a. Straight load (N) b. Across load (N)	1600 530
14.2	For pantograph disconnect a. Straight load (N) b. Across load (N)	2000 800
15	Rated magnetising/ capacitive current make and break capacity (Amp.rms)	0.7
16	Rated contact zone for P.G. isolator when fixed contacts are supported on flexible conductors. a) Horizontal deflection (Metres) b) Vertical deflection (Metres) c) Total amplitude of longitudinal movement with respect to support conductor (Meters)	0.5 0.3 0.4
17	Phase to Phase spacing for installation (mm)	7000
18	Minimum clearance (mm): a) Phase to earth b) Phase to Phase	3500 4000
19	Height of centre line of terminal pad above ground level (mm)	8200
20	Maximum radio interference voltage at 1 MHz and 1.1 x rated phase to earth voltage (micro volts)	500
21	Minimum corona extinction voltage (kV rms)	320
22	Rating of auxiliary contacts.	10A at 220V DC & 110V DC with breaking capacity of 2 A DC with time constant not less than 20 millisecond.
23	Seismic level (Horizontal Acceleration)	0.3 g
24	Operating time	12 sec. or less.

APPENDIX - B**DRAWING OF FOUNDATION AND BASE CHANNEL DETAILS FOR
400 KV ISOLATORS**

The following drawings for 400 kV Isolators are enclosed herewith for general guidance:

SNo.	Description	Drawing No.
1.	Foundation details for 420 kV Pantograph Isolators.	JICA/MPPTCL/TR-101-107/400 kV PANTO. ISO. FDN.
2.	Base channel fixing details – HCB with two earth switches	JICA/MPPTCL/TR-101-107/400 kV HCB- BASE CHANNEL

**FOUNDATION DETAILS FOR
420 KV PANTOGRAPH ISOLATOR**



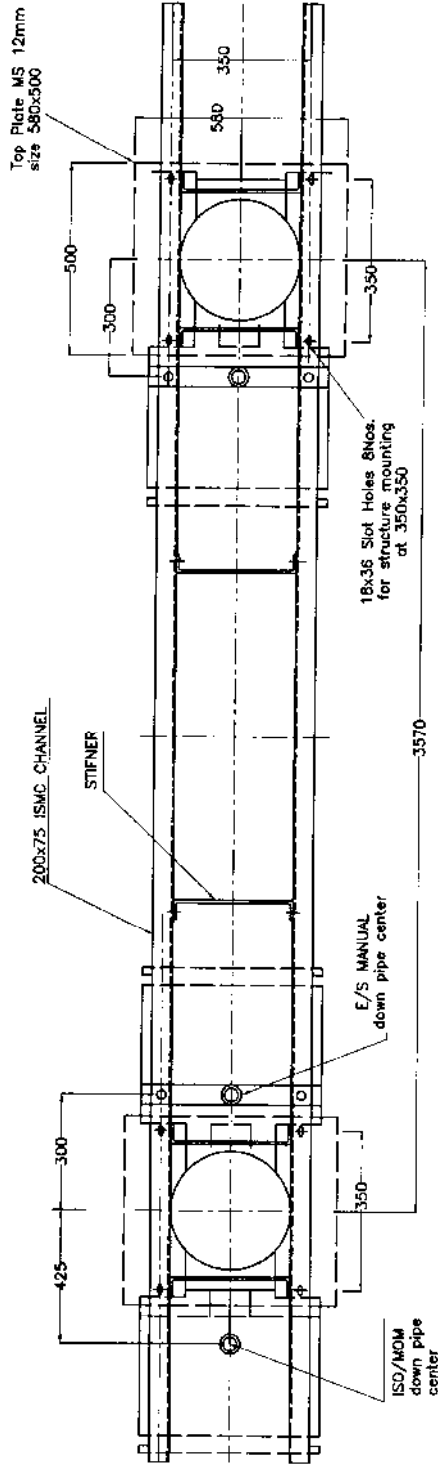
ALL DIMENSIONS ARE IN MM

TENDER PURPOSE ONLY

M. P. POWER TRANSMISSION Co. LTD. JABALPUR

DRAWING No:- JICA/MPPTCL/TR-101-107/400KV PENTO. ISO. FDN.

BASE CHANNEL FIXING DETAILS
HCB WITH TWO EARTH SWITCHES TO BE SUPPLIED BY FIRM



NOTE:-

1. ALL DIMENSION ARE IN mm
2. ALL FERROUS PARTS ARE HOTDIP GALVANISED.
3. ALL NONFERROUS CONTACT POINTS ARE SILVER PLATED
4. BASE CHANNEL IS COVERED UNDER SCOPE OF TENDER.

TENDER PURPOSE ONLY

M. P. POWER TRANSMISSION Co. LTD. JABALPUR

DRAWING No:- JICA/MPPTCL/TR-101-107/HCB-BASE CHANNEL

SCHEDULE – I(A)**“DESCRIPTION OF EQUIPMENT FOR SCHEDULE FOR RATES AND PRICES TO BE FURNISHED IN VOLUME-VI”**

SNo.	Particulars of Equipment / Item	Qty.
1.	400 kV, 2000 A, 1425 kV BIL 3 phase Pantograph Isolator with single earth switch alongwith terminal connectors complete with fixed contact assembly and all accessories including support structure and insulators meeting all technical requirements as described in the specification.	As per Price Schedule
2.	400 kV, 2000 A, 1425 kV BIL 3 phase Pantograph Isolator without earth switch alongwith terminal connectors complete with fixed contact assembly and all accessories including support structure and insulators meeting all technical requirements as described in the specification .	
3.	400 kV, 2000 A, 1425 kV BIL 3 phase Horizontal Centre Break Isolator with two earth switches alongwith terminal connectors complete with all accessories including support structure and insulators meeting all technical requirements as described in the specification .	
4.	400 kV, 2000 A, 1425 kV BIL 3 phase Horizontal Centre Break Isolators without earth switch alongwith terminal connectors complete with all accessories including support structure and insulators meeting all technical requirements as described in the specification	
5.	400 kV, 2000 A, 1425 kV BIL 1phase Horizontal Centre Break Isolators with earth switch (set of three) alongwith terminal connectors complete with all accessories including support structure and insulators meeting all technical requirements as described in the specification.	

NOTE :

1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.
2. The quantity of above equipments has been mentioned in Price Schedule.

SECTION – II (B)
2.1.5 - TECHNICAL SPECIFICATION FOR
220 kV, 132 kV & 33 kV ISOLATORS

1.1 SCOPE :

The scope of this specification covers design, manufacturing and supply of equipment as per Section-I, Volume-II. The bidder mentioned in the Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The Purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment/material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS :

Applicable Standards for the offered equipments / items shall be as per Section-I.

3.0 CLIMATIC CONDITIONS :

Applicable climatic conditions shall be as per Section – I.

5.0 SYSTEM PARTICULARS :

Applicable System Particulars shall be as per Section – I.

5.0 GENERAL TECHNICAL REQUIREMENT FOR 220 kV, 132 kV & 33 kV ISOLATOR WITH / WITHOUT EARTH SWITCH :

5.1 TYPE & RATING :

5.1.1 Three phase / Single phase double break Isolators shall have three posts per phase triple pole /single pole single throw, gang operated outdoor type, silver plated contacts with horizontally operating blade and isolators posts arranged vertically. Single phase horizontal centre break Isolators without earth switch, shall have two posts per phase, double pole gang operated outdoor type silver plated contacts with horizontally operating blade and isolators posts arranged vertically. Rotating blade feature with pressure relieving contacts is necessary, i.e. the isolators shall have turn and twist arrangement. This arrangement shall be described in details alongwith the bid. However, the design of turn & twist arrangement shall be to our approval. Banging type feature is not acceptable.

All isolators with/ without earth switch shall operate through 90 degree from their fully closed position to fully open position, so that the break is distinct and clearly visible from the ground level. All 220 kV & 132 kV isolators will have manual operating mechanism with worm and reduction gear, whereas 33 kV Isolators will have manual operating mechanism without worm and reduction gear. The earth switch shall have separate operating mechanism but without worm and reduction gear.

5.1.2 The 220 kV & 132 kV Isolators offered by the bidders shall be designed for a normal current rating of 1250 Amp and 33 kV Isolators shall be designed for a normal current rating of 800 / 1200 / 2400 Amp. The Isolators shall be suitable for continuous service at the system voltages specified herein. The isolators are not required to operate under load but they must be called upon to handle magnetisation currents of the power transformers and capacitive currents of bushings, busbar connections, very short lengths of cables & current of voltage transformers and dividers.

5.1.3 It may please be noted that the all types of Isolators are to be supplied with matching structure and Solid core Insulator. Structure to be supplied shall be as per our specification for which drawing is available in the Tender document. As Civil foundation for structure will be as per our civil drawing, structure base should be suitable for civil foundation. The prices of isolators are to be quoted accordingly including the cost of structure and Solid core Insulator. Further one prototype Isolator assembly complete with structure and solid core insulator duly assembled as per MPPTCL drawings at the premises of Isolator manufacturer shall be offered for inspection of MPPTCL before taking up mass supply. The proto assembly shall be checked for proper operation and fitting to avoid any mismatch during actual erection in the fie.

5.1.4 The inspection of the offered Isolators will be carried out after erection of the Isolators alongwith insulators on the support structure. A drawing of purchaser's standard support structure is enclosed with this specification for reference. The manufacturer will have to fabricate mounting structure generally conforming to purchaser's drawing. Each and every Isolator will have to be checked by erecting the same on the structure complete with support insulators by the manufacturer at his works before offering the Isolators for inspection. Serial number of Isolator will be punched / engraved on all the component parts of the Isolators.

5.1.5 The rated insulation strength of the equipment shall not be lower than the levels specified in IS-9921/IEC Publication No. 129.

5.2 TEMPERATURE RISE :

The maximum temperature attained by any part of the equipment when in service at site under continuous, full load conditions and exposed to the direct rays of sun shall not exceed 45 degree centigrade above ambient. The limit of temperature rise shall not be exceeded when corrected for the difference between ambient temperature at site and the ambient temperature specified in the approved specifications. The corrections proposed shall be stated in the bid and shall be subject to approval of the purchaser.

5.3 ISOLATOR INSULATION :

5.3.1 Insulation to ground, insulation between open contacts and the insulation between phases of the completely assembled isolating switch shall be capable of withstanding the dielectric test voltage specified in IS-9921 / IEC Publication No. 129.

Insulation between open contacts of a pole shall be atleast 15% more than the insulation between the live parts of pole to ground.

5.3.2 The mounting structure for the isolator shall be arranged by the purchaser separately. However, the following is binding on the bidder:-

- a. The isolators offered shall be suitable for solid core insulator.
- b. The bidder shall have to specifically given an assurance in the bid that the isolator of his supply shall be manufactured to make it suitable for us with insulators with following fixing details :-

Sl. No.	Voltage rating	Details of flange	PCD of which these holes are provided	No. of holes	Size of holes
1	220 kV	Top	127 mm	4	M16
		Bottom	254 mm	8	Ø18
2	132 kV	Top	127 mm	4	M16
		Bottom	225 mm	8	Ø18
3	33 kV	Top	76 mm	4	M12
		Bottom	76 mm	4	M12

- c. The isolators are to be supplied with mounting base channel and fixing nuts and bolts. The drawings of our standard structures for 220 kV, 132 kV & 33 kV Isolators are enclosed herewith in Appendix-B.

The bidder will have to give a specific assurance that the isolators of his supply shall be suitable for mounting on the structure as per drawing enclosed with specification.

5.4 MAIN CONTACTS :

All isolators shall have heavy duty self aligning and high pressure line type fixed contact of modern design and made of hard drawn electrolytic copper. The fixed female contact should be of complete reverse loop type. Broken loop type contacts will not be acceptable. The fixed contacts would be placed in a 'C' clamp. The various parts shall be accordingly finished to ensure inter-changeability of similar components. Fixed contacts shall have three jaws (three pairs of fingers) essentially for 220 kV, 132 kV & 33 kV 1200 Amp Isolators and also preferably for 33 kV 800 Amp Isolators. For 33 kV 2400 Amp Isolators, minimum of four jaws (four pairs of fingers) shall be provided. Each pair of fingers shall form reverse loops to hold moving contacts. Stopper provided in the fixed contact will overlap inside reverse loop assembly strips to stop over travel of moving contact pipe. It should be made of material having high melting point e.g. Teflon to withstand rise in temperature. Countersunk screws should be provided to secure the stopper in fixed contact which should be flushed properly to avoid damage to moving contact surface. These screws shall not be used for fixing of reverse loop contacts to the holding C- clamp.

Separate arrangement will be provided for fixing of reverse loop contacts to the 'C' clamp. The thickness of jaw holding bracket ('C' clamp) to hold fixed contact jaws should not be less than 6 mm made of HDG Mild steel. This 'C' clamp shall be placed on a channel of adequate thickness. This channel shall be welded on an insulator mounting plate of 8 mm thickness. The springs of fixed contact shall have housing to hold it in place. The spring shall be made of stainless steel having minimum thickness of 12 SWG. The cap on spring should be made of Teflon to withstand rise in temperature. The pad for connection of terminal connector shall be of Aluminium Alloy. The minimum size of isolator pad available for fixing of terminal connector shall be 110 mm x 110 mm with thickness not less than 12 mm, to suit terminal connector included in scope of supply. The contact length between the fixed contact terminal strips and aluminium terminal pad (where bimetallic strip is provided) shall be not less than 110 mm.

Suitable rain hood shall be provided overlapping the bushes on turn & twist arrangement to prevent accumulation of dust and other foreign particles so as to avoid jamming of rotation of moving contact pipe. Centre post top pin for holding the turn & twist assembly should be adequate in size to avoid any bending of turn & twist mechanism. The U fork holding the moving copper pipe should be made out of GI strip not less than 8 mm thick in case of 220 kV Isolator and not less than 6 mm thick in case of 132 kV & 33 kV Isolators. The horizontal arm (parallel to the moving pipe) of U fork should be atleast 500 mm long for 220 kV Isolator, 400 mm long for 132 kV Isolator & 200 mm long for 33 kV Isolator. Nut & bolt arrangement is preferable to hold the pin in place of lock pin. The turn & twist assembly of moving centre post top contact should be provided with sealed ball bearing at centre of mechanism. Flat washers 2 Nos. on each side of turn and twist spring may be provided (4 No). In turn & twist mechanism, size of hook lever should not be less than 20 mm.

The switch blades forming the moving contacts shall be made from tubular section of hard drawn electrolytic copper. The outer diameter of moving contact pipe shall be not less than 50 mm in case of 220 kV & 132 kV Isolator and 33 kV, 1200 Amp Isolators. For 33 kV, 800 Amp Isolators outer diameter of moving contact pipe shall be not less than 38 mm. For 33 kV, 2400 Amp Isolator, moving contact pipe shall be adequately dimensioned. The contacts shall be liberally dimensioned so as to withstand safely the highest short-circuit and over voltages that may be encountered during service. The surfaces of contacts shall be rendered smooth and silver plated. The thickness of silver plating shall be not less than 25 microns. In nut shell, the male and female contacts assemblies shall be of robust construction and design of these assemblies shall ensure:-

- a. Electro-dynamic withstand ability during short circuit without any risk of repulsion of contacts.
- b. The maximum current density shall be as under:-
 - i) For hollow tube sections :- 2.0 Amp. /sq.mm
 - ii) For other sections and terminal connectors:-

- 1.6 Amp/ sq.mm (for Copper) & 1.0 Amp / sq.mm (for Aluminium).
- c. Thermal withstand ability during short circuit.
- d. Constant contact pressure even when the live parts of the insulator stacks are subjected to tensile stresses due to linear expansion of connected bus-bar of flexible conductors either because of temperature variations or strong winds.
- e. No wiping action during closing and opening.
- f. Self alignment assuring closing of the switch without minute adjustment. The details/ drawings of contact, springs fixing arrangement contact pressure, current transfer assembly, limit of temperature rise etc., shall be furnished alongwith the bid.

The thickness of moving contact pipe should be uniform on the periphery at all points. Due care should be taken to ensure that copper pipe of good quality from reputed source and of electrolytic grade only is utilized in manufacture of moving contacts. The moving contact pipe should be supported with 2 mm thick brass bushes at rotating points with lubricating facility for smooth operation. The bushes should be machined having proper collar on one side and other side to be press fitted. The earthing switches shall each be provided with three sets of suitable type of fixed contacts below the fixed contacts assemblies of the main switch on the incoming supply side and three sets of moving contacts having ganged operation. These contacts too shall be fabricated out of electrolytic copper and dimensioned to withstand the current on the line. Nut & Bolts of minimum 12 mm size shall be used, except in case of current carrying parts.

5.5 PRE-ARCING CONTACTS :

Pre-arcing contacts of first to make and last to break type shall be provided for main contacts.

5.6 AUXILIARY SWITCHES :

5.6.1 All 220 kV isolators and earthing switches shall be provided with 220 Volt / 110 Volt DC auxiliary switches for their remote position indication on the control board and for electrical interlocking. The auxiliary switch shall have the following number of contacts :-

- a. For all earthing switches : 3 normally open and
3 normally closed.
- b. For all main isolators : 6 normally open and
6 normally closed set of
contacts.

All contacts should be brought out on terminals. Provision shall be kept for adding more auxiliary switch contacts at a later date. Auxiliary switches shall be of robust construction of some reputed make and housed in weather proof, vermin proof,

dust free covers mounted on the respective operating mechanism. Schematic diagram for set of contacts shall be furnished. A laminated schematic diagram of auxiliary switch contacts shall be pasted on inner side of door of mechanism box. The auxiliary switches should be positive type. The auxiliary switches should be spring loaded so that contacts are either NO or NC. The wire connection to the auxiliary switches shall be through suitable lug screwed to the switch. The connection to the auxiliary switch should be screw on type.

The auxiliary switches shall be capable of carrying the current of atleast 10 Amp. continuously and shall be capable of breaking current of atleast 2 Amp. in 220V/ 110V DC circuit, with time constant of not less than 20 milliseconds. The auxiliary switches shall be actuated by a cam or similar arrangement directly mounted on the isolator and shall be without any intermediate levels/ linkages to ensure fool proof operation.

It shall be possible to change normally closed contact into normally open contacts and vice versa at site.

5.6.2 For 132 kV & 33 kV Isolators, auxiliary switches are not required.

5.7 CLAMPS / CONNECTORS :

- i) The clamps / connectors shall be made of Aluminium alloy Grade A6 as per IS:5561(1970) and shall be suitable for twin zebra ACSR for 220 kV and 33 kV 1200 & 800 Amp Isolators with universal takeoff arrangement. For 33 kV, 2400 Amp Isolator, terminal connector shall be suitable for 4" IPS Aluminum tube (with horizontal takeoff arrangement) / quad moose ACSR (with universal takeoff arrangement). For quad moose ACSR conductor, compression type (boltless type) terminal connectors shall be provided.
- ii) The design of clamp shall be to our approval. However, responsibility of satisfactory design of the clamps/ connectors to safely withstand the mechanical stresses and carry the rated current without exceeding specified temperature rise shall solely rest with the bidder. The clamps to be offered should be manufactured by pressure or gravity die-casting method only and not by sand casting process.
- iii) It is necessary that suitable clamps are offered alongwith the isolator and also it is obligatory to give complete technical particulars of clamps alongwith the drawing as per following details:-
 - a. The terminal connector shall be manufactured and tested as per IS-5561 or equivalent International standard.
 - b. All castings shall be free from blow holes, surface blisters, cracks and cavities. All the sharp edges shall be blurred and rounded off.
 - c. No part of the clamp shall be less than 12 mm thick.

- d. All current carrying parts shall be designed and manufactured to have minimum contact resistance.
 - e. Connectors shall be designed to be corona free as per relevant standard.
 - f. All nuts and bolts shall be of 12mm size and made of HDG mild steel.
 - g. Bimetallic sleeve/ liner shall be 2 mm thick.
 - h. The conductor should be tightened by six bolts. Conductor holding length must not be less than 100 mm.
- iv) Wherever necessary bi-metallic strip of standard quality shall be used.
 - v) The surface of clamps to be tightened by six bolts should be flat in shape so that it may be possible to open the nuts and bolts by normal spanners. Therefore, any type of groove in the clamp body for fixing of nuts should be avoided.
 - vi) The portion of clamp to hold the conductor should be flat and straight and not zig-zag in construction, at both the sides, so that heating of clamp by throttling action of current may be avoided.
 - vii) Space of at least 50% of diameter of nuts should be available after the hole at both the sides of conductor holding portion for better mechanical strength.
 - viii) The clamp for twin Zebra ACSR Conductor shall be made suitably in three pieces so that each conductor may be tightened separately.
 - ix) Size of terminal connector for which the clamp is designed and also rated current under site conditions shall be embossed / punched on each part of clamps except hardware.

5.8 ISOLATOR AND EARTH SWITCH OPERATION :

5.8.1 Each 220 kV & 132 kV isolator switch shall be equipped with local manual operating device with worm & reduction gear. It shall be possible to pad lock the manual operating handle both in the open and close positions of the switches. Additional castle type outer lock shall be provided on the manual operating handle and control cubicle as to prevent the operation of isolator manually & locally when the corresponding circuit breaker is 'ON'. The earth switch may be local manual operated by separate mechanism without worm & reduction gear.

5.8.2 All 33 kV Isolators and earthing switches shall have manual operating mechanism without worm and reduction gear.

5.8.3 OPERATING MECHANISM FOR 220 KV, 132 KV & 33 KV ISOLATOR :

All Isolators and earthing switches shall have separate dependent manual operation. The main isolator operation shall be through worm and reduction gear for 220 kV & 132 kV Isolator and without worm and reduction gear for 33 kV Isolator. The operating mechanism shall provide quick, simple and effective operation. The design of manual operation shall be such that one man shall be able to operate the isolator without undue effort and isolator should open/close with more than 20 revolutions of crank. In case of any operational problem in worm and reduction gear assembly, suitable arrangement should be incorporated for manual operation of main switch, after by passing worm and reduction gear assembly. To hold operating pipe of main switch in position, suitable guide should be provided to arrest movement in case of by passing of worm & reduction gear assembly. The earth switch shall have simple manual operating mechanism. In the earth switch only banging type feature is required, therefore the operating mechanism should be such that the blade goes very smoothly in the fixed contact. There should not be any jerk during operation. The earth switch plate should not move due to gravity. In the rotating insulator, the design should be such that the shaft length is enough to accommodate the locknut in a proper manner. Flexible copper strips should be provided for main and earth handle.

5.8.4 The isolators may be required to operate occasionally with considerable long idle intervals. Special care shall be taken for selection of material of gear to meet this requirement. The gear shall be made of EN-353 or aluminium bronze or any better quality material and lubricated for life with suitable lubricant. Gear operating box should be properly sealed to prevent any leakage of grease / lubricating material. Provision for future lubrication should also be made. The gear box shall be fully enclosed/ covered in an enclosure. The gear box enclosure should be made by casting process and not of sheet steel to provide proper gear alignment. It should be filled with graphite grease or non-hardening grease. Complete details of component, material and grade, lubricant material and grade shall be furnished in the bid.

5.8.5 The gear operating mechanism shall be housed in cabinet made out of 12 SWG sheet steel with adequate channel support to withstand weight of gear. The operating handle shall also be placed in the cabinet. The cabinet shall be liberally designed to have sufficient working space. 2 No. rectangular frames made of 50x50x6 mm angle shall be provided to fix gear operating box on structure angles (for 220 kV & 132 kV Isolator). 20 x 14 mm slots both in horizontal and vertical direction will be provided on gear operating box support to facilitate adjustment for fixing.

5.8.6 The isolators and isolator with earth switches inclusive of their operating mechanism, should be such that they cannot come out of their open or closed positions by gravity, wind pressure, vibrations, reasonable shocks, or accidental touching of connecting rods of the operating mechanism. Isolators and earth switches should be capable of resisting in closed position the dynamic and thermal effects of maximum possible short circuit current at the installation point. They shall be so constructed that they do not open under the influence of the short circuit current. The operating mechanism should be of robust construction, easy to operate by a single

person and conveniently located for local operation in the switchyard. Operating mechanisms for main switch & earth switch should be provided with flexible copper strips for earthing of handle. The operating handle shall be of 32 mm dia. and 750 mm long. Arrangement in tandem pipes for locking the mechanism in ON and OFF positions should be provided.

5.8.7 ON/OFF marking shall be provided on operating mechanism of main switch and earth switch. Direction will also be indicated. Proper locking arrangement with lock & key of operating handle in ON & OFF position should be provided.

5.9 PIPES :

Tandem pipes shall be class B pipe having size of atleast 32 mm NB for 220 kV & 132 kV Isolators and 25 mm NB for 33 kV Isolators. The operating pipe shall also be class B with size of atleast 50 mm NB for 220 kV & 132 kV Isolator and 32 mm NB for 33 kV Isolator. The pipe shall be terminated into suitable universal type joints between the insulator bottom bearing and operating mechanism. The tandem pipes shall have threaded type length adjustors of atleast 20 mm dia for 220 kV isolator, 16 mm dia for 132 kV Isolator & 12 mm dia for 33 kV isolator at both ends. These adjustors shall have 8 mm thick rectangular link plates with 16 Ø holes housing 2 mm thick gun metal / brass bushes press / rivet fitted in the holes to avoid slipping during transit or in service. The rotary insulator bottom plate shall have U fork type arrangement for linking tandem pipes to them. These U fork arms shall be made of galvanized MS atleast 6 mm thick for 220 kV & 132 kV Isolators and 4 mm thick for 33 kV Isolators and shall have 16 Ø holes housing 2 mm thick gun metal / brass bushes press fitted to them. The U fork and tandem pipe shall be linked together with threaded adjustor through 12 Ø gear steel grade pin having collar cap at top and hole for split type locking pin at bottom for locking it in position. Double (2 No.) tandem pipes shall be provided for smooth operation of 220 kV & 132 kV isolators. For 33 kV Isolators with earth switch (to be mounted on gantry structure), sliding clamps may be provided for length adjustment.

Adjustable locking shall be provided in the tandem pipes to lock their position with the base channel in both open and close position of the Isolator.

Bushes may be provided on coupling of tandem pipe with insulator rotating base (3 Nos.). Bushes may also be provided on both sides of operating down pipe (2 Nos.) at support clamps. Bushes shall be made by machining process for smooth movement and should have minimum thickness of 2 mm. Bushes should be machined having one side proper collar and other side to be press fitted. Flange type joint should be provided at the bottom and universal coupling at top of down operating pipe to avoid any play during operation. The thickness of the flanges shall be atleast 8 mm for 220 kV isolator and 6 mm for 132 kV & 33 kV Isolator and the flange joint shall be made through atleast 4 GI bolts of not less than 12 Φ dia.

The 33 kV Isolator with earth switch shall be mounted on gantry structure at a height of 4240 mm from ground level. The operating mechanism for earth switch and main switch are to be fixed on the gantry columns which are at a distance of 1600

mm on either side from the isolator pole. Therefore the phase coupling pipe for earth switch and main switch should have length of 4500 mm each for proper operation. The length of operating pipes for main switch and earth switch should also be about 3700 mm.

5.10 **BASE CHANNELS :**

The isolator shall be mounted on a base fabricated from steel channel section of adequate size not less than 150 mm x 75 mm for 220 kV & 132 kV Isolators and 100 mm x 50 mm for 33 kV Isolators to withstand total weight of Isolator and insulators and also all the forces that may encountered by the isolator during service. The strengthening /jointing of base channels should be made by same size channels, to eliminate any vibrations during operations. Mounting plates for insulators shall be big enough to properly accommodate insulator metal parts (Base flanges). For fixing of bearing housing, one M.S. plate of 8 mm thickness should be welded on mounting channels, covering entire width of mounting channel base. The M.S. Plate will have slotted round hole in the middle for accommodating bearing assembly. Suitable holes shall be provided on the base channel to facilitate its mounting on our standard structures as detailed in enclosed drawing. The steel channel in each phase shall be mounted in vertical position and over it two mounting plates atleast 8 mm thick with suitable nuts and bolts shall be provided for minor adjustment at site. Suitable marking on various parts including mounting channel should be provided for proper identification. At about 30 mm from both the ends of each base channel, 4 mm thick plate of size 150 mm x 75 mm for 220 kV & 132 kV Isolators and 100 mm x 50 mm for 33 kV Isolators should be welded to the channel. Over these plates, name plates shall be riveted on both sides of all the three channels (overall six no. name plates to be provided). Pasting of name plates is not acceptable.

5.11 **CLEARANCES :**

We have adopted the following minimum clearances for isolators in our system. The bidders should therefore keep the same in view while submitting their bids.

Sl. No.	Description	Centre distance between poles (centre to centre) i.e ph. to ph. clearance	Distance between centre lines of outer posts on same pole.
1	a. 220 kV 3 Phase Double Break Isolator	4.0 metres	3.2 metres
	b. 220 kV Single Phase HCB Isolator	4.0 metres	2.6 metres
2	132 kV Isolator	2.5 metres	2.1 metres
3	33 kV Isolator	1.4 metres	0.96 metre

The plate provided for fixing insulator shall be of hot dip galvanized steel with thickness not less than 8 mm. ¾" size bolt should be used on insulator mounting plate for adjustment of height of insulators.

5.12 **INTERLOCKS AND EARTH SWITCHES :**

- i) Line earth switches shall consist of three earthing links per isolator which will normally rest against the frame when the connected isolator is in closed position. The earthing links for the three phases shall be mechanically linked to a coupling shaft which shall be capable of being fitted on either side of the isolator. Earth switch shall be mechanically interlocked with the main switch so that it is possible to close or open the earth switch only when the main switch is in the open position & its closing operation shall not be possible. In the earth switch only banging type feature is required. Therefore, the earthing switches should be provided with counter balance weight so that the earth switches do not fall due to gravity and it moves very smoothly in upward direction i.e. against gravity. The length of lever and counter weight should be selected carefully so that earth switch is in horizontal position in fully opened condition. Each earthing switch shall be designed to withstand electrodynamic stress due to currents upto 50 KA (peak) as per IEC recommendations. The contacts shall be of silver plated copper only.
- ii) All shafts, couplings etc shall be galvanised. Flexible copper connectors of atleast 50sq.mm cross-section shall be provided between the rotating shafts and the frame work.

5.13 **BEARINGS :**

The design and construction of the various bearings shall embody all the features required to withstand climatic conditions specified, so as to ensure dependable and effective operation even after long periods of in-action of these isolators and switches. Bearing housings should be weather proof. Facilities should be provided for lubrication of bearings. The location and number of bearings provided for reducing friction shall be clearly intimated alongwith suitable drawings.

The bearing housing shall be made of HDG mild steel with smooth surface suitably machined for seating the bearings. Each bearing assembly shall have two nos. (taper roller thrust and ball) bearing with adequate shaft diameter. A minimum distance of 150 mm, 100 mm & 70 mm between thrust and ball bearings shall be provided for 220 kV, 132 kV & 33 kV isolators respectively, to avoid wobbling during operation. The bearings shall be of reputed make e.g. SKF, HMT, NBC, TATA & lubricated for life. All other friction locations shall be provided with suitable bearings/ stainless steel or brass bushes. Complete details of arrangement offered shall be furnished.

5.14 **DESIGN, MATERIAL AND WORKMANSHIP :**

The successful bidder shall assume full responsibility for co-ordination and adequate design. All materials used in the construction of the equipment shall be of

the appropriate class, well finished and of approved design and name. All similar parts should be accurately finished and inter-changeable.

5.15 PAINTING, GALVANISING AND CLIMATE PROOFING :

All interiors and exteriors of control cabinets shall be thoroughly cleaned to remove all rust, scales, corrosion, grease and other adhering foreign matter and the surfaces treated by recognized phosphating (eg seven tank phosphating sequence). After such preparation of surfaces, two coats of zinc oxide primer shall be given by suitable stoving and air drying before final painting. Colour of the final paints shall be of shade No. 697 of IS i.e. epoxy light gray. The finally painted cubicle shall present aesthetically pleasing appearance free from any dent or uneven surface. Paint inside the metallic housing shall be of anti-condensation type and the paint on outside surfaces shall be suitable for outdoor installation. All components shall be given adequate treatment of climate proofing as per IS-3202 or equivalent international standard so as to withstand corrosive and severe service condition.

5.16 All ferrous parts shall be heavily hot dip galvanised. Bolts, nuts, pins and washers, etc. used on the isolators shall also be galvanised. All nuts, bolts and washers in current carrying parts shall also be hot dip galvanised. Special attention shall be paid to give tropical treatment to all the equipment as it will be subjected during service to extremely severe exposure to atmospheric moisture and to long period of high ambient temperature. All current carrying parts shall be of non-ferrous metal or alloys and shall be designed to limit sharp points, edges and similar sharp faces.

5.17 GENERAL:

As described in the above paragraphs, the bidder shall quote the prices of isolators inclusive of set of terminal connectors. Mounting structure will be arranged by the purchaser separately. The bidder should not include mounting structures in this bid. The base channel alongwith nuts, bolts and washers for the mounting of isolator on our structure and operating down pipe shall however be included. The operating mechanism together with down take pipe operating handle etc. will be included in the scope of supply by the bidder. Bill of material will be provided with details of all minor /major items. The counter balance spring cushions etc. shall be provided to prevent impact at the end of travel in both on opening and closing. The name plate engraved and riveted on the channel and operating mechanism shall be provided. The name plate shall contain all details e.g. customer's name, order No. and date, type, serial no., rated voltage, rated current, rated short time current etc.

5.18 ESSENTIAL SPARE ITEMS :

5.18.1 The Bidders may please note that the name of essential items required for operation and maintenance of Isolators have been mentioned in Annexure – E of Section – I Volume – II Part – I. The prices of those essential spare items may please be included while offering the prices for isolators covered under the package. The spares shall be interchangeable with the identical parts of similar isolators. These shall be of the same materials and workmanship and shall meet the same requirements.

5.18.2 Description of Essential Spare Items : The technical specification of essential spare items mentioned in Annexure – E have been already described in this bid document.

6.0 TESTS :

6.1 TYPE TEST :

All the equipment offered, shall be fully type tested as per relevant Indian Standards or any equivalent International Standard (as specified in clause-2) during the last five years from the date of bid opening. Copy of test reports shall be enclosed with the bid. For any change in the design/type already type tested and the design/type offered against this bid, the MPPTCL reserves the right to demand repetition of same or all type tests without any extra cost. Non compliance of this requirement will make the bid non-responsive.

6.2 ACCEPTANCE AND ROUTINE TESTS :

- a) The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards or equivalent International Standards in presence of Purchaser's representative.
- b) Immediately after finalisation of the programme of type/acceptance/routine testing, the manufacturer shall give sufficient advance intimation to MPPTCL, to enable him to depute his representative for witnessing the tests.

7.0 INSPECTION :

- i. MPPTCL shall have access at all times to the works and all other places of manufacture, where the isolators are being manufactured and the Bidder shall provide all facilities for unrestricted inspection, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.
- ii. The successful Bidder 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 arrangements could be made for inspection.
- iii. No material shall be dispatched from the 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 successful bidder of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipment are later found to be defective.
- v. For the purpose of inspection, it will be duty of the supplier to provide to the inspecting officer, the detailed order, approved

drawings, comments, if any, on the drawings and all amendments (if any) made in any term/ condition/specification/ GTP of the order and all relevant IS, IEC, standards. Failure to provide documents demanded by the inspector shall render the inspection as "Fake Inspection Call" and penalty may be imposed on the supplier on this account

8.0 QUALITY ASSURANCE PLAN & STAGE INSPECTION :

QAP & stage inspection shall be as per Section – I Volume – II.

9.0 DOCUMENTATION :

9.1 All drawings shall conform to latest version of international standards organization (ISO) 'A' series of drawing sheet/Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. Units.

9.2 LIST OF DRAWINGS AND DOCUMENTS :

The Bidder shall furnish four sets of following details and drawings along with his bid :-

- i. Complete assembly drawing showing plan and elevation views of the isolator, complete with details of operating mechanism, mounting dimensions etc.
- ii. Sketches and descriptive details of :
 - a. The outline dimensions of the isolating and earth switches.
 - b. Details of main contacts.
 - c. The mechanical interlock between earth and isolating switches.
 - d. The details of fixed and moving contacts and the arrangement of pressure relief.
 - e. Turn & Twist mechanism.
 - f. Bearing assembly.
 - g. Terminal connectors.
 - h. Name plates to be provided.
 - i. Operating mechanism, type of gear, size and thickness of box, gland plate, gland etc.
- iii. Drawings with details to substantiate the suitability of the jaw design.
- iv. Type Test reports in case the equipment has already been type tested.

9.3 The successful Bidder shall within two weeks of placement of order, submit four sets of final versions of all the above drawings for Purchaser's approval. The

Purchaser shall communicate his comments/approval on the drawings to the Bidder within reasonable time. The Bidder 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 Purchaser's comments. After receipt of Purchaser's approval, the Bidder shall within three weeks submit 20 prints and two good quality reproducible of the approved drawings for Purchaser's use.

9.4 The Bidder before commencement of supply, shall submit six sets of the type test reports, duly approved by the Purchaser. Two copies of acceptance and routine tests certificates, duly approved by the Purchaser shall accompany the dispatched consignment.

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

9.6 Twenty (20) copies of nicely printed and bound volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment supplied shall be submitted by the Bidder for distribution to field officers prior to the dispatch of the equipment. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. The manual shall also contain a set of all the approved drawings, type test reports etc.

9.7 Approval of drawings/work by MPPTCL shall not relieve the Bidder of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material, which in his judgment is not in full accordance there with.

10. PACKING AND FORWARDING :

10.1 Bidder shall ensure that 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.

11. DISCREPANCY IN TECHNICAL PARTICULARS :

Regarding discrepancy in technical particulars, stipulation under Section-I, Volume-II shall be applicable.

APPENDIX- A**PRINCIPAL TECHNICAL PARAMETERS
OF ISOLATORS**

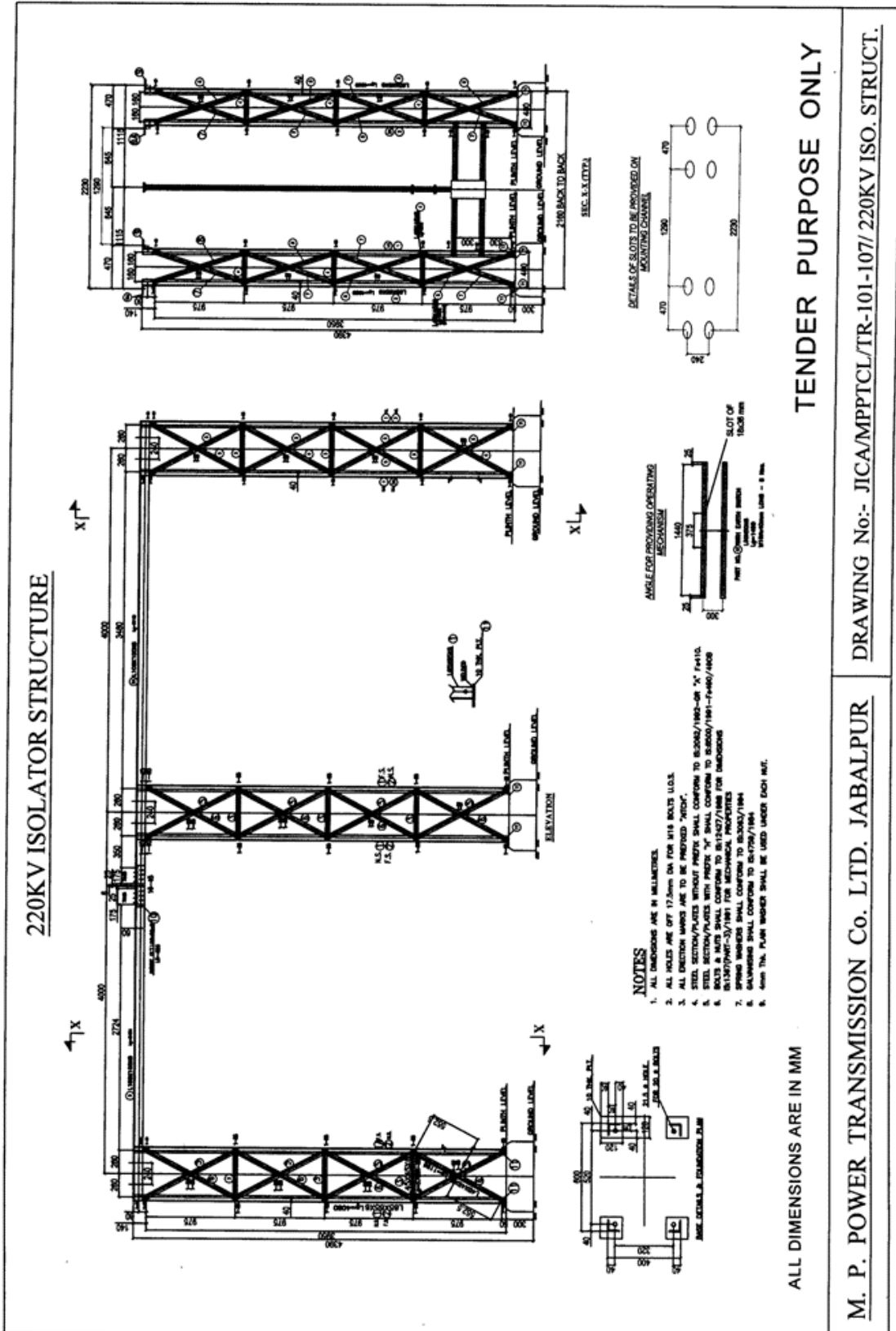
SNo.	Item	220 kV	132 kV	33 kV
1	Rated Frequency (Hz)	50		
2	System Neutral Earthing	Effectively Earthed		
3	No. of Phases (Poles)	3		
4	Temperature Rise	As per relevant IS/IEC Publication		
5	Suitable for:- Rated Voltage (kV rms) Frequency (Hz)	245 50	145 50	36 50
6	Type of disconnect (AB)	Double Break (DB) / Horizontal Centre Break (HCB)	Double Break (DB)	Double Break (DB)
7	Rated normal current (Amp.rms)	1250	1250	800/1200 /2400
8	Rated short time with stand current of disconnects and earthing switches Duration (KA rms)	40 KA for 1 sec.	40 KA for 1 sec	26.2 KA for 2 sec
9	Rated peak withstand current (kA)	100	100	65.5
10	Rated short circuit current of Earth Break (kA peak).	100	100	65.5
11 11.1	Rated insulation level: 1.2/50 microsecond lightning impulse withstand voltage (+ve or -ve polarity) a) To earth (kVp) b) Across insulating distance: One terminal subjected to lightning impulse (kVp) and opposite terminal subjected to power frequency (kV rms) Voltage	1050 1200	650 750	170 195
11.2	Rated 1 minute power frequency with stand voltage (kV rms)	460	275	70
12	Minimum creepage distance of support and rotating insulator (mm)	6125	3500	900

13	Rated Mechanical Terminal Load for two column horizontal break disconnect a) Straight load (N) b) Across load (N)	800 270	- -	- -
14	Rated magnetizing/ capacitive current make and break capacity (Amp.rms)	0.7	0.5	0.5
15	Phase to Phase spacing for installation (mm)	4000	2500	1400
16	Minimum clearance (mm): c) Phase to earth d) Phase to Phase	2150 4000	1075 2500	480 1400
17	Height of centre line of terminal pad above ground level (mm)	7000	4600	3900
18	Maximum radio interference voltage at 1 MHz and 1.1 x rated phase to earth voltage (micro Volts)	500	-	-
19	Minimum corona extinction voltage (kV RMS)	176	-	-
20	Rating of auxiliary contacts.	10A at 220V DC & 110V DC with breaking capacity of 2 A DC with time constant not less than 20 millisecond.	-	-
21	Approximate Height of insulator (mm)	2500	1500	508

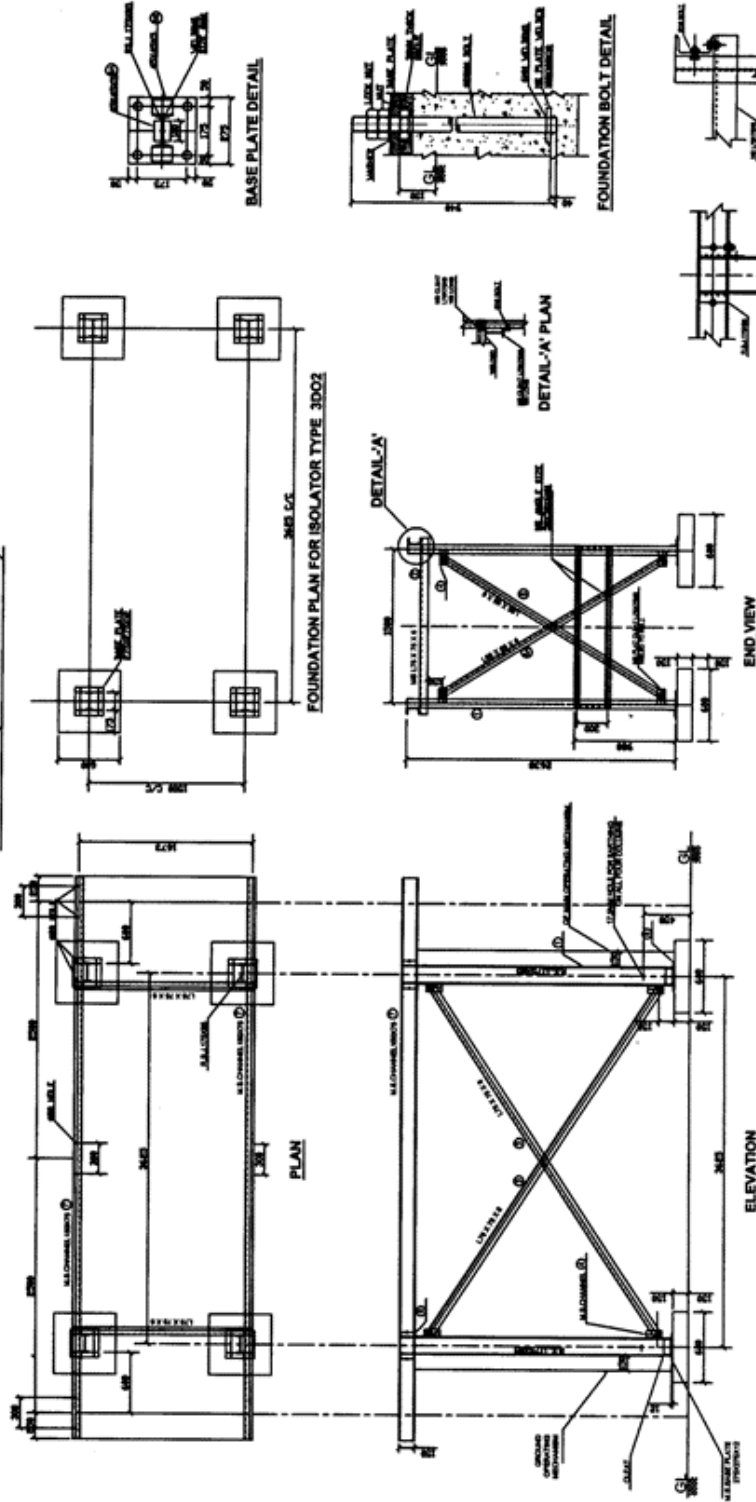
APPENDIX - B**DRAWING OF SUPPORT STRUCTURES & GENERAL ARRANGEMENT**

The drawings showing general arrangement and support structure for 220 kV, 132 kV & 33 kV Isolator is enclosed herewith for general guidance:

S.No.	Description	Drawing No.
1	Drawing of support structure for 220 kV Isolator	JICA/MPPTCL/TR-101-107/220 kV ISO. STRUCT.
2	Drawing of support structure for 132 kV Isolator	JICA/MPPTCL/TR-101-107/132 kV ISO. STRUCT.
3	GA Drawing of 132 kV Isolator with earth switch	JICA/MPPTCL/TR-101-107/GA 132 kV ISOLATOR
4	Drawing of support structure for 33 kV Isolator	JICA/MPPTCL/TR-101-107/33 kV Iso. Struct.
5	Pad Clamp suitable for Twin Zebra ACSR Conductor	JICA/MPPTCL/TR-101-107/ PAD CLAMP (TWIN ZEBRA)



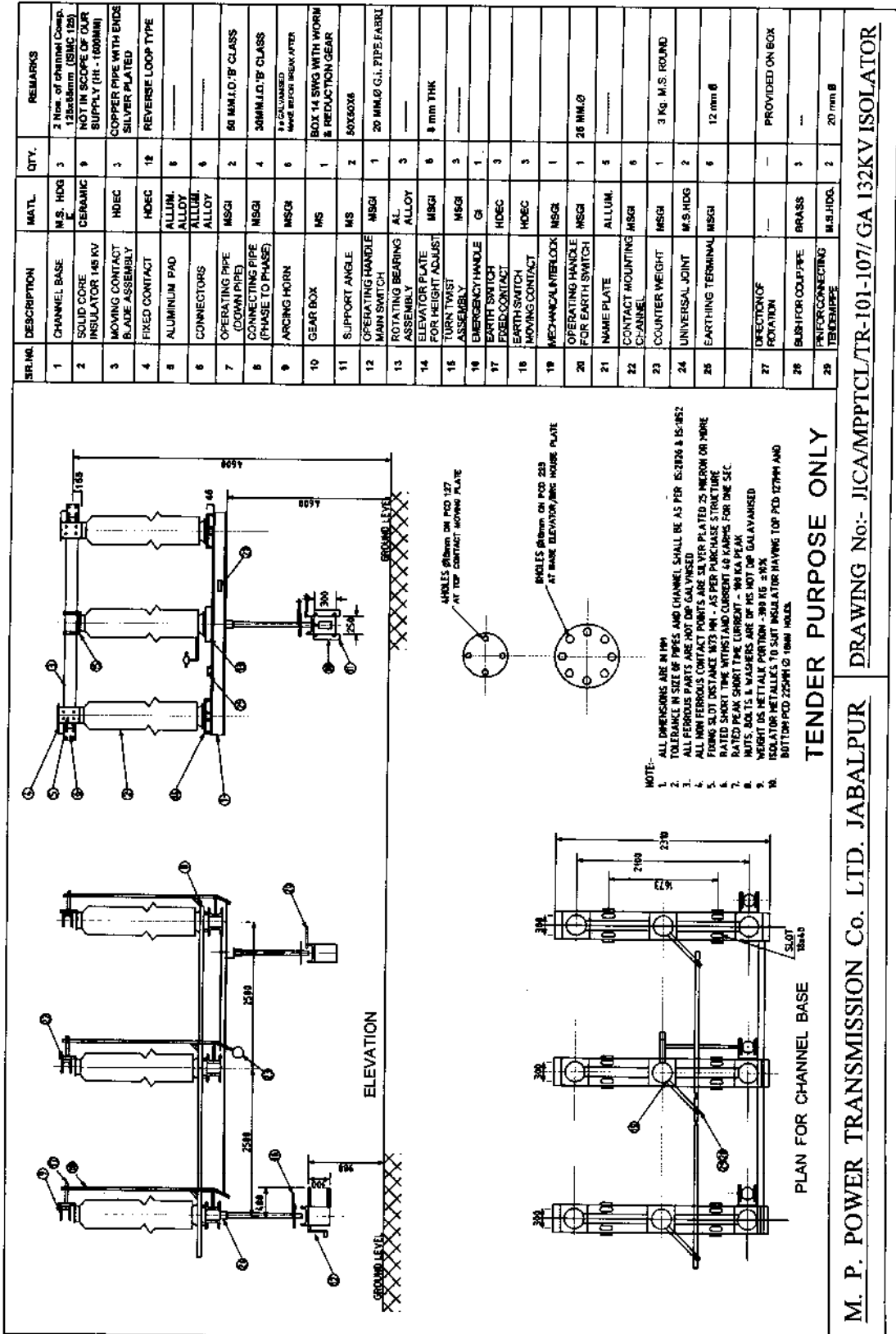
**STRUCTURAL DRAWING FOR 132KV ISOLATOR (LOW LEVEL)
3DO2 (BOLTED)**



TENDER PURPOSE ONLY

M. P. POWER TRANSMISSION Co. LTD. JABALPUR

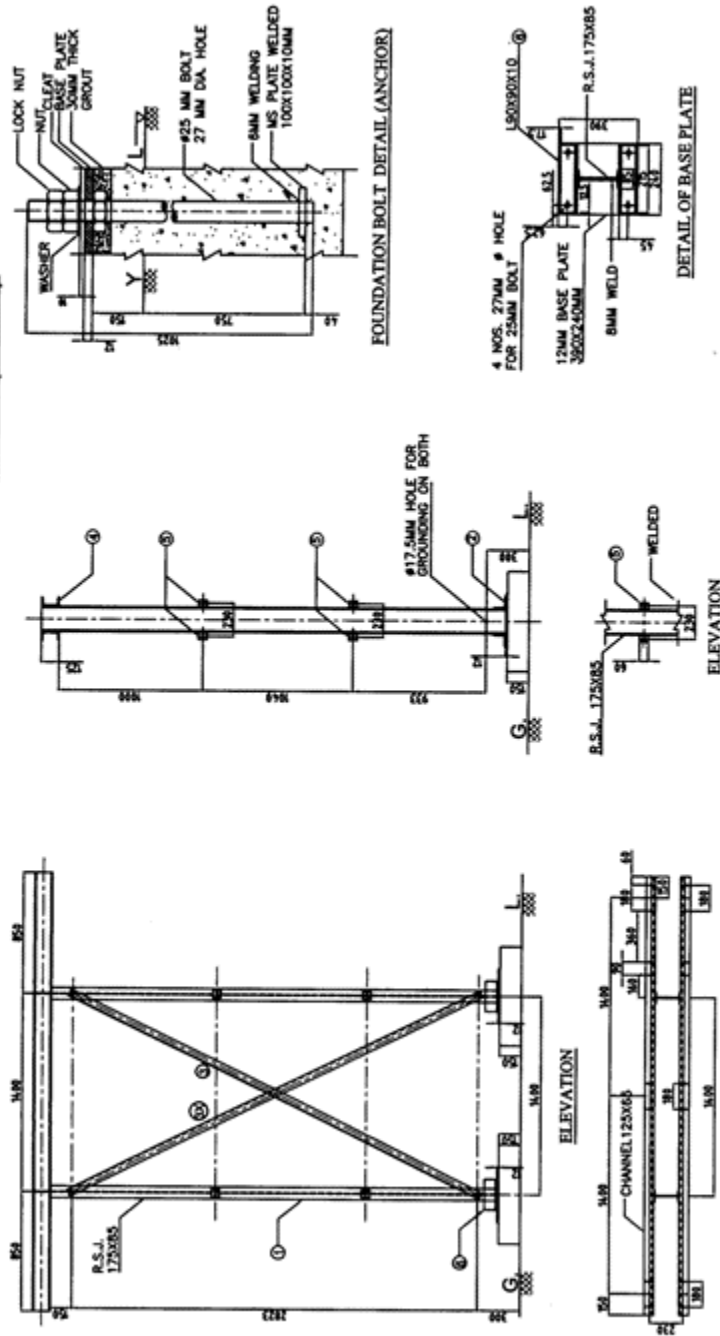
DRAWING No:- JICA/MPPTCL/TR-101-107/ 132KV ISO. STRUCT.



Sr.No	DESCRIPTION	MATL.	QTY.	REMARKS
1	CHANNEL BASE	M.S. HDG	3	2 Nos. of Channel Comp. 12x55mm (S.M.C. 12)
2	SOLID CORE INSULATOR 145 KV	CERAMIC	9	NOT IN SCOPE OF OUR SUPPLY (H. - 1000MM)
3	MOVING CONTACT BLADE ASSEMBLY	HOBC	3	COPPER PIPE WITH ENDS SILVER PLATED
4	FIXED CONTACT	HOBC	18	REVERSE LOOP TYPE
5	ALUMINUM PAD	ALUM. ALLOY	6	
6	CONNECTORS	ALLOY	4	
7	OPERATING PIPE (DOWN PIPE)	MSGI	2	60 MM I.D.'B' CLASS
8	CONNECTING PIPE (PHASE TO PHASE)	MSGI	4	30MM I.D.'B' CLASS
9	ANCHOR HORN	MSOR	6	Ø 4 GALVANISED MADE BEFORE BREAK AFTER
10	GEAR BOX	MS	1	BOX 14 SWG WITH WORM & REDUCTION GEAR
11	SUPPORT ANGLE	MS	2	50X50X6
12	OPERATING HANDLE MAIN SWITCH	MSGI	1	20 MM I.D. G.I. PIPE FABRI
13	ROTATING BEARING ASSEMBLY	AL. ALLOY	3	
14	ELEVATOR PLATE FOR HEIGHT ADJUST	MSGI	6	Ø 8 mm THK
15	TURN TWIST ASSEMBLY	MSGI	3	
16	EMERGENCY HANDLE	CS	1	
17	EARTH SWITCH FIXED CONTACT	HOBC	3	
18	EARTH SWITCH MOVING CONTACT	HOBC	3	
19	MECHANICAL INTERLOCK FOR EARTH SWITCH	MSGI	1	
20	OPERATING HANDLE FOR EARTH SWITCH	MSGI	1	20 MM Ø
21	NAME PLATE	ALUM.	5	
22	CONTACT MOUNTING C-ANSEL	MSGI	6	
23	COUNTER WEIGHT	MSGI	1	3 Kg. M.S. ROUND
24	UNIVERSAL JOINT	M.S. HDG	2	
25	EARTHING TERMINAL	MSGI	6	12 mm Ø
27	DIRECTION OF ROTATION			PROVIDED ON BOX
28	BUSH FOR COAL PIPE	BRASS	3	
29	PIECE FOR CONNECTING TERMINAL PIPE	M.S. HDG.	2	20 mm Ø

M. P. POWER TRANSMISSION Co. LTD. JABALPUR DRAWING No:- JICAMPPTCL/TR-101-107/GA 132KV ISOLATOR

STRUCTURAL DRAWING OF ISOLATER (1D03)

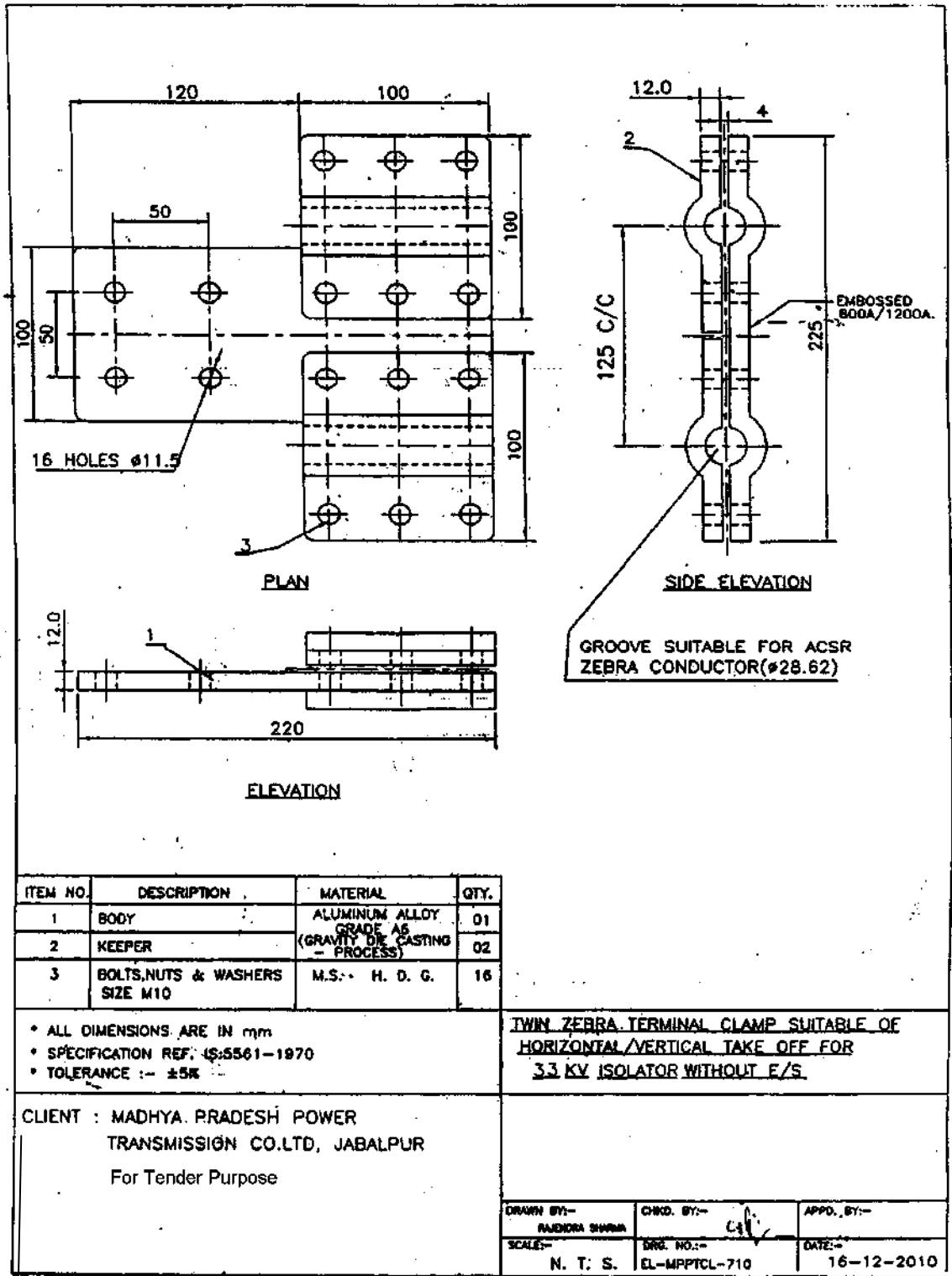


- 1) All dimensions are in mm.
- 2) All holes are 17.5 mm dia for 16mm dia bolts if not stated.
- 3) All steel members bolts nuts, etc are not dip galvanised.
- 4) All steel shall conform to I.S.:226/I.S.:2002.
- 5) SWS shall be supplied with each bolts.
- 6) Min. rolled & cut to be supplied shall be 20mm & 23mm for 16 mm dia bolts respectively.
- 7) Bolts of M.S.B class shall be used.
- 8) All item nos. to be prefixed with "U16-1D03"
- 9) THIS DRAWING IS PREPARED FROM MPSEB, JABALPUR DRC. NO.38-108-3381

Length	Quantity	Channel	Washers	Nuts	Washers	Length	Quantity
16mm Dia Bolt - 40mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 40mm Long	4
16mm Dia Bolt - 50mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 50mm Long	4
16mm Dia Bolt - 60mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 60mm Long	4
16mm Dia Bolt - 70mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 70mm Long	4
16mm Dia Bolt - 80mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 80mm Long	4
16mm Dia Bolt - 90mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 90mm Long	4
16mm Dia Bolt - 100mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 100mm Long	4
16mm Dia Bolt - 110mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 110mm Long	4
16mm Dia Bolt - 120mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 120mm Long	4
16mm Dia Bolt - 130mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 130mm Long	4
16mm Dia Bolt - 140mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 140mm Long	4
16mm Dia Bolt - 150mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 150mm Long	4
16mm Dia Bolt - 160mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 160mm Long	4
16mm Dia Bolt - 170mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 170mm Long	4
16mm Dia Bolt - 180mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 180mm Long	4
16mm Dia Bolt - 190mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 190mm Long	4
16mm Dia Bolt - 200mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 200mm Long	4
16mm Dia Bolt - 210mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 210mm Long	4
16mm Dia Bolt - 220mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 220mm Long	4
16mm Dia Bolt - 230mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 230mm Long	4
16mm Dia Bolt - 240mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 240mm Long	4
16mm Dia Bolt - 250mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 250mm Long	4
16mm Dia Bolt - 260mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 260mm Long	4
16mm Dia Bolt - 270mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 270mm Long	4
16mm Dia Bolt - 280mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 280mm Long	4
16mm Dia Bolt - 290mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 290mm Long	4
16mm Dia Bolt - 300mm Long	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Plain Washers - 30mm Thk	4	16mm Dia Bolt - 300mm Long	4

TENDER PURPOSE ONLY

M. P. POWER TRANSMISSION Co. LTD. JABALPUR **DRAWING No:- JICAM/PPPTCL/TR-101-107/ 33KV Iso. Struct.**



SCHEDULE – I (A)
“DESCRIPTION OF EQUIPMENT FOR
SCHEDULE FOR RATES AND PRICES
TO BE FURNISHED IN VOLUME-VI”

SNo.	Particulars of Equipment / Item	Qty.
A	220 kV Isolators	As per Price Schedule
1.	220 kV 1250 A Double Break 3 Phase Isolator with earth switch complete with the following:- a. Manual operating mechanism for main switch with worm & reduction gear. b. Manual operating mechanism for earth switch c. Pad locks with three keys for main switch and earth switch and castle interlock. d. 6 Nos Terminal connectors. e. 3 Nos. Base channels f. 6NO + 6NC contacts for main switch. g. 3NO +3NC Contacts for earth switch. h. All other accessories as per technical specification	
2	Same as ‘1’ above but 220 kV, 1250 Amp without earth switch (i.e. except item (b) above).	
3	220 kV 1250 A Single Phase Horizontal Centre Break Isolator without earth switch complete with the following:- a. Manual operating mechanism for main switch with worm & reduction gear. b. Pad locks with three keys. c. 2 Nos Terminal connectors. d. 1 No. Base channel e. 3NO + 3NC contacts for main switch. f. All other accessories as per technical specification	
B	132 kV Isolators	
4	132 kV 1250 A double break three phase isolator with earth switch and set of spares as per Annexure-D Section-I Vol. II, Part-I complete with the following :- a. Manual operating mechanism for main switch with worm & reduction gear. b. Manual operating mechanism for earth switch. c. Pad locks with three keys for main switch and earth switch and castle interlock. d. 6 Nos. Terminal connectors. e. 3 Nos. Base channels f. All other accessories as per technical specification.	
5	Same as ‘4’ above but 132 kV 1250 Amp without earth switch (i.e. except item (b) above).	

SNo.	Particulars of Equipment / Item	Qty.
6	132 kV 1250 A Single Phase Double Break Isolator without earth switch and complete with the following:- a. Manual operating mechanism for main switch with worm & reduction gear. b. Pad locks with three keys. c. 2 Nos. Terminal connectors. d. 1 No. Base channel e. All other accessories as per technical specification	As per Price schedule
C	33 kV Isolators	
7	33 kV 800A double break three phase isolator with earth switch and set of spares as per Annexure-D Section-I Vol. II, Part-I complete with the following :- a. Manual operating mechanism for main switch. b. Manual operating mechanism for earth switch. c. Pad locks with three keys for main switch and earth switch and castle interlock. d. 6 Nos. Terminal connectors. e. 3 Nos. Base channels f. All other accessories as per technical specification.	
8	Same as '7' above but 33 kV, 1200 Amp with earth switch.	
9	Same as '7' above but 33 kV, 1200 Amp without earth switch (i.e. except item (b) above).	
10	Same as '7' above but 33 kV, 2400 Amp without earth switch (i.e. except item (b) above).	

NOTE:

1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.
2. The quantity of above equipments has been mentioned in Volume VI

SECTION – II
2.1.6 - TECHNICAL SPECIFICATION FOR
SOLID CORE INSULATORS

1.0 SCOPE :

The scope of this specification covers design, manufacturing and supply of equipment as per Section-I, Volume-II. The bidder mentioned in the Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The Purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment/material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS :

Applicable Standards for the offered equipments / items shall be as per Section-I.

3.0 CLIMATIC CONDITIONS :

Applicable climatic conditions shall be as per Section – I.

4.0 SYSTEM PARTICULARS :

Applicable System Particulars shall be as per Section-I

5.0 GENERAL TECHNICAL REQUIREMENT :

5.1 The insulators shall conform to the latest applicable Indian or IEC Standard and in particular to IS-2544.

5.2 Porcelain used for the manufacture of insulators shall be homogenous, free from flaws or imperfections that might affect the mechanical or di-electric quality. They shall be thoroughly vitrified, tough & impervious to moisture. The glazing of the porcelain shall be of uniform brown colour, free from blisters, burnsters and other similar defects. Insulators of the same rating and type shall be interchangeable.

5.3 The porcelain and metal parts shall be assembled in such a manner that any thermal differential expansion between the metal and porcelain parts throughout the range of temperature variation shall not loosen parts or create undue internal stresses, which may affect the electrical or mechanical strength and rigidity. Each cap and base shall be machine faced and smoothly hot dip galvanized. The cap and base of the insulators shall be interchangeable with each other.

5.4 Special care shall be taken for cementing the hardware into the porcelain insulators and also for using proper cementing for forming solid core insulators assembly. The bidder must specify the type of cementing used and should give proper explanation duly supported with necessary test certificates to justify that the cementing used is of the highest quality to ensure trouble free performance of solid core insulators.

5.5 The metallic flanges, nuts, bolts & washers shall be hot dip galvanized. The nuts, bolts & washers for making one complete insulator stack and also for fixing the isolators shall be included alongwith insulators.

5.6 The tapped holes shall be of standard size except that the diameter may be oversize by not more than 0.25 mm. They shall be suitable for steel bolts having standard dimensions after galvanizing. The length of full thread shall not be less than the nominal bolt diameter. The threads of tapped holes in galvanized fittings shall be cut after galvanizing.

6.0 TESTS :

6.1 Type Test :

All the insulators offered, shall be fully type tested as per relevant Indian Standards or any equivalent International Standard (as specified in clause-2) during the last five years from the date of bid opening. Copy of test reports shall be enclosed with the bid. For any change in the design / type already type tested and the design / type offered against this bid, the Purchaser reserves the right to demand repetition of same or all type tests without any extra cost.

6.2 Acceptance And Routine Tests :

6.2.1 The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards or equivalent International Standards in presence of Purchaser's representative.

6.2.2 Immediately after finalisation of the program of type/ acceptance/ routine testing, the manufacturer shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

7.0 INSPECTION :

- i. The Purchaser shall have access at all times to the works and all other places of manufacture, where the solid core insulators are being manufactured and the Bidder shall provide all facilities for unrestricted inspection of the Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.
- ii. The successful Bidder shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of insulator in its various stages, so that arrangements could be made for inspection.
- iii. For the purpose of inspection, it will be duty of the supplier to provide, to the inspecting officer, the detailed order, approved drawings, comments, if any, on the drawings and all amendments(if any) made in any term/ condition/specification/ GTP of the order and all relevant IS, IEC, standards. Failure to provide documents demanded by the inspector shall render the inspection as "Fake Inspection Call" and relevant penalty may be imposed on the supplier on this account
- iv. No material shall be dispatched from the point of manufacture unless the material has been satisfactorily inspected and tested.
- v. The acceptance of any quantity of the insulator shall in no way relieve the successful bidder of his responsibility for meeting all the requirement of this

specification and shall not prevent subsequent rejection if such insulator are later found to be defective.

8.0 QUALITY ASSURANCE PLAN & STAGE INSPECTION :

QAP & stage inspection shall be as per Section – I Volume – II.

9.0 DOCUMENTATION :

9.1 All drawings shall conform to latest version of International Standards Organization's (ISO's) 'A' series of drawing sheet / Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for microfilming. All dimensions and data shall be in S.I. Units.

9.2 List of Drawings And Documents :

The Bidder shall furnish two sets of following details and drawings along with his bid.

- a. General outline and assembly drawings of the insulators together with technical particulars.
- b. Sectional views showing top and bottom portion of insulator alongwith depth of threaded portion on metal cap, details of bottom flange etc.
- c. Shed profile with complete details of various parameters.
- d. Details of flanges joining upper and lower stack of insulator.
- e. Details of nuts and bolts to be provided on top and bottom portion of insulator included in the scope of supply.
- f. Mounting details of top and bottom portion.
- g. Type Test reports in case the insulator has already been type tested.
- h. Test reports, literature, pamphlets of the bought out items and raw material.

9.3 The successful Bidder shall within two weeks of placement of order, submit four sets of final versions of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments / approval on the drawings to the Bidder within reasonable time. The Bidder 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 Purchaser's comments. After receipt of Purchaser's approval, the Bidder shall within three weeks submit 20 prints and two good qualities reproducible of the approved drawings for Purchaser's use.

9.4 The Bidder before commencement of supply shall submit six sets of the type test reports, duly approved by the Purchaser. Two copies of acceptance and routine tests certificates, duly approved by the Purchaser shall accompany the dispatched consignment.

9.5 The manufacturing of the insulator 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 insulator prior to the approval of the drawing shall be at the Bidder's risk.

- 9.6 Ten (10) copies of nicely printed and bound volumes of operation, maintenance and erection manuals in English Language, for each type and rating of insulator supplied shall be submitted by the Bidder for distribution to field officers, prior to the dispatch of the insulator. The manual shall contain all the drawings and information required for erection, operation and maintenance of the insulators. The manual shall also contain a set of all the approved drawings, type test reports etc.
- 9.7 Approval of drawings / work by Purchaser shall not relieve the Bidder of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The insulator shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material, which in his judgment is not in full accordance therewith.

10.0 PACKING AND FORWARDING :

Bidder shall ensure that 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.

11.0 DISCREPANCY IN TECHNICAL PARTICULARS :

Regarding discrepancy in technical particulars, stipulation under Section-I, Volume-II shall be applicable.

APPENDIX - A
PRINCIPAL PARAMETERS OF
SOLID CORE INSULATORS

S No.	PARTICULARS	400 KV		220 KV	132 KV	33 KV
		1	Type	Outdoor Cylindrical Porcelain Solid Core Post Insulator	Outdoor Porcelain Solid Core Operating Rod Insulator	Outdoor Cylindrical Porcelain Solid Core Post Insulator
2	Rated Frequency (Hz)	---50---				
3	System Neutral Earthing.	--Effectively Earthed--				
4	Suitable for:- Rated Voltage (KV) Rated Frequency (Hz)	420 50	420 50	245 50	145 50	36 50
5	One minute power frequency with stand voltage(Wet) (KV)	680	680	460	275	70
6	Lightning Impulse withstand test voltage (KV)	1550	1550	1050	650	170
7	Switching Impulse withstand Voltage (KV)	1050	1050	-	-	-
8	Minimum creepage distance Total (mm).	10500	10500	6125	3500	900
9	Visible discharge voltage (KV)	320	-	154	105	27
10	Mechanical strength. Ultimate Bending Strength (Nm) Torsional Strength (Nm) Compression Strength (N)	8000 4000 320000	2400 2500 80000	8000 4000 260000	6000 3000 140000	6000 1500 60000
11	Height of Insulator (mm).	3910	3910	2500	1500	508
12	Top metal fitting pitch circle dia (mm).	127	127	127	127	76
13	Bottom metal fitting pitch circle dia (mm).	300	127	254	225	76
14	No. of holes & diameter. i) Top flange ii) Bottom flange	4 holes of M16 8 holes of Ø18	4 holes of M16 4 holes of Ø18	4 holes of M16 8 holes of Ø18	4 holes of M16 8 holes of Ø 18	4 holes of M12 4 holes of M12
15	No. of units per stack	3	3	2	1	1

SCHEDULE – I (A)**“DESCRIPTION OF EQUIPMENT FOR SCHEDULE FOR RATES AND PRICES TO BE FURNISHED IN VOLUME-VI”**

SNo.	Particulars of Equipment / Item	Qty.
A	400 KV Solid Core Insulators	As per Price Schedule
1	Supply of 400 KV outdoor cylindrical porcelain solid core post insulator complete with top and bottom fixing nuts, bolts and washers meeting all technical requirements of tender specification	
2	Supply of 400 KV outdoor cylindrical porcelain solid core operating rod insulator complete with top and bottom fixing nuts, bolts and washers meeting all technical requirements of tender specification	
B	220 KV Solid Core Insulators	
3	Supply of 220 KV outdoor cylindrical porcelain solid core insulator complete with top and bottom fixing nuts, bolts and washers meeting all technical requirements of tender specification.	
C	132 KV Solid Core Insulators	
4	Supply of 132 KV outdoor cylindrical porcelain solid core insulator complete with top and bottom fixing nuts, bolts and washers meeting all technical requirements of tender specification.	
D	33 KV Solid Core Insulators	
5	Supply of 33 KV outdoor cylindrical porcelain solid core insulator complete with top and bottom fixing nuts, bolts and washers meeting all technical requirements of tender specification.	

NOTE :

1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.
2. The quantity of above equipments has been mentioned in Volume VI.

SECTION – II
2.1.7- TECHNICAL SPECIFICATION FOR 36 KV, 1x12 MVAR
SHUNT CAPACITOR BANKS

1.0 SCOPE :

The scope of this specification covers design, manufacturing and supply of equipment as per Section-I, Volume-II. The bidder mentioned in the Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The Purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment/material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS :

Applicable Standards for the offered equipments / items shall be as per Section-I.

3.0 CLIMATIC CONDITIONS :

Applicable climatic conditions shall be as per Section – I.

4.0 SYSTEM PARTICULARS :

Applicable System Particulars shall be as per Section – I.

5.0 DESIGN CRITERIA REQUIREMENTS AND CONSTRUCTIONAL DETAILS OF CAPACITOR BANK :

5.1 The Capacitor Bank shall be suitable for being installed outdoors.

5.2 The Shunt Capacitor Bank should be designed for satisfactory operation even with presence of harmonics in the system. For the purpose of shunt capacitor design, values of 6%, 3%, 8% and 2% of the second, third, fifth and seventh harmonic level should be assumed. However, the correctness of design of the capacitors and the entire scheme will be the responsibility of the successful bidder.

5.3 At each location 36 KV, 1x12 MVAR Shunt Capacitor Bank shall be connected in double star formation and each star connected bank shall be unearthed with a floating neutral, but interconnected by a neutral protective Current Transformer (NCT) of suitable ratio to operate protective relay at its 20% current setting whenever one capacitor unit fails. The NCT shall be arranged separately by the purchaser. The capacitor banks should be offered in three tier arrangement so that limitation of space may not create problem for the purchaser.

5.4 Capacitor unit should be made up of 100% polypropylene dielectric with NON PCB impregnant liquid and provided with internal fuse. Units should be painted and arranged in open galvanised steel rack with copper tinned bus bars for their interconnections.

- 5.5 If the failure of one or more elements causes an over voltage of less than 10% tolerable on the other remaining healthy units, then the unbalance current shall cause in the first step to sound an alarm. But if more than the above number of elements fails causing a voltage rise of more than 10% on the other healthy units then the unbalance current shall cause to trip and isolate the capacitor bank instantaneously in the second step.
- 5.6 The per phase and individual star group rating shall be built up by series parallel combination of individual units as per details indicated in Appendix-A enclosed, so as to achieve the desired bank rating.
- 5.7 The insulation level and creepage distance of bushing used for capacitor units shall be suitable for number of series groups in each rack. The mounting racks shall be completely galvanized. The racks shall be suitably insulated by adequate post insulators duly considering the number of series groups in each rack. The complete assembly shall also be duly insulated from earth potential by solid core insulators. The mounting racks shall be complete with rack insulators, hardware etc. for assembly into complete bank. The design of mounting rack for capacitor bank assembly shall conform to enclosed sample drawing No. JICA/MPPTCL/TR-101-107/Rack Assembly in Appendix-B
- 5.8 Although the tolerances in the output rating of each individual unit shall be as per IS-13925 (Part I) 2012 or any equivalent International Standard, yet it shall be ensured that in a completely assembled bank, the departures from the nominal rating and within the specified tolerance values shall not cause nuisance alarm or tripping since such alarm or tripping shall be to meet only with the protective requirements specified above,
- 5.9 Individual units shall be designed to meet with the requirements of the permissible overloads as specified in IS 13925 (Part-I) 2012, or any equivalent International Standard. Each unit shall also be provided with internal discharge devices complying with the requirements of IS 13925 (Part-I) 2012, or any equivalent International Standard.
- 5.10 Internal fuses for individual elements within unit shall be as per the manufacturer's design and shall be ensured for adequacy such as to withstand normal switching inrush transient currents, discharge current when the bank is switched off. Fuses shall be capable of disconnecting a faulty unit or element over a wide range of unit terminal voltages from 70% to 150%. In case all the elements in the same row are fused out in cascade in an internal fuse unit then the fuse element blown out shall be capable of successful disconnection, with a voltage of not less than 100% rated voltage appearing across its terminals. The unit shall also withstand this voltage successfully and continuously. An internal element/ elements fuse blowing out shall not cause case rupture of the container of the unit.
- 5.11 The individual capacitor units shall be of ungrounded case type with two bushings and fully insulated for the unit rated voltage. The capacitance shall be built up with high grade, all polypropylene dielectric film and aluminium foil. The polypropylene film shall cover the aluminium foil smoothly, evenly and without any locked air pockets or voids. The containers shall be of mild steel duly

welded and hermetically sealed. All welded joints shall be finished smoothly. All welding shall be done using modern welding technique and bushings of each unit shall be preferred to be of welded type. The intention is that the capacitor units shall be totally leak proof so that even if the units are mounted horizontally on the racks problem of oil leakage is not involved during the entire life of capacitor units. The interior of the capacitor shall be degreased and de-rusted and shall not be painted. The exterior of the containers shall be sand blasted, phosphated and painted on the exterior with anticorrosive base primers and finished with two coats of admiralty gray paint conforming to IS 117 shade No. 632 and Phosphate treatment shall conform to IS 6005, or any equivalent International Standard. The insulating liquid shall be such that it shall remain chemically inert to the dielectric film and aluminium foil and shall not degrade chemically itself while in service. The capacitance value in microfarad and rating in KVAR shall be engraved on each capacitor unit.

- 5.12 The rated voltage and BIL of each capacitor unit bushings shall be carefully selected in line with the provisions and duty as indicated under IS:13925 (Part-I) 2012, or any equivalent International Standard.
- 5.13 Guaranteed failure rate i.e. number of units failed per year should be less than 0.5% per annum during the period of guarantee. In case of failure of any unit within guarantee period the supplier will have to give free replacement of capacitor units for each failed unit. This may be noted carefully.
- 5.14 The complete assembly of the capacitor bank shall be on a galvanized mild steel bolted type structure. The support structure for capacitor bank shall provide minimum phase to ground clearance of 3.7 metres. The details of mounting structure connections with relevant drawings shall be furnished. The mounting structure details for mounting the capacitor banks has to be furnished by the Bidder. The capacitor banks shall be mounted suitably ensuring sufficient clearances. The design of mounting structure for capacitor bank shall conform to enclosed sample drawing No. JICA/MPPTCL/TR-101-107/Ped Assembly in Appendix-B.
- 5.15 It may be noted by the bidders that only 166.67 KVAR, 6.93 KV rating internal fuse capacitor units are acceptable to the purchaser. Lower or higher rating units are not acceptable.
- 5.16 Each unit shall be of self contained outdoor type with two bushings. The container of each capacitor unit shall have outer dimension and mounting dimensions as per enclosed sample drawing No. JICA/MPPTCL/TR-101-107/Cap Unit in Appendix-B. The container shall be made out of minimum 1.6 mm CRCA sheet duly painted with epoxy based paint to resist severe atmospheric condition, making the unit suitable for outdoor installation. The bushing shall be of porcelain and shall be joined to the case by solder sealing method. The welding of container and sealing of bushing has to be done properly to avoid leakage of oil during service period.
- 5.17 Each capacitor unit shall contain an internal discharge resistor designed to drain out the residual voltage to 50 volts or less within 10 minutes after disconnection from supply.

6.0 COMPLETENESS OF EQUIPMENT :

- 6.0 For each installation, 1 No. 36 KV, 12 MVAR, 3 phase 50 Hz double star connected capacitor bank is required complete with the following accessories.
- 6.0.1 Each 12 MVAR bank will comprise of 72 capacitor units of 166.67 KVAR, 6.93 KV rating.
 - 6.0.2 Each 12 MVAR capacitor bank will be organized in double star formation i.e. with 36 units in each star and the two stars of 12 MVAR capacitor bank will be protected through neutral current transformer. The NCT shall be arranged separately by the purchaser.
 - 6.0.3 36 units in each star of the bank will be mounted in 3 series groups such that each series group will have four units of 166.67 KVAR, 6.93 KV rating in parallel.
 - 6.0.4 It shall be ensured that the bottom most stack of insulators under the main capacitor bank structure shall be suitably rated to provide the BIL of 170 KV as per our specification.
- 6.1 For each substation, 1x12 MVAR bank as per above description shall be required complete with the following :
- a. 72 Nos. 166.67 KVAR, 6.93 KV Capacitor Units for each 12 MVAR capacitor bank. On the body of each Capacitor Unit rated voltage, rated KVAR rating, rated capacitance, S.No. (in the manner MPPTCL / SNo.), make and year of manufacture shall be engraved / inscribed.
 - b. One No. galvanized mounting structure, of required height and approved sturdy design, for each 12 MVAR bank, as per approved drawing.
 - c. All interconnections, mounting arrangement, terminations, earthing arrangement, mounting racks, base insulator, terminal connector, nuts/ bolts, required quantity of conductor/ strip for formation of neutral point and making connections to NCT and all other required accessories for completing the bank in a neat manner. The terminal connector shall be suitable for Zebra ACSR.
 - d. Foundation bolts of 20 mm dia for bolted type hot dip galvanized steel support structure.
 - e. One complete set of 2 mm thick MS sheet foundation templates for structure of each 12 MVAR capacitor bank, to be delivered in advance alongwith foundation bolts.
 - f. 1 No. Digital Capacitance Meter to measure capacitance for each substation.
 - g. 2 Nos. caution boards, of size 915 mm x 610 mm with inscription as per approved drawings, for each capacitor bank painted with anti corrosive base primers and finished with two coats of white paint.
 - h. A minimum of 5% additional nuts and bolts required for mounting individual capacitor units of each capacitor bank.

- i. 6 Nos. spare capacitor units of rating 166.67 KVAR, 6.93 KV as per description furnished above for each substation where 1 No. 12 MVAR capacitor bank will be installed.

7.0 TESTS ON CAPACITORS:

The capacitor units will be tested at the manufacturer's work for all tests as per IS: 13925 (2012), or any equivalent International Standard including the following tests.

a. Type Tests

As per clause 10.1 and sub clauses thereof as per IS 13925 (2012).

The endurance test reports for power capacitor as per IS-13925 / IEC 871 – 2 (latest) shall be submitted alongwith the tender.

b. Routine Tests

As per IS 13925 (2012), or any equivalent International Standard.

c. Acceptance Tests

As per IS 13925 (2012), or any equivalent International Standard.

8.0 TECHNICAL SPECIFICATION FOR STEEL STRUCTURES

8.1 SCOPE :

8.1.1 The scope of supply of structural work includes the following items:

- i. Support structure for 36 KV, 1x12 MVAR Capacitor Bank. The design of support structures for capacitor bank shall conform to enclosed sample drawing No. JICA/MPPTCL/TR-101-107/Ped Assembly in Appendix-B. The description of support structures are indicated in Annexure-I.
- ii. 33 KV Post Insulator structure complete with post insulators for connection of Capacitor Bank (in three tier formation) with adjacent equipment shall conform to enclosed drawing No. JICA/MPPTCL/TR-101-107/Spl. PI Structure Assembly in Appendix-B.
- iii. The bidder will have to submit his design for support structure required for capacitor bank only. It may be noted that the structure for 33 KV Post Insulator shall be as per standard design of purchaser. It is in this context that design/drawing for 33 KV Post Insulator structure as per the purchaser's standard specification specified in Clause 8.3 may be adopted by the bidder.

8.1.2 It is not the intent to specify completely herein all the details and construction of fabricated structures. However the material shall conform, in all respect, to high standards of workmanship and shall be capable of performing duties specified herein. The material offered shall be complete in all respect.

8.2 STANDARDS :

Applicable Standards for the offered equipments / items shall be as per Section-I.

8.3 TYPE OF STRUCTURES:

The bidder shall submit his design for the support structure for capacitor bank. For 33 KV Post Insulator structure, standard design/ drawing as specified by the purchaser may be adopted by the bidder. The specification of structures which are to be supplied as per the standard design of purchaser are indicated as under:

S.No.	Particulars	Unit Weight (MT)
1.	33 KV Post Insulator Structure (for Capacitor Bank)	0.376

8.3.1 WEIGHT OF STRUCTURE:

- i. The supply of fabricated switchyard structures includes its accessories e.g. bolts, nuts, spring & plain/pack washers etc. Scope of supply shall also include foundation bolts and nuts required for foundation.
- ii. The Bidders may please note that weight of Structure mentioned above is the weight of steel sections (excluding the weight of nuts, bolts and washers; required alongwith the structures).

8.3.2 QUANTITY OF NUTS & BOLTS ETC. :

The details of nuts, bolts and washers and quantity required alongwith each 33 KV post insulator structure for capacitor banks are as under:-

SNo	Type of Structure	Sizes / Unit Weight of Nuts and Bolts (Qty in Nos)	Plain Washers for 16 mm dia bolt (Qty in Nos)	Size of Foundation Bolts (dia x length) in mm and quantity (Nos)
1	33 KV Post Insulator Structure (for Capacitor Banks)	16 mm dia x 55 mm - 15 Nos.	15	30 mm dia x 1320 mm - 4 Nos.

NOTE:

- i. A set of one bolt and one nut required for assembly of structure shall have one number spring washer and one number plain washer.
- ii. Each foundation bolt shall have three numbers nuts, one number Anchor plate and one number plain washer. The anchor plate shall have a hole at the centre suitable for diameter of foundation bolt.
- iii. Accessories which are not indicated in above tables but details of which are given in our technical specification or which are necessary for completeness and satisfactory operation of structures shall be deemed to be included in Bidder's scope of supply.

8.3.4 BASIS OF PRICE:

The bidders are requested to offer their rates ON PER STRUCTURE BASIS. The prices on per structure basis should include cost of fabricated steel

sections, cost of galvanized nuts, bolts, foundation bolts, washers etc. and other specified accessories.

8.3.5 DRAWING AND DESIGN:

The successful bidder will be required to supply structures as per the details furnished by the purchaser. By and large, steel sections like Channels, Angles, Flats and Plates would be required for fabrication of structures covered in this specification. Tubular type structures will not be required.

8.3.6 SHOP DRAWINGS:

The successful bidder shall prepare shop drawings for fabrication of structures and 2 sets of shop drawings of each type of structure shall be made available to the purchaser for his record.

8.4 MATERIAL, FABRICATION AND WORKMANSHIP

The structures shall be of structural steel quality conforming to latest version of IS:2062. Structural steel sections manufactured according to latest IS: 808, or any equivalent International Standard shall be taken into consideration for fabrication of structures. Tested steel sections having yield strength not less than 2550 kg/sq cm shall be used.

8.4.1 PROCUREMENT OF STEEL BY THE BIDDER:

The following provisions shall apply in connection with the procurement of steel by the bidder:

- i. The steel used for the fabrication of structures, etc., shall be mild-steel of tested quality as per latest version of IS:2062, or any equivalent International Standard.
- ii. The steel shall generally be procured from the Main Steel Producers. However, in case of sections not rolled/ available from the main producers, the same could be procured from re-rollers as per quality conforming to relevant IS provided:
 - a. Re-rolling of structural steel sections is done from billets/ingots of tested quality only.
 - b. Re-rolled sections are duly tested as per relevant IS, or any equivalent International Standard. It may, however, be noted that additional cost, if any, on account of procurement of steel sections from re-rollers shall not be payable.
- iii. The bidders should take into account the fabrication wastage while offering the prices. The purchaser shall not accept any liability in connection with the actual wastage of steel during fabrication or otherwise and no additional cost will be allowed on this account.
- iv. Substitutions, if any, of steel sections of the structure parts by higher size, due to their non-availability or otherwise shall be to the bidder's account. The purchaser shall not accept any liability on this account.

8.4.2 FABRICATION WORKMANSHIP:

- i. Except where hereinafter modified, details of fabrication shall conform to latest version of IS: 802, or any equivalent International Standard. The fabrication shall be done strictly in accordance with the drawing made available by the purchaser.
- ii. The structures shall be accurately fabricated to bolt together easily at site without any undue strain on the bolts.
- iii. The diameter of the hole shall be equal to the diameter of the bolt plus 1.5mm.
- iv. Necessary drain holes shall be provided at all points of the structures where pockets of depressions are likely to hold water.
- v. All similar parts shall be made strictly interchangeable. All steel sections before any work is done on them, shall be carefully leveled, straightened and made true to detailed drawings by methods which should ensure that granular configuration of steel is not distorted. Further, while assembly the adjacent matching surfaces should be in close contact throughout. No rough edges shall be permitted in the entire structures. Hammering is not permitted for straightening.
- vi. Cutting may be done by shearing, cropping, flame cutting or sawing. The surface so cut shall be cleaned smooth, reasonably square and free from deformation and distortion.

8.4.3 DRILLING AND PUNCHING:

- i. The holes in the member shall either be drilled or punched with a jig, the former process will be preferred.
- ii. Punching may be adopted for providing holes in steel sections up to 12 mm thickness. For thicker sections, drilling shall be done.
- iii. The holes shall be punched/ drilled after bending and relative position of these holes shall be maintained with the use of proper templates/ jigs and fixtures.
- iv. The holes shall be perfectly circular and no tolerance in this respect is permissible. The holes shall be perpendicular to the Steel sections.
- v. All burrs left by drills or punch shall be removed completely. When the structure members are in position, the holes shall be truly opposite to each other. Drilling or ramming to enlarge defective holes shall not be permitted.
- vi. The minimum spacing of bolt and edge distance shall be as under:
 - a. For 16 mm diameter bolt, edge distance of 20 mm from hole centre to rolled or swaned edge and 23 mm from hole centre to sheared or flame cut edge.
 - b. The gap between the edges of the connected members in butt joint shall not be more than 6 mm and less than 4 mm.

- vii. The bolt gauge distance in flanges of angle sections shall generally be in accordance with "Hand Book for structural Engineers-Structural Steel Sections Revised)."

8.4.4 GALVANISING:

- i. Structural steel wherever applicable as per clause 8.1.1 above shall be galvanised after fabrication. Galvanising of Steel section shall conform to latest version of IS:2629 & IS:4759 and shall withstand tests as per IS:2633, or any equivalent International Standard.
- ii. The galvanising shall be done after all fabrication work is completed, except that the nuts may be tapped or re-run after galvanising. Threads of bolts and nuts shall have a net fit and shall be such that they can be turned with finger throughout the length of the threads of bolt and they shall be capable of developing full strength of the bolts. Spring washers shall be electro-galvanised as per latest version of IS: 1573, or any equivalent International Standard.

8.4.5 GALVANISED BOLTS, NUTS AND WASHERS:

- i. The bolts (5.6 quality) and nuts (5.0 quality) shall be of HRH mild steel and hot dip galvanized. Spring washers shall be supplied for insertion under all nuts. These washers shall be of steel, electro galvanized, and positive lock type and of 3.5 mm thickness. Bolt heads and nuts shall be of hexagonal shape.
- ii. The nuts shall be forged and tapped after galvanizing and then lubricated. The nuts shall be chamfered on one face only; the other face shall be machined.
- iii. The bolts shall be manufactured by cold/ hot forging process and the threads shall be rolled.
- iv. The bolts and nuts shall be free from forging and threading defects such as cuts, splits, burrs, bulging, taper, centricity, loose fit etc. The bolts shall be threaded upto standard length only as per relevant Indian Standard and not to full length.
- v. The bolts and nuts shall conform to IS:1967, IS:12427, IS:1363, IS:1367, or any equivalent International Standard.
- vi. The spring washers suitable for diameter of the bolts shall be manufactured out of rectangular section with tolerances as per IS:3063, or any equivalent International Standard. The spring washer steel shall conform to IS:4072, or any equivalent International Standard. The spring washers after coiling shall be suitably heat treated so as to result in the finished washer having hardness 43 to 50 HRC when tested in accordance with latest version of IS:1586, or any equivalent International Standard. Surface of the washers shall be free of scales and burrs. The washers shall be coiled without any kinks (except for the shape with turned-up ends). The ends of the washer shall not abut when the washers are compressed. The ends shall be so served as to prevent tangling.

- vii. The spring washer shall be electro galvanized with chromate passivation. The electro galvanizing of washers should conform to 'severe' grading service conditions incorporated in IS:1573, or any equivalent International Standard. The local thickness of zinc coating should be minimum 25 microns and average thickness 38 microns. It should be further suitably heat treated to avoid any danger of hydrogen embrittlement.
- viii. Plain/ pack washers shall be 4 mm thick and shall be suitable for diameter of respective bolts.
- ix. A set of one bolt and one nut required for assembly of structure shall have one number spring washer.
- x. Every foundation bolt shall have two numbers nuts.

8.5 TOLERANCES:

- i. The maximum allowable difference in the diameter of the hole on the two sides of the plate or angle shall not exceed 0.8 mm.
- ii. The tolerance cumulative or between consecutive holes shall be within ± 0.5 mm.
- iii. The tolerance on the overall length of member shall be within ± 1.6 mm.
- iv. The tolerance on gauge distance shall be within ± 0.5 mm.
- v. Rolling and weight tolerance of steel sections shall be as per latest version of IS:1852 and IS:808, or any equivalent International Standard.

8.6 MARKING:

Every member of the structure shall be distinctly given punch mark as per structural drawings. Bidder's identification mark shall also be punched. The marking shall be done with marking dies of minimum 18 mm size and this mark shall be in "legible English letters".

8.7 PACKING AND MARKING ON PACKING:

8.7.1 The material shall be boxed or bundled for transport preferably in the following manner:

- i. Large members like angles, channels etc., shall be packed in bundles securely wrapped four times around each end and over 900 mm with steel wire of 3.55 mm diameter with ends twisted tightly. As far as practicable, a bundle shall consist of all the large members of one structure only.
- ii. Small loose pieces shall be nested and bolted together holes wrapped round at least four times with steel wire of 3.55 mm diameter and its ends twisted tightly or packed in wooden crates. Gross weight of each bundle shall not exceed 200 Kgs.
- iii. Bolts, nuts and washers required for structures shall be packed in heavy gunny bags accurately tagged in accordance with the contents

and a number of bags packed in a solid box of 22 mm thick lumber with paneled ends to be accurately nailed and further reinforced with 22 mm x 75 mm Buttons round the sides at the ends with 25 mm x 1.26 mm iron band stretched entirely around the buttons with ends overlapping atleast 150 mm. Gross weight of each box shall not exceed approximately 200 Kgs.

- iv. Packing list incorporating all relevant details e.g., quantity of structures, number and size of steel sections, quantity of nuts, bolts, washers etc., shall be forwarded alongwith each consignment.
- v. In the nut shell, the packing arrangement should be such that all packages of one particular type of structure are identifiable at site for the purpose of allocation for a particular work. In case more than one structure of a particular type is delivered in Transmission Stores/ Work Site, combined packing arrangement by way of clubbing members of similar type (for more than one structure) in a combined package should not be done. Unified packing procedure for each structure should be adopted.

8.7.2 Each bundle or packing shall be marked in "legible English letters" in the following manner :-

- i. Reference of purchase order.
- ii. The name of the consignee (as per dispatch instructions given by the purchaser).
- iii. Ultimate destination (if any) as required by the purchaser.
- iv. The relevant marks and number of structure members or reference or bolts, nuts and small components for easy identification.
- v. Bidders identification:

The marking shall be stenciled and indelibly inked on the top members in the bundles, on wooden boxes and also on gunny bags containing smaller components.

8.8 GENERAL GUIDE-LINE FOR INSPECTION:

8.8.1 For Fabricated Structure Members:

- i. Visual examination and quantity verification of offered lot.
- ii. Sample selection from the offered lot.
- iii. Dimension, fabrication and trueness verification of structure members from shop drawing.
- iv. Galvanising test of each sample i.e., dip test, hammer test and mass of Zinc test.
- v. Random verification Zinc coating over Galvanized surface by Alko meter.
- vi. Tensile test and bend test of each sample.
- vii. Chemical composition test of at least two samples per offered lot.

- viii. Verification of manufacturer's test certificate for mild steel used in structure members.

8.8.2 For Bolts, nuts and washers:

- i. Visual examination and quantity verification of offered lot.
- ii. Sample selection from the offered lot as per relevant IS for each items.
- iii. Dimension, fabrication and trueness verification.
- iv. Galvanizing test of each sample.

Other acceptance tests for respective items as per relevant IS

9.0 TESTS :

9.1 TYPE TEST :

All the equipment offered, shall be fully type tested as per relevant Indian Standards or any equivalent International Standard (as specified in clause 2.1) during the last **five** years from the date of bid opening. Copy of test reports shall be enclosed with the bid. For any change in the design/ type already type tested and the design/ type offered against this bid, the Purchaser reserves the right to demand repetition of same or all type tests without any extra cost.

9.2 ACCEPTANCE AND ROUTINE TESTS :

The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards or equivalent International Standards in presence of Purchaser's representative.

Immediately after finalization of the programme of type/ acceptance/ routine testing, the manufacturer shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

10. INSPECTION :

- i. MPPTCL shall have access at all times to the works and all other places of manufacture, where the isolators are being manufactured and the Bidder shall provide all facilities for unrestricted inspection, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.
- ii. The successful Bidder 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 arrangements could be made for inspection.
- iii. For the purpose of inspection, it will be duty of the supplier to provide, to the inspecting officer, the detailed order, approved drawings, comments, if any, on the drawings and all amendments(if any) made in any term/ condition/specification/ GTP of the order and all relevant IS, IEC, standards. Failure to provide documents demanded by the inspector shall render the inspection as "Fake Inspection Call" and relevant penalty may be imposed on the supplier on this account

- iv. No material shall be dispatched from the point of manufacture unless the material has been satisfactorily inspected and tested.
- v. The acceptance of any quantity of the equipment shall in no way relieve the successful bidder of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipment are later found to be defective.

11.0 QUALITY ASSURANCE PLAN & STAGE INSPECTION :

QAP & stage inspection shall be as per Section – I Volume – II.

12.0 DOCUMENTATION :

12.1 All drawings shall conform to latest version of international standards organization (ISO) 'A' series of drawing sheet/Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. Units.

12.2 LIST OF DRAWINGS AND DOCUMENTS :

12.2.1 The Bidder shall furnish four sets of following details and drawings along with his bid.

- i. Complete assembly drawing showing plan and elevation views of the capacitor banks, complete with details of various accessories viz. support insulators, connecting strip, racks etc.
- ii. Sketches and descriptive details of :
 - a. Rack assembly drawing
 - b. Capacitor unit.
 - c. Terminal connector, Insulators etc.
 - d. Rating plate and caution board.
- iii. Structural drawing, design calculations and loading data for the support structure for capacitor bank.
- iv. Type Test reports in case the equipment has already been type tested.
- v. Calculations towards unbalance current.
- vi. Test reports, literature, pamphlets of the bought out items and raw material.

12.2.2 The successful Bidder shall within two weeks of placement of order, submit four sets of final versions of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/approval on the drawings to the Bidder within reasonable time. The Bidder 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 Purchaser's comments. After

receipt of Purchaser's approval, the Bidder shall within three weeks submit 20 prints and two good quality reproducibles of the approved drawings for Purchaser's use.

- 12.2.3** The Bidder for distribution, before commencement of supply, shall submit six sets of the type test reports, duly approved by the Purchaser. Adequate copies of acceptance and routine tests certificates, duly approved by the Purchaser shall accompany the dispatched consignment.
- 12.2.4** The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Bidder's risk.
- 12.2.5** Twenty (20) copies of nicely printed and bound volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment supplied shall be submitted by the Bidder for distribution, prior to the dispatch of the equipment. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. The manual shall also contain a set of all the approved drawings, type test reports etc.
- 12.2.6** Approval of drawings/ work by Purchaser shall not relieve the Bidder of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material, which in his judgment is not in full accordance therewith.

13.0 PACKING AND FORWARDING :

13.1 Bidder shall ensure that 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.

14. DISCREPANCY IN TECHNICAL PARTICULARS :

 Regarding discrepancy in technical particulars, stipulation under Section-I, Volume-II shall be applicable.

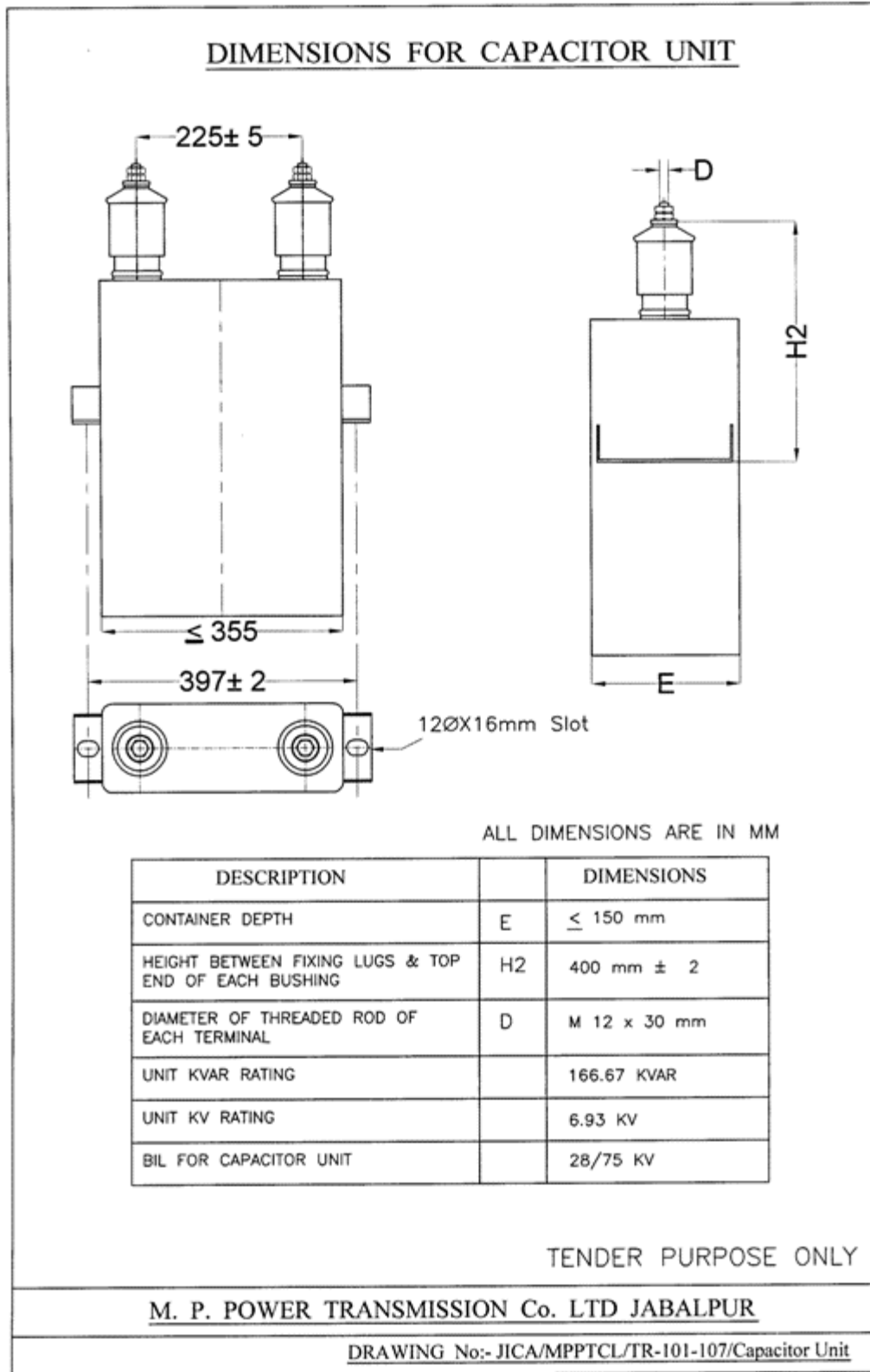
APPENDIX - A
PRINCIPAL PARAMETERS OF
36 KV, 12 MVAR CAPACITOR BANKS

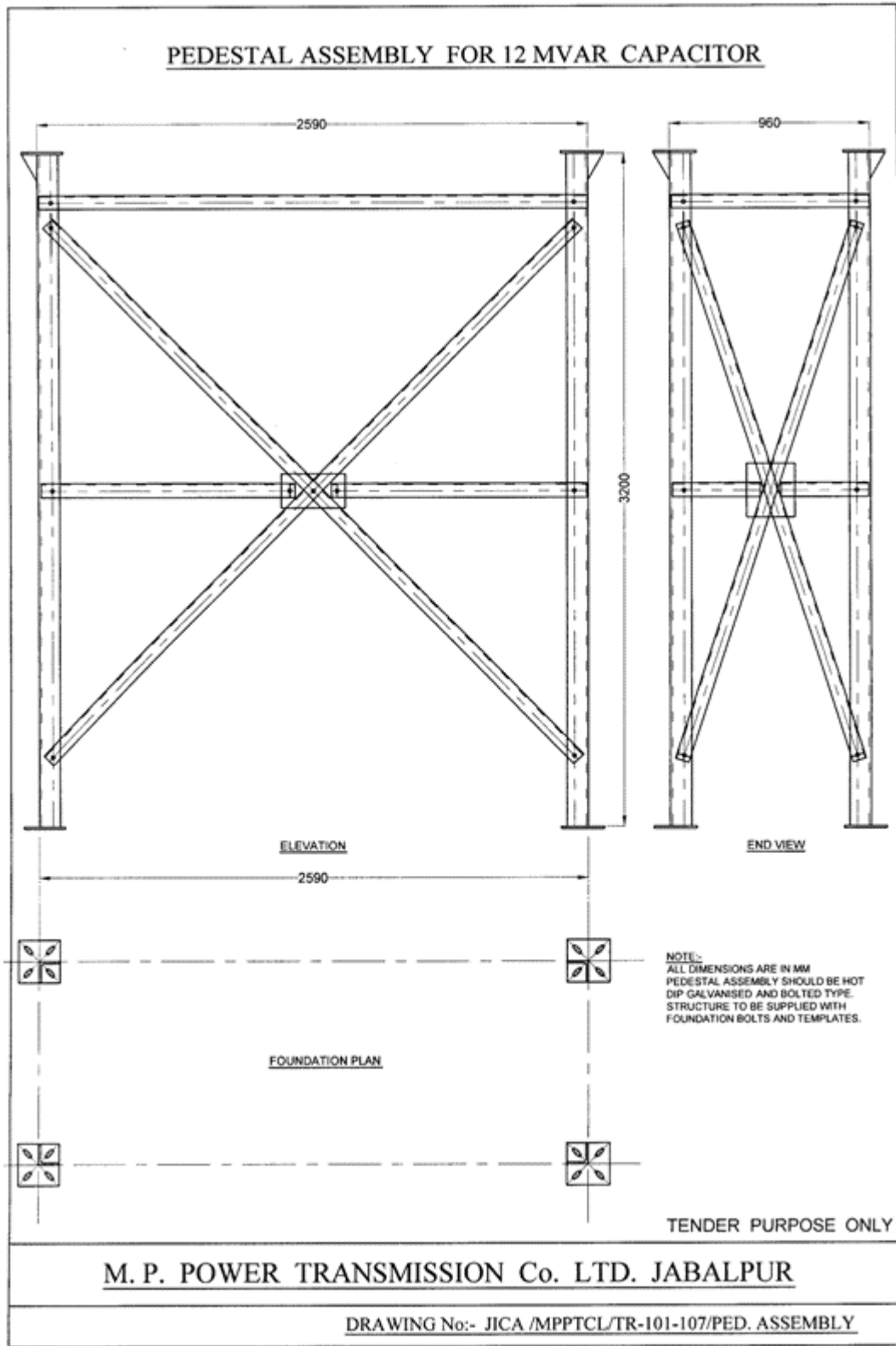
S.No.	Particulars	Parameters
1.	Nominal system voltage	33 KV
2.	Highest system voltage	36 KV
3.	Rated capacitor bank voltage	36 KV
4.	Basic insulation level	170 KVp
5.	P.F. withstand voltage	70 KV
6.	Type of connection	Double Star
7.	Rating of Shunt Capacitor at highest voltage	12 MVAR
8.	Number of phases	3
9.	KVAR and voltage rating of each unit	166.67 KVAR / 6.93 KV
10.	Total Nos. of units in each bank of 1x12 MVAR	72 Nos.
11.	Total Nos. of Series Groups per phase per Star group	3
12.	Number of units in parallel per series group per phase	4
13.	Type of fuse	Internal fuse design

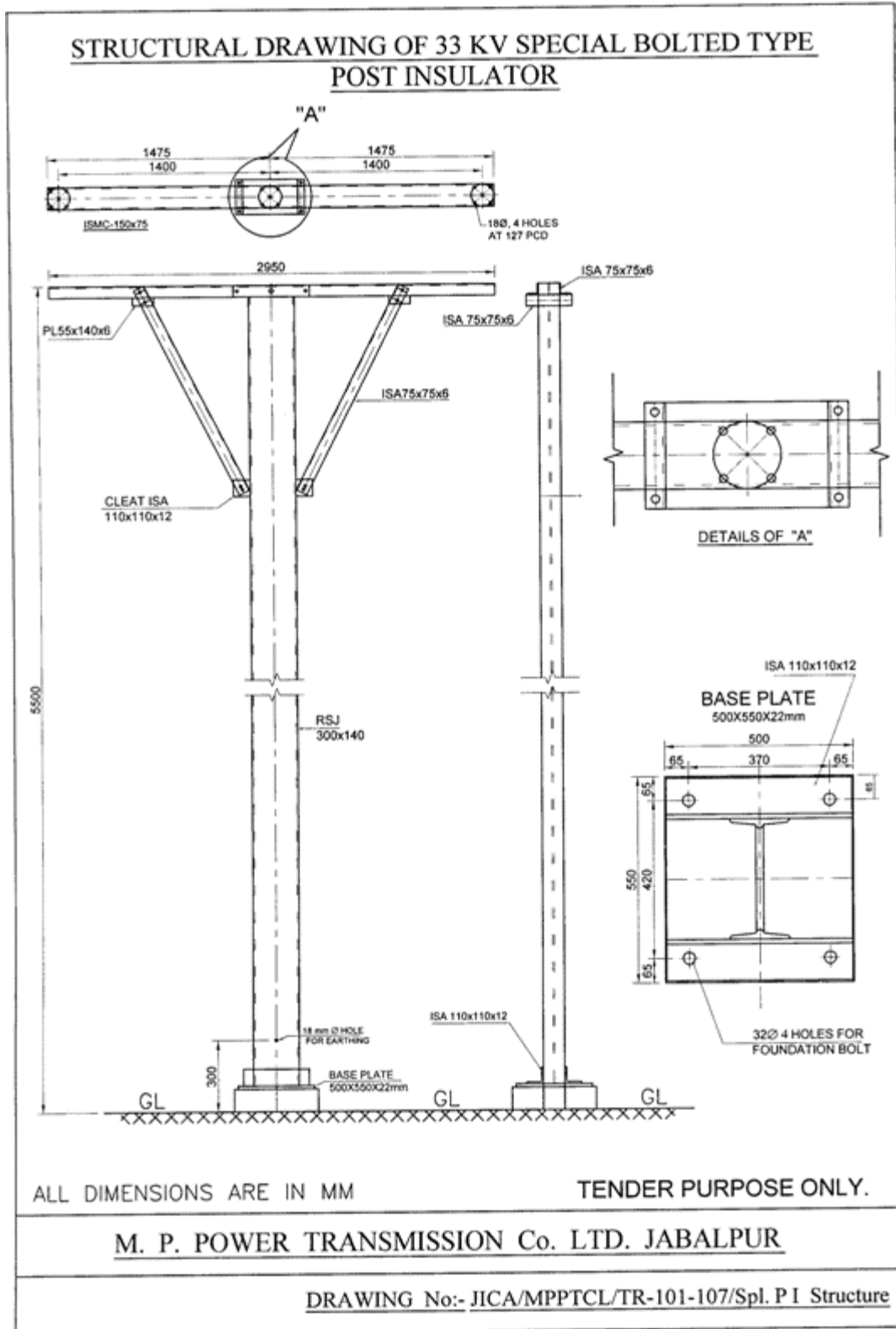
APPENDIX- B**DRAWINGS OF CAPACITOR UNITS, RACK ASSEMBLY AND STRUCTURES**

The following sample drawings showing dimensions of capacitor unit, rack assembly and mounting structure for 36 KV, 1x12 MVAR Capacitor Bank and 33 KV special PI Structure (for capacitor Bank) are enclosed here with for general guidance :-

SNo.	Description	Drawing No.
1.	Dimensions for capacitor unit	JICA/MPPTCL/TR-101-107/Capacitor Unit
2.	Rack Assembly suitable for 24 units	JICA/MPPTCL/TR-101-107/Rack Assembly
3.	Pedestal Assembly for 12 MVAR Capacitor Bank	JICA/MPPTCL/TR-101-107/PED. ASSEMBLY
4.	33 KV Special Bolted Type Post Insulator Structure	JICA/MPPTCL/TR-101-107/Spl. PI Structure







SCHEDULE – I (A)**“DESCRIPTION OF EQUIPMENT FOR SCHEDULE FOR RATES AND PRICES TO BE FURNISHED IN BIDDING FORM OF SECTION-IV, VOLUME-I”**

SNo.	Particulars of Equipment / Item	Qty.
1	<p>a. 36 KV, 1x12 MVAR Capacitor Bank with 72 No. Internal Fuse Capacitor Units of 166.67 KVAR, 6.93 KV rating in double star formation complete with all interconnections, mounting arrangement, base insulators, foundation templates, caution boards (2 Nos.), nuts and bolts for mounting individual units including minimum of 5% spare nuts and bolts.</p> <p>b. Bolted type hot dip galvanized steel support structure with foundation bolts for item “1a” above.</p> <p>c. Digital capacitance meter</p> <p>d. Internal Fuse Capacitor Units of 166.67 KVAR, 6.93 KV rating (6 No. as spare with each Bank)</p>	As per Price schedule
2.	33 KV Post Insulator Structure (for Capacitor Bank) complete with Post Insulators.	

NOTE:

1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.
2. The quantity of above equipments has been mentioned in Volume VI.

SECTION-II

2.2.1 TECHNICAL SPECIFICATION FOR 400 KV & 220 KV CAPACITIVE VOLTAGE TRANSFORMER (CVT) AND 132 KV COUPLING CAPACITOR

1.0 SCOPE :

The scope of this bid covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Specification means "Original Equipment Manufacturer (OEM)". The purchaser means the "MPPTCL".

In case bidder is not OEM, sole responsibility of offering equipments/materials of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS:

2.1 Applicable Standards for the offered equipments /items shall be as per Section-I, Volume-II.

2.2 If the equipment offered by the Bidders conforms to any other standards, salient points of comparison between the standards adopted and the specific standards shall be clearly brought out in relevant schedule of technical deviation. It will be sole responsibility of Bidders to prove that the salient features of offered equipment are equivalent or better than IS.

2.3 ACCEPTANCE OF OTHER AUTHORITATIVE STANDARDS :

In the preceding paragraph relevant Indian standard / IEC standard bid have been shown. However, the equipment meeting any other authoritative international standard, which ensures equal or better quality than the standards, mentioned shall also be acceptable. Equipment for which Indian Standards are not available, the relevant British standards and IEC recommendations will be applicable. Please attach photocopy of all such standards according to which the equipment has been offered.

3.0 CLIMATIC CONDITIONS:

3.1 Applicable climatic conditions shall be as per Section-I, Volume-II.

3.2 AUXILIARY POWER SUPPLY:

Auxiliary Power Supply for offered EHV equipments shall be as per Section-I Volume-II.

4. DISCREPANCY IN TECHNICAL PARTICULARS:

Regarding discrepancy in technical particulars stipulation under Section-I Volume-II shall be applicable.

5.0 TECHNICAL REQUIREMENTS FOR 400 KV AND 220 KV CAPACITIVE VOLTAGE TRANSFORMERS & 132 KV COUPLING CAPACITOR

5.1 400KV CAPACITOR VOLTAGE TRANSFORMER

400KV CVTs shall be of capacitive voltage divider type with electromagnetic intermediate transformer, mounted in 420KV class shedded oil-filled porcelain bushing, suitable for outdoor service and upright mounting on steel or RCC supports. The electromagnetic unit would consist of compensating reactor and intermediate transformer alongwith protective and damping devices and should have a separate terminal box with all the secondary terminals brought out.

5.1.1 BASIC DESIGN

5.1.2 The voltage transformers covered in this specification are required for protection, metering, telemetering, telecontrol and synchronizing purposes.

5.1.2.1 The capacitors should also be capable of being used for carrier coupling for telemetering, telecontrol, protection and telephony, using wide carrier bandwidth. The value of capacitance shall be chosen for reliable wide band carrier and shall not be less than 4400 picofarads. The reactance of the teed branch of the voltage transformer shall be adjusted to minimize carrier loss. With carrier frequency coupling device connected to the earth load of the intermediate coupling capacitor, the accuracy of the capacitor voltage transformer shall remain within the specified limits.

CVT shall be suitable for high frequency (HF) coupling required for power line carrier communication. 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 500KHZ. Details of the arrangement shall be furnished along with the bid. H.F. terminal of the CVT shall be brought out through a suitable bushing & shall be easily accessible for connecting to the coupling filters of the carrier communication equipment, whether utilized. Further, earthing link with fastener to be provided for H.F. terminal.

5.1.2.2 The volumetric variations of the oil dielectric inside the capacitive divider are to be compensated by special means. The capacitive divider should be hermetically sealed so as to avoid penetration of moisture and air.

5.1.2.3 The electro-magnetic unit is to be located in a metal tank which should be hermetically sealed. The oil level variation due to temperature variations is to be counter-balance by a suitably designed dimensioned gas-cushion. The terminal box of this electromagnetic unit should contain all the secondary terminals, single phase fuses and earthing terminals.

5.1.2.4 The CVTs shall be designed to provide the required accuracy level upto the given burdens. The accuracies must be maintained within the standard range of frequency required. No modifications such as change in taps etc. are to be made at site, as long as the unit has to operate within the limits of the guaranteed burden. The CVT shall be thermally and dielectrically safe enough when the secondary terminals are loaded with guaranteed thermal burden. The ferroresonance oscillation should be suppressed by means of a suitable damping device, permanently connected to one of the secondary windings. The CVTs are to be designed to conform to the transient

response requirements of IEC-186 A, i.e. during transient oscillation following a short circuit on the primary side, the secondary output voltage shall fall to a value of less than 10% of the peak value before short-circuit, within 20 milliseconds.

5.1.2.5 The temperature co-efficient of the CVT shall be low enough, so that, the accuracies are not affected by temperature variation.

5.1.2.6 Since CVTs shall be suitable for carrier coupling, their natural frequency should lie well above the highest carrier frequency normally employed, viz, 600 KHz. The high frequency capacitance and equivalent series resistance of the complete capacitor stack shall be within the requirements of sub-clause 10.1 of IEC-358-1971, i.e. the high frequency capacitance should not deviate by more than-20% or +50% from the rated capacitances over the carrier frequency range. The equivalent series resistance over the entire carrier frequency range shall be less than 40 Ohms.

5.1.2.7 The CVT shall conform to the following technical requirement.

- 5.1.2.8** Rated system voltage - 420 KV
- 5.1.2.9** Rated frequency - 50 Hz
- 5.1.2.10** System fault level - 40 KA(RMS) (for 1 sec.)
- 5.1.2.11** Method of system neutral earthing - Effectively earthed
- 5.1.2.12** Installation and type - Outdoor, single phase suitable for upright mounting on steel or RCC supports.
- 5.1.2.13** No. of secondary windings - 3
- 5.1.2.14** Rated secondary voltage, burden & accuracy.

WINDING NO.	RATED VOLTAGE (VOLTS)	RATED BURDEN (VA)	ACCURACY CLASS
I	110/√3	100	3P
II	110/√3	100	3P
III	110/√3	100	0.2

The accuracy of 0.2 on secondary III should be maintained through out the entire burden range on all the windings without any adjustments during operation.

5.1.2.15 **Transformation ratio:**

- (a) $\frac{I \ \& \ II \ (400 \times 10^3)}{\sqrt{3}} \ / \ \frac{110}{\sqrt{3}}$
- (b) $\frac{III \ (400 \times 10^3)}{\sqrt{3}} \ / \ \frac{110}{\sqrt{3}}$

5.1.2.16 **Winding utilization**

- Winding - I for main I protection
- Winding -II for main II protection
- Winding -III for metering

- 5.1.2.17** Rated Voltage Factor 1.20 continuous, 1.5 for 30 seconds
- Rated Voltage of Surge Arrestor connected at sec. of CVT 24 (KV rms)

5.1.2.18 RATED INSULATION LEVEL:

(i)	1.2/50 micro-sec. Impulse withstand voltage.	1425 KV(rms)
(ii)	One minute dry power frequency withstand.	630 KV(rms)
(iii)	50/2500 micro-sec. Switching impulse Withstand voltage	1050 KV(Peak)
5.1.2.19	Standard reference range of frequency (for which the accuracies are valid)	96% to 103% for protection and 99% to 101% for metering
5.1.2.20	Whether CVTs are suitable for use on carrier coupling	Yes
5.1.2.21	Total capacitance pico-farads	4400+10% - 5%
5.1.2.22	(a) High frequency capacitance on the entire carrier frequency Range.	Within 80% to 150% of rated capacitance.
	(b) Equivalent series resistance over the entire carrier frequency range	Less than 40 Ohms
5.1.2.23	Stray capacitance and stray Conductance of the low voltage Terminal over entire carrier frequency range.	As per IEC-358
5.1.2.24	Maximum stray capacitance (PF)	300+0.05C _n (C _n is the rated capacitance)
5.1.2.25	Stray conductance	As per IEC-358
5.1.2.26	(a) One minute power frequency test voltage between low voltage terminal and earth terminal.	10KV (rms)
	(b) One minute power frequency test voltage on secondary winding	3KV (rms)
5.1.2.27	Limits of temperature rise	As per relevant IEC/IS
5.1.2.28	The Bidder shall give the schematic drawing of the CVT offered with details of any arrangement / circuit provided for any adjustment of the phase and ratio error in his bid.	

5.1.2.29 Switching impulse withstand test shall be performed using the standard switching impulse wave of 250/2500 microseconds.

CREEPAGE DISTANCE:

5.1.2.30 All bushings shall have a creepage distance of 25mm/KV of system line to line nominal voltage. The protected creepage distance shall not be less than 50% of the total protected creepage distances. The Bidder shall clearly indicate the creepage distances of various bushings and insulators included in his offer.

5.1.2.31 Maximum radio interference voltage (maximum radio noise level) at 266KV to ground. Not exceeding 500 micro volts

5.1.2.32 Visual corona extinction voltage Kilo volts (rms) 320

5.1.2.33 Partial discharge level at rated voltage for capacitive divider less than 10 Pico Coulombs

5.1.2.34 The secondary of the voltage transformer shall be protected by a suitable high speed switch or a miniature circuit breaker with three NO & two NC contacts.

5.1.2.35 Carrier frequency choke in series with the electro magnetic unit shall be used to prevent the loss of signal through the winding of the transformer.

5.1.2.36 The secondary ratio shall not be arranged by providing any auxiliary transformer.

5.1.3 TERMINAL CLAMPS:

5.1.3.1 Terminal clamps shall be suitable for connection to twin Moose ACSR Conductor (with a sub-conductor spacing of 450mm).

5.1.3.2 The clamps shall be corona-free, terminal clamps shall be tested for short-time current test, temperature rise test corona test etc. Type test reports for such tests shall furnished along with the offer, in case these tests have already been conducted.

5.1.1.3 Two clamps type grounding terminals shall be provided for connection to the purchaser's grounding conductor.

5.1.4 TERMINALS

CVT secondary terminal shall be brought out in a weather proof terminal box. The terminal box shall be provided with glands suitable for 1100V grade, steel wire armoured, screened PVC sheathed, multicore, 10 Sq mm² stranded copper conductor cables.

5.1.5 POLARITY

Polarity marks shall be indelibly marked on each voltage transformer and at the load terminals at the associated terminal block.

5.1.6 NAME PLATE:

CVT shall be provided with name plate showing the particular and diagram of the voltage transformer, in line with IS:3156.

5.1.7 BUSHINGS:

The bushings shall be made of homogenous, 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. Oil filled bushings shall be hermetically sealed to prevent ingress of moisture. Cast metal and caps for the bushings shall be of high strength, hot dipped galvanized malleable iron. They shall have smooth surface to prevent discharge taking space between the metal parts and porcelain as a result of ionization.

5.1.8 MOUNTING :

Each 400KV CVT shall be of self supporting type and shall be supplied without mounting pedestal (structure). The CVT shall be suitable for mounting on our steel structure, which shall be arranged by the purchaser. The mounting dimensions of the offered CVT shall match with the mounting dimensions of structures indicated in enclosed Annexure-I. However before manufacturing CVT the drawing of the CVT including the details of base mounting arrangement of the unit shall be got approved by us so as to fabricate a matching mounting structure at our end. Data regarding minimum recommended phase to phase spacing between the 400KV CVTs and the clearance from grounded objects required at various heights of CVTs shall be mentioned in the offer.

5.1.9 INSULATING OIL:

The insulating oil for first filling of oil in each CVT shall be in the scope of bidder. Only best quality new EHV Grade transformer oil should be used with the equipments with minimum BDV of 70KV. The oil shall comply in all respect with the provisions of the latest version of IS: 335 or IEC publication no. 60296 (as amended up to date). The oil parameter viz. Tan Delta, value, resistivity, PPL & BDV of oil filled in CVTs shall be recorded in the test certificates of respective CVTs. The CVT 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 sampling valve provided at the bottom of CVT should be protected by providing metallic cover or blanking plug/plate. Valve should be welded to avoid any leakage. The method adopted for hermetic sealing shall be described in the bid. Cores of Electromagnetic voltage transformers shall be constructed of high grade non-aging silicon steel lamination.

5.1.10 PAINTING & FINISH

All interiors and exteriors of tanks, and other metal parts shall be thoroughly cleaned to remove all rust, scales, erosion, grease or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible shall be painted with not less than two coats of heat resistant, oil insoluble, insulating varnish. Steel surfaces exposed to the weather shall be given a priming coat of zinc chromate and two coats of final paint. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped, or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling. Bolts and nuts exposed to the atmosphere shall be of galvanized steel. In view of severe climatic conditions, hot dip galvanized steel parts shall be required to prevent corrosion.

5.1.11 No separate over voltage protection device e.g. spark gap, voltage arrester, voltage dependent resistor etc. shall be used in the CVT.

5.2 220 KV CAPACITOR VOLTAGE TRANSFORMERS(CVT) :

The 220KV capacitor voltage transformers shall be of outdoor type, oil immersed, self cooled suitable for operation in 3phase 220KV solidly grounded system under the climatic conditions specified. These CVTs should be mechanically strong to withstand the stresses due to wind pressure of 150kg/Sq. meter. The outer shell be wet processed porcelain with liberal creepage distance to prevent flashover under the most adverse tropical conditions.

The capacitor voltage transformers shall have three secondary windings. Two windings are meant for metering purpose and other secondary winding is for protection. All the three secondary shall be rated for 63.5V. The 220KV capacitor voltage transformers shall have the following ratings.

Nominal system voltage	220KV		
Highest system voltage	245KV		
Rated frequency	50 c/s		
Earthing	Effective		
No.of secondary windings	Three		
	Secondary-I	Secondary-II	Secondary-III
Application	Protection	Metering	Metering
Voltage ratio for all the three secondary windings	$\frac{220 \text{ KV}}{\sqrt{3}} / \frac{110 \text{ V}}{\sqrt{3}}$		
Class of accuracy	3P	0.2	0.2
Rated out put burden VA	100	50	50
Rated simultaneous burden	75VA		
Basic insulation level	1050KVp		
Resultant high frequency capacitance(pf)	4400 + 10% -5 %		
Creepage distance	25mm/KV		
Frequency pass band	50-500KHz		

5.2.1 Technical Requirement:

- (i) The CVT shall incorporate potential devices, suitable for connection to synchronising equipment comprising of synchronoscope, voltmeter, synchronising lamps and the automatic synchroniser.
- (ii) Each CVT shall be suitable for connection directly to the line without the use of auxiliaries such as isolating switches or fuses. The capacitors of the unit shall be so designed that the application of impulse voltage shall not damage the internal working elements or cause a change in their electrostatic capacitance.
- (iii) The primary and secondary capacitors shall preferably be housed in entirely sealed and oil filled porcelain insulator to eliminate breathing and prevent ingressing air and moisture in to the assembly. Provision shall however be made to accommodate the expansion and contraction of oil.
- (iv) The magnetic type intermediate transformer for CVT shall be of oil immersed and self cooled design and shall be suitable for metering, relaying and synchronizing services. The core of this transformer shall be of high grade, non-ageing, cold rolled, laminated, electrical silicon steel of low hysteresis loss and of high permeability so as to ensure high accuracy at normal and high over voltages. The primary windings shall be connected through a compensating reactor between phase and neutral with the neutral point solidly grounded. An oil level gauge should be provided on the EMU.

5.2.2 Damping Device :

Each capacitor voltage transformer shall be provided with suitable damping device so that Ferro resonance oscillations due to saturation of iron core of transformer or of any inductance connected in parallel with it or initiated by any other condition shall disappear immediately and shall not affect the proper working of protective relays. The design of the compensating reactor and the intermediate transformer as well as of the additional damping devices inserted in the secondary of intermediate transformer shall be such that the phenomenon of Ferro resonance cannot occur.

5.2.3 The design of capacitors shall generally be based on the following requirements:

- i. Comparatively low specific voltage between capacitor coils.
- ii. Low dielectric loss over a wide frequency band.
- iii. Low variation of capacitance due to changes of temperature.
- iv. Very high natural frequency.

- v. Corona free design to keep the noise level of carrier frequency link low.
- vi. Low stray capacity to ground to reduce the carrier frequency energy losses in the neighborhood of carrier connection.
- vii. High mechanical strength of porcelain and its fastenings to ensure that it is resistant against bending stresses which might occur due to a wind pressure of 150kg/sq. meter.

5.2.4 The design of the potential unit of the CVTs shall be based on the following requirements in connection with protective relaying.

- i. They must transmit accurately sudden drops of primary voltage.
- ii. The measuring errors on the three phases of a set of CVTs should be matched in accuracy.
- iii. The CVTs must not enter into sub harmonic resonance and transient oscillations during energisation must be damped out sufficiently/rapidly.
- iv. They must have sufficiently low short circuit impedance as seen from secondary.
- v. The transient response should be such that the value of the secondary voltage of CVT after 20 milliseconds from the instant of short circuit should be less than 10 % of the peak voltage before test.
- vi. A suitable device should be provided to limit the over voltage impressed on the transformer

5.2.5 Base Housing :

The measuring or the secondary unit comprising of compensating reactor, intermediate transformer along with its accessories, damping impedances etc, shall be contained in a heavily hot dip galvanized steel enclosure which will also serve as a mounting base for the capacitor stack and a housing for carrier accessories.

5.2.6 Terminal Connector :

1. Terminal connectors suitable for single Zebra ACSR conductor shall be offered along with the equipment. The drawings of clamps and connectors shall be got finalized and approved by us before supplying the equipment. The clamps shall be made of LM9 or LM25 aluminum alloy by gravity die casting process or pressure die casting process only and sand die casting process is not acceptable. Any other process followed or material used for manufacturing the clamps shall also be indicated in the offer.
 - a. The secondary terminals of the potential device and the terminal for high frequency coupling as well as the earthing terminal shall be placed inside a water proof terminal cabinet outside the steel

enclosure. This cabinet shall also be hot dip galvanised and shall have hinged door provided with locking arrangements. Cable boxes to receive high frequency cable and control equipments shall be mounted on the bottom of this cabinet and shall be included in the scope of supply.

5.2.7 Mounting :

Each 220KV CVT shall be of self supporting type and shall be supplied without mounting pedestal (structure). The CVT shall be suitable for mounting on our steel structure, which shall be arranged by the purchaser. The mounting dimensions of the offered CVT shall match with the mounting dimensions of structures indicated in enclosed Annexure-II. However before manufacturing CVT the drawing of the CVT including the details of base mounting arrangement of the unit shall be got approved by us so as to fabricate a matching mounting structure at our end. Data regarding minimum recommended phase to phase spacing between the 220KV CVTs and the clearance from grounded objects required at various heights of CVTs shall be mentioned in the offer.

5.2.8 Insulation Oil :

The insulating oil for first filling of oil in each CVT shall be in the scope of bidder. Only best quality new EHV Grade transformer oil should be used with the equipments with minimum BDV of 70KV. The oil shall comply in all respect with the provisions of the latest version of IS: 335 or IEC publication no. 60296 (as amended up to date). The oil parameter viz. Tan Delta, value, resistivity, PPL & BDV of oil filled in CVTs shall be recorded in the test certificates of respective CVTs. The CVT 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 sampling valve provided at the bottom of CVT should be protected by providing metallic cover or blanking plug/plate. Valve should be welded to avoid any leakage. The method adopted for hermetic sealing shall be described in the bid. Cores of Electromagnetic voltage transformers shall be constructed of high grade non-aging silicon steel lamination.

5.2.9 PAINTING & FINISH

All interiors and exteriors of tanks, and other metal parts shall be thoroughly cleaned to remove all rust, scales, erosion, grease or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible shall be painted with not less than two coats of heat resistant, oil insoluble, insulating varnish. Steel surfaces exposed to the weather shall be given a priming coat of zinc chromate and two coats of final paint. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped, or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling. Bolts and nuts exposed to the atmosphere shall be of galvanized steel. In view of severe climatic conditions, hot dip galvanized steel parts shall be required to prevent corrosion.

5.2.10 No separate over voltage protection device e.g. spark gap, voltage arrester, voltage dependent resistor etc. shall be used in the CVT.

5.3 TECHNICAL REQUIREMENTS FOR 132KV COUPLING CAPACITOR

5.3.1 The 132KV coupling capacitors shall be of outdoor type, oil filled, pedestal mounted and mechanically strong to withstand the stresses due to wind pressure of 150KG/sq.meter. The outer shell will be one piece wet processed porcelain with liberal creepage distance to prevent flashover under the most adverse tropical condition.

The 132KV coupling capacitor shall have the following electromechanical characteristics:

Nominal system voltage	132KV
Highest system voltage	145KV
Installation	Outdoor
One minute power frequency withstand test voltage (dry)	275KV
One minute power frequency withstand test voltage(wet)	275KV
Impulse withstand voltage	650 KV
Rated capacitance	4400pf + 10% -5%
Rated frequency	50 Hz

5.3.2 Technical Requirements :

- (i) Please note that we are standardizing value of capacitors in our system and intending to use capacitor value as 4400pf. It is therefore requested that capacitor for 132KV system should be offered with a rated capacitance value of 4400pf.
- (ii) The 132KV coupling capacitors must conform to the basic impulse level, dry and wet withstand voltage and the creepage distances.
- (iii) The clamps shall be made of LM9 or LM25 aluminum alloy by gravity die casting process or pressure die casting process only and sand die casting process is not acceptable. Any other process followed or material used for manufacturing the clamps shall also be indicated in the offer. The successful bidders will arrange to supply sufficient number of clamps and connectors along with the main equipment. The drawings of clamps and connectors shall be got finalized and approved by us.
- (iv) The 132kV coupling capacitor shall be supplied without mounting pedestal (structure). The Coupling Capacitor shall be suitable for mounting on our steel structure, which shall be arranged by the purchaser. The mounting dimensions of the equipments shall match with the mounting dimensions of structures indicated in enclosed Annexure-I. However before manufacturing coupling capacitor the drawing of the coupling capacitor including the details of base mounting arrangement of the unit shall be got

approved by us so as to fabricate a matching mounting structure at our end.

6.0 GUARANTEED TECHNICAL PARTICULARS FOR 400 KV CVT, 220 KV CVT & 132 KV COUPLING CAPACITOR :

Guaranteed technical particulars for 400 KV, 220 KV CVT & 132KV Coupling Capacitor called for shall be furnished along with the bid. Particulars which are subject to guarantee shall be marked clearly. Any other particulars considered essential may please also be furnished.

7.0 TESTS :

7.1 Type Test :

All the equipment offered, shall be fully type tested as per relevant Indian Standards or any Equivalent International Standard. In case the equipment of the type and design offered, has already been type tested, Bidder shall invariably furnish type test reports from the reputed and approved national/international laboratory/ Government approved test houses to prove that specifications of EHV equipments offered conform to the relevant standard. Test certificates shall clearly indicate the type and model number etc., so that relevant details of offered EHV equipments could be verified. While submitting bids the model and type etc., shall be clearly indicated. Type test reports so furnished should not pertain to the period earlier than five years from the date of opening of Bid. In case the type tests were carried out earlier than five years, the manufacturer will have to conduct these tests before commencement of supply. For this purpose, the Bidder may quote unit rates for carrying out each type test. This will not be considered for price evaluations. For any change in the design/type already type tested and the design/type offered against this bid, the Purchaser reserves the right to demand repetition of same or all type tests without any extra cost. Non compliance of this requirement will make the bid non responsive.

7.2 Acceptance And Routine Tests :

7.2.1 The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards or equivalent International Standards in presence of Purchaser's representative.

7.2.2 Immediately after finalization of the programme of type/ acceptance/ routine testing, the manufacturer shall give advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

7.2.3 The CVTs shall be subject to the following routine / site tests in addition to routine tests as per IEC/IS.

- (i) Capacitance and loss angle measurement before and after voltage test (as per IEC:358)
- (ii) Partial discharge test on capacitor dividers (as per IEC- 358)
- (iii) Sealing test (as per IEC-358)

- (iv) Natural frequency of capacitor unit determination (Resonant frequency of capacitor units).

8.0 INSPECTION:

- i. The Purchaser shall have access at all times to the works and all other places of manufacture, where the 400KV & 220KV Capacitor Voltage Transformer & 132 KV Coupling Capacitors are being manufactured and the Bidder shall provide all facilities for unrestricted inspection of the Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein. Purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. Supplier shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembled cvt/cc.
- ii. The successful Bidder shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of equipment of the 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. Successful Bidder shall within 30 days of placement of order, submit list of bought out accessories and the names of sub-suppliers.
- iv. The acceptance of any quantity of the equipment shall in no way relieve the successful bidder 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.
- v. In case for any reasons inspection is not completed or equipment is not found to be complete with all accessories as per confirmation given with the letter of inspection call, purchaser will reserve the right to recover the complete cost of deputation of inspecting team to the works of the manufacturer.

9.0 QUALITY ASSURANCE PLAN:

9.1 The Bidder must establish that they are following a proper quality assurance programme for manufacture of 400KV, 220 KV CVT & 132 KV Coupling Capacitor. The Bidder shall invariably furnish following information along with his offer. Information shall be separately given for individual type of equipment offered.

- i) Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of Bidder's representative and copies of test certificates.
- ii) Information and copies of test certificates as mentioned in (i) above in respect of bought out items.
- iii) List of manufacturing facilities available.

- iv) Levels 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 equipment available with the Bidder for final testing of equipment specified and test plant limitations, if any, vis-à-vis type test, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

9.2 The successful Bidder shall submit following information to the Purchaser.

- i) List of raw materials as well as bought out accessories and the names of sub supplier selected from the lists furnished along with offer.
- ii) Type test certificate of the raw material and bought out accessories.
- iii) Quality Assurance Plan (QAP) with hold points by Purchaser's inspection. The quality assurance plans and hold points shall be discussed between the Purchaser and Bidder before the QAP is finalized.

9.3 The successful Bidder shall submit the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

10.0 DOCUMENTATION:

10.1 All drawings shall conform to the latest version of International Standards Organization (ISO)'A' series of drawing sheet/Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for micro testing. All dimensions and data shall be in SI Units.

11.0 LIST OF DRAWINGS AND DOCUMENTS:

- 11.1** The Bidder shall furnish four sets of following drawings along with his offer.
- a) General outline and assembly drawings of the equipment showing front & side elevation and plan views and all accessories, external features with detailed dimensions, net & shipping weights, size of lifting lugs, quantity of insulating oil .
 - b) Sectional views showing General Constructional Features, lifting lugs, etc.
 - c) Name plate drawing with terminal markings & connection diagram.
 - d) Schematic drawing.

- e) Dimensional drawing of terminal clamps and connectors showing material composition, permissible temperature rise, current carrying capability etc.
- f) Type Test reports
- g) Test reports, literature, pamphlets of the bought out items.

11.2 The successful Bidder shall within two weeks from signing of contract, submit four sets of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/approval on the drawings to the Bidder within reasonable time. The Bidder 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 Purchaser's comments. After receipt of Purchaser's approval, the Bidder shall within three weeks submit 20 prints and two good quality reproducible (Soft copy) of the approved drawings for Purchaser's use.

11.3 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 Bidder's risk.

11.4 The bidder shall submit nicely printed and bound volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment supplied for distribution, along with the equipments. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. The manual shall also contain a set of all the approved drawings and type test reports etc.

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

12.0 ENGRAVING, PACKING AND FORWARDING:

12.1 The details such as order no. and date, year of manufacture and "MPPTCL" should be engraved on each and every equipment. 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 Bidder shall be responsible for any damage during transit, due to improper and inadequate packing and handling. 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. Bidder shall supply, any material, found short inside the packing cases without any extra cost.

12.2 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.

12.3 The Bidder shall ensure that the packing list and bill of material is approved by the Purchaser before despatch.

14.0 SCHEDULE

Schedules, questionnaire and annexure attached with this specification are the integral part of the specification and shall be submitted duly filled in by the Bidders alongwith the offer. Bill of material for each equipment shall be submitted by the bidder separately. Makes of the equipment shall be clearly indicated. Bidders may please note that a general mention that the components shall be of reputed make will not be acceptable.

15.0 COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS

15.1 Bid shall be complete in all respects and shall include all minor component, accessories, small wiring etc., not specifically mentioned in the Schedule, specifications etc; but essential for the completeness of the system. Bidders shall not be eligible for extra charges in respect of such minor components, accessories, small wiring etc., though not included specifically in this specification but requires for satisfactory operation of equipment offered.

15.2 Bidders must furnish following information along with technical Bid.

15.2.1 Complete details of all the accessories which will be supplied

15.2.2 It is obligatory on the part of bidders to ensure that supply of all accessories along with Main equipment are simultaneously delivered to avoid any holdups. Responsibility for obtaining timely supplies of bought out items will rest on the bidders and only on this basis, delivery period will be offered in the Bid.

15.2.3 It may be noted that in case of damages/shortages due to improper packing or any other negligence ,replenishment shall be arranged within one months time. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and also in case defective supply of any item is reported, will rest on the bidders.

17.0 GUARANTEE FOR SUPPLY OF SPARES FOR 10 YEARS OPERATION:

As specified in the bid document, the bidder has to furnish an undertaking that the spares required for satisfactory operation of offered goods shall be made available at reasonable cost over a minimum period of 10 years from the date of

commissioning of goods in purchaser's system. In the absence of such an undertaking, the offer will be treated as non-responsive.

18.0 Please ensure the Bid document containing number of pages has been properly page numbered and signed by the bidder. All Bid documents including Schedules and Annexure should be indexed properly and index of the document should be enclosed/placed at the beginning of the document.

APPENDIX-A(I)**PRINCIPAL PARAMETERS FOR 400 KV CVT**

The CVT shall conform to the following technical requirement.

1. Rated system voltage - 420 KV
2. Rated frequency - 50 Hz
3. System fault level - 40 KA(RMS) (for 1 sec.)
4. Method of system neutral earthing - Effectively earthed
5. Installation and type - Outdoor, single phase suitable for upright mounting on steel or RCC supports.
6. No. of secondary windings - 3
7. Rated secondary voltage, burden & accuracy.

WINDING NO.	RATED VOLTAGE (VOLTS)	RATED BURDEN (VA)	ACCURACY CLASS
I	$110/\sqrt{3}$	100	3P
II	$110/\sqrt{3}$	100	3P
III	$110/\sqrt{3}$	100	0.2

The accuracy of 0.2 on secondary III should be maintained through out the entire burden range on all the windings without any adjustments during operation.

8. **Transformation ratio:**
 - (a) $\frac{I \ \& \ II \ (400 \times 10^3)}{\sqrt{3}} \ / \ \frac{110}{\sqrt{3}}$
 - (b) $\frac{III \ (400 \times 10^3)}{\sqrt{3}} \ / \ \frac{110}{\sqrt{3}}$
9. **Winding utilization :**
 - Winding - I for main I protection
 - Winding -II for main II protection
 - Winding -III for metering
10. Rated Voltage Factor - 1.20 continuous, 1.5 for 30 seconds
 Rated Voltage of Surge Arrestor connected at sec. of CVT - 24 (KV rms)
11. **RATED INSULATION LEVEL:**
 - (i) 1.2/50 micro-sec. Impulse Withstand voltage - 1425 KV(rms)
 - (ii) One minute dry power Frequency withstand - 630 KV(rms)
 - (iii) 50/2500 micro-sec. Switching impulse Withstand voltage - 1050 KV(Peak)

- | | | | |
|-----|---|---|--|
| 12. | Standard reference range of frequency (for which the metering accuracies are valid) | - | 96% to 103% for protection and 99% to 101% for |
| 13. | Whether CVTs are suitable for use on carrier coupling | - | Yes |
| 14. | Total capacitance pico-farads | - | 4400+10% - 5% |
| 15 | a) High frequency capacitance on the entire carrier frequency Range. | - | Within 80% to 150% of rated capacitance. |
| | (b) Equivalent series resistance over the entire carrier frequency range | - | Less than 40 Ohms |
| 16. | Stray capacitance and stray Conductance of the low voltage Terminal over entire carrier frequency range. | - | As per IEC-358 |
| 17. | Maximum stray capacitance (PF) | - | 300+0.05Cn (Cn is the rated capacitance) |
| 18. | Stray conductance | - | As per IEC-358 |
| 19. | (a) One minute power frequency test voltage between low voltage terminal and earth terminal. | - | 10KV (rms) |
| | (b) One minute power frequency test voltage on secondary winding | - | 3KV (rms) |
| 20. | Limits of temperature rise | - | As per relevant IEC/IS |
| 21. | The Bidder shall give the schematic drawing of the CVT offered with details of any arrangement / circuit provided for any adjustment of the phase and ratio error in his bid. | | |
| 22. | Switching impulse withstand test shall be performed using the standard switching impulse wave of 250/2500 microseconds. | | |

CREEPAGE DISTANCE:

23. All bushings shall have a creepage distance of 25mm/KV of system line to line nominal voltage. The protected creepage distance shall not be less than 50% of the total protected creepage distances. The Bidder shall clearly indicate the creepage distances of various bushings and insulators included in his offer.

- 24. Maximum radio interference voltage (maximum radio oise level) at 266KV to ground. - Not exceeding 500 micro volts
- 25. Visual corona extinction voltage - Kilo volts (rms) 320
- 26. Partial discharge level at rated voltage for capacitive divider - less than 10 Pico Coulombs
- 27. The secondary of the voltage transformer shall be protected by a suitable high speed switch or a miniature circuit breaker with three NO & two NC contacts.
- 28. Carrier frequency choke in series with the electro magnetic unit shall be used to prevent the loss of signal through the winding of the transformer.
- 29. The secondary ratio shall not be arranged by providing any auxiliary transformer.

APPENDIX-A(II)**PRINCIPAL PARAMETERS FOR 220 KV CVT**

Nominal system voltage	220KV		
Highest system voltage	245KV		
Rated frequency	50 c/s		
Earthing	Effective		
No.of secondary windings	Three		
	Secondary-I	Secondary-II	Secondary-III
Application	Protection	Metering	Metering
Voltage ratio for all the three secondary windings	$\frac{220 \text{ KV}}{\sqrt{3}} / \frac{110 \text{ V}}{\sqrt{3}}$		
Class of accuracy	3P	0.2	0.2
Rated out put burden VA	100	50	50
Rated simultaneous burden	75VA		
Basic insulation level	1050KVp		
Resultant high frequency capacitance(pf)	4400 + 10% -5 %		
Creepage distance	25mm/KV		
Frequency pass band	50-500KHz		

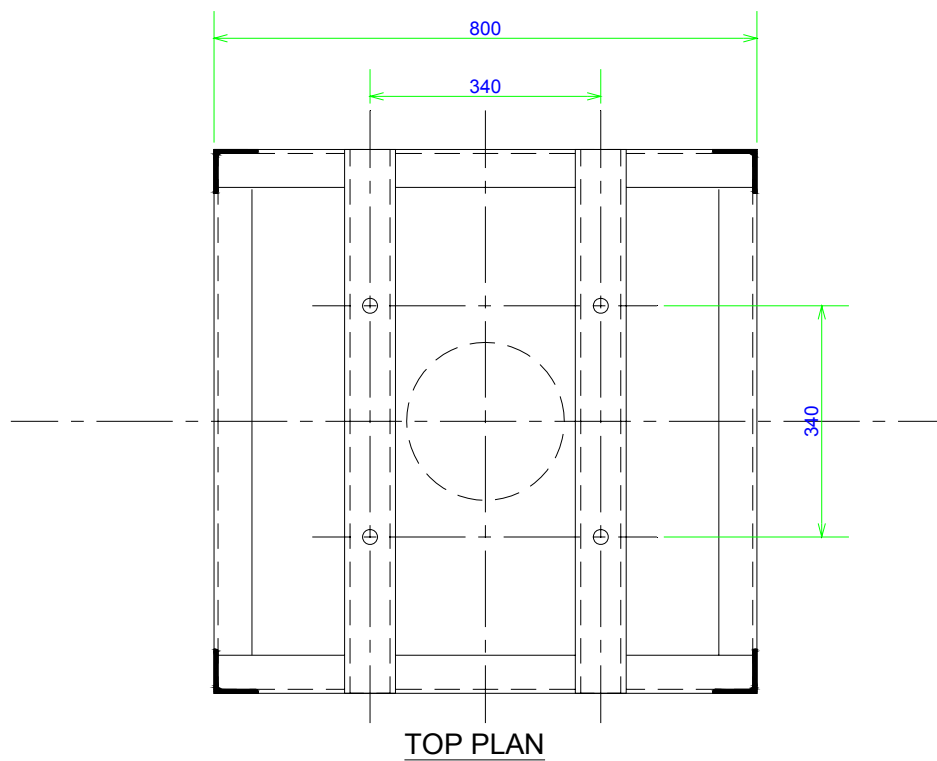
APPENDIX-A(III)**PRINCIPAL PARAMETERS FOR 132 KV COUPLING CAPACITOR**

Nominal system voltage	132KV
Highest system voltage	145KV
Installation	Outdoor
One minute power frequency withstand test voltage (dry)	275KV
One minute power frequency withstand test voltage(wet)	275KV
Impulse withstand voltage	650 KV
Rated capacitance	4400pf + 10% -5%
Rated frequency	50 Hz

APPENDIX-B

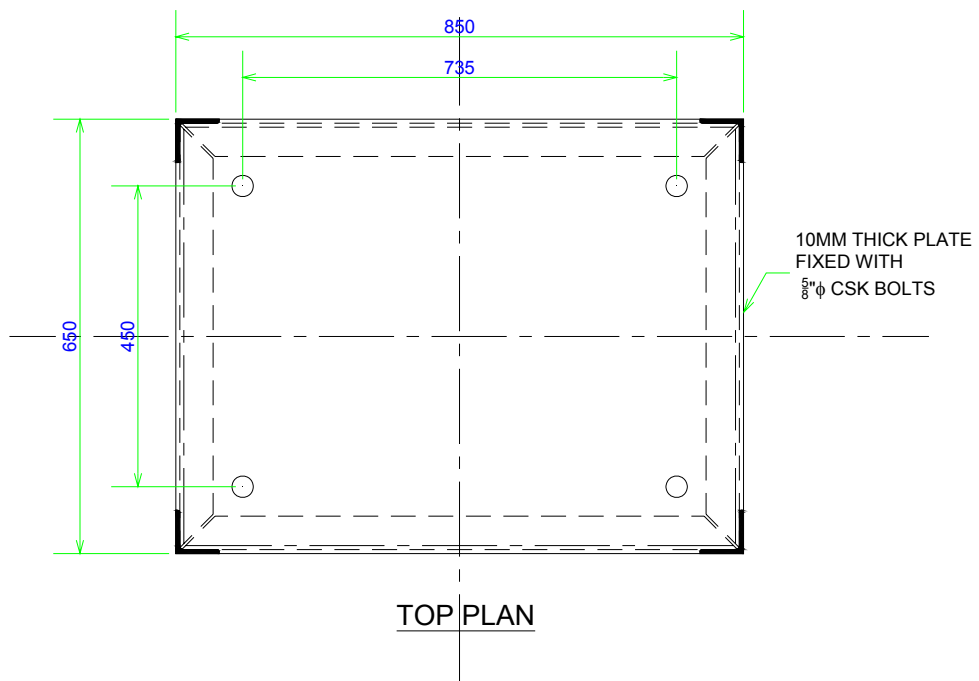
S.No	Drawing No.	Description
1	JICA/MPPTCL/TR-101 TO 107/132KV CC BASE PLATE	Base Plate Drawing for 132KV CC
2	JICA/MPPTCL/TR-101 TO 107/220 KV CVT BASE PLATE	Base Plate Drawing for 220 KV CVT
3	JICA/MPPTCL/TR-101 TO 107/400 KV CVT BASE PLATE	Base Plate Drawing for 400 KV CVT

BASE PLATE MOUNTING DETAILS
132KV COUPLING CAPACITOR (3KO2)



D R A W I N G N U M B E R :-
JICA/MPPTCL/TR-101 TO 107/132KV C C BASE PLATE

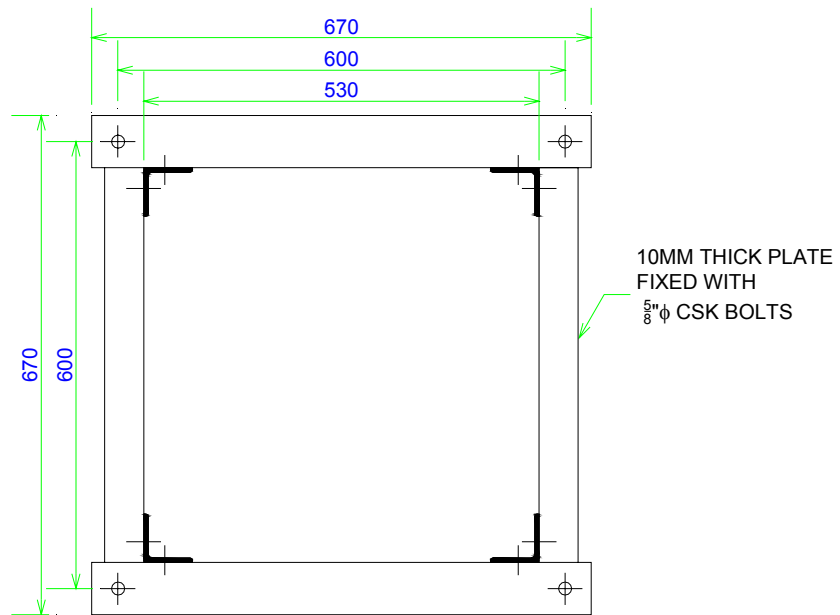
BASE PLATE DETAILS FOR 220KV CVTs



D R A W I N G N U M B E R :-

JICA/MPPTCL/TR-101 TO 107/220KV CVT BASE PLATE

BASE PLATE DETAILS FOR 400KV CVTs



TOP PLAN

D R A W I N G N U M B E R :-

JICA/MPPTCL/TR-101 TO 107/400KV CVT BASE PLATE

SCHEDULE-I (A)
DESCRIPTION OF EQUIPMENT FOR SCHEDULE FOR RATES AND PRICES
TO BE FURNISHED IN VOLUME-VI

SNo	Particular of equipment/item	Qty.
A	400 KV CVT	As per Price Schedule
	400KV Capacitive Voltage Transformer with capacitance of 4400 pF with three winding Secondary Windings(two with 3P Accuracy Class for Protection-I&II & other one with 0.2 Accuracy Class for Metering) along with Clamps and Connectors meeting all technical requirements of the specification	
B	220 KV CVT	
	Supply of 220 KV CVT complete with all accessories, terminal connectors etc confirming to all technical requirements as described in the bid document	
C	132 KV Coupling Capacitor	
	132 KV Coupling Capacitor With Capacitance of 4400 pF along with Clamps and Connectors meeting all technical requirements of the specification etc.	

- Note : 1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.**
- 2. The quantity of above equipments has been mentioned in Volume VI.**

SECTION-II

2.2.2 TECHNICAL SPECIFICATION FOR 400 KV, 220 KV & 132 KV WAVE TRAP

1.0 SCOPE :

The scope of this bid covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Specification means "Original Equipment Manufacturer (OEM)". The purchaser means the "MPPTCL".

In case bidder is not OEM, sole responsibility of offering equipments/materials of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS :

2.1 Applicable Standards for the offered equipments /items shall be as per Section-I, Volume-II.

2.2 If the equipment offered by the Bidders conforms to any other standards, salient points of comparison between the standards adopted and the specific standards shall be clearly brought out in relevant schedule of technical deviation. It will be sole responsibility of Bidders to prove that the salient features of offered equipment are equivalent or better than IS.

2.3 ACCEPTANCE OF OTHER AUTHORITATIVE STANDARDS :

In the preceding paragraph relevant Indian standard / IEC standard bid have been shown. However, the equipment meeting any other authoritative international standard, which ensures equal or better quality than the standards, mentioned shall also be acceptable. Equipment for which Indian Standards are not available, the relevant British standards and IEC recommendations will be applicable. Please attach photocopy of all such standards according to which the equipment has been offered.

3.0 CLIMATIC CONDITIONS :

3.1 Applicable climatic conditions shall be as per Section-I, Volume-II.

3.2 AUXILIARY POWER SUPPLY :

Auxiliary Power Supply for offered EHV equipments shall be as per Section-I Volume-II.

4. DISCREPANCY IN TECHNICAL PARTICULARS :

Regarding discrepancy in technical particulars stipulation under Section-I Volume-II shall be applicable.

5.0 TECHNICAL SPECIFICATION FOR 400 KV, 220 KV & 132 KV WAVE TRAP

5.1 BASIC DESIGN OF 400KV WAVE TRAP

5.1.1 400kV Wave Trap shall be offered complete with Tuning pot, lighting arrester, birds barriers supporting insulators, auxiliary pedestals, associated hard wares, supporting structures, clamps & connectors etc. The Wave Traps shall be generally in accordance with the latest IEC 353 for Wave Traps and shall comprise of main coil, protective device and a tuning device. The Wave Traps shall be epoxy impregnated type to ensure reliability in adverse field conditions. Each Wave Traps shall be supplied duly equipped with the following accessories;

- (i) One set of copper connectors, with fixing nuts and bolts for connection between main coil, tuning device and protective device.
- (ii) **Complete set of Pedestal mounting structure, insulator stacks with other accessories & hardwares required for Pedestal mounting installation as well as various connections in the switch yard.**
- (iii) One set of connecting clamps for connecting the line trap to EHT Line and substation side equipment.
- (iv) Suitable birds barriers.

The above items shall not be supplied in loose but shall be duly fitted with the main coil of the Wave Trap. The Wave Trap and its associated clamps, fitting etc. shall not display RI level higher than 2500 micro volt at 266 KV and should have corona extinction voltage of 320 KV. Necessary corona rings shall be provided to ensure compliance with this requirement. Depending on the design, it may be necessary to provide bird barriers which shall be included by the bidder in his offer.

5.1.2 The Wave Trap shall conform to the following technical requirements:-

SNo	Particulars	For 400KV
1	Rated Continuous current	2000 Amps
2	Nominal system voltage	400KV
3	Maximum continuous operating voltage	420KV
4	System frequency	50Hz (+/- 2%)
5	Design ambient temperature	50 ⁰ C
6	Rated short circuit current (1Second)	40 KA r.m.s.
7	Nominal discharge current of the station class protective device	10KA
8	Type of tuning	Broad band
9	Rated blocking band frequency or specific band width in the range	50 KHz to 500 KHz
10	Minimum resistive component of impedance within the blocking band	450 Ohms
11	Rated inductance of main coil	1.0 mH
12	Resistive component of impedance within its carrier frequency blocking range shall not be less than	570 Ohms

The bidder shall indicate continuous Current rating of the Wave Trap at 65°C Ambient.

5.1.3 Wave Trap shall be provided with a protective device in the form of surge arrester which shall be designed and arranged such that neither significant alteration in the protective function nor physical damage shall result from either temperature rise or magnetic field of the main coil at continuous rated current or rated short time current.

The lightning arrester shall be of standard design and of latest technology. Its rated discharge current shall be 10KA. The Lightning arrester provided with the wave trap shall fully comply with the requirements of IS : 3070 Part-I / IEC – 99 – I – Part I . It shall conform to type tests as applicable and type test certificates for the same shall be submitted by the bidder.

5.1.4 The wave trap on 400 KV lines shall show no visual corona discharge at a voltage of 320 KV (rms) power frequency falling voltage. Corona rings should be provided. Radio interference voltage for 420 KV wave trap shall not exceed 500 Micro Volts at 280 KV (rms)

5.1.5 Type tests including impulse voltage test and power frequency voltage test on tuning device as per latest IEC – 353 shall be performed. The following additional type tests are also proposed to be performed on wave traps along with other type tests mentioned in IEC – 353.

- a. Corona Extinction Voltage Test
- b. Radio influence Voltage Measurement.

The bidder must enclose all reports of type and routine tests conducted on 400KV Wave traps as per IEC – 353 along with their bids.

5.1.6 WAVE TRAP MOUNTING:

5.1.6.1 The wave trap shall be suitable for out-door Pedestal mounting and shall be mechanically strong enough to withstand the stresses due to maximum wind pressure of 260 Kg per sq. meter.

5.1.6.2 For pedestals mounting, each wave trap shall be mounted on a Tripod structure formed by three insulators stacks arranged in a triangular form. All the accessories, insulators, hardwares and mounting stool including bolts for fixing the wave trap on insulators shall be non-magnetic material and shall be supplied by the bidder. The standard arrangement of pedestal mounting of 400kV wave trap shall be adopted. A drawing showing the standard pedestals mounting arrangement should be furnished for our approval and the mounting arrangement should be provided as per the design approved by us.

The auxiliary pedestals shall be so design that circulation eddy current is prevented and it allows taking out “outgoing jumpers” of the Wave Trap conveniently without any problem.

5.1.7 TERMINAL CONNECTORS FOR 400 KV WAVE TRAPS :

5.1.7.1 The wave trap should be suitable for connecting to ACSR Twin Moose conductor with horizontal or vertical take off. Necessary clamps shall be supplied along with the wave trap. The design shall be to our approval.

5.1.7.2 Terminal connectors shall conform to IS: 5561.

5.1.7.3 No part of clamp or connector (including hardware) shall be of magnetic material.

5.1.7.4 Radio interference voltage for 400KV shall not exceed 500 Micro Volts at 280 KV (rms) respectively.

5.1.7.5 Clamps / connectors shall be designed for the same current rating as wave trap and temperature shall not exceed 80° C.

5.1.7.6 Clamps / connectors shall conform to type tests as per IS: 5561. Type test reports shall also be submitted for following additional type tests.

- (a) Visual corona extinction test
- (b) Radio interference voltage

5.1.7.7 Terminal connector shall also meet the following requirement .

- a) Terminal connector should be made of A6 Aluminium alloy as per IS 5561 and shall be manufactured by gravity die casting or by pressure die casting process. Sand casted terminal connectors are not acceptable.
- (b) All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- (c) No part shall be less than 12 mm thick.
- (d) The nuts, bolts & washers used in the current path shall be of good quality HDG mild steel material with minimum dia of 12 mm only.
- (e) Wherever necessary bimetallic strips, copper aluminium liner / bimetallic sleeve of minimum thickness of 2 mm shall be provided.
- (f) All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- (g) The terminal connectors should be tightened by six bolts. Conductor hold length must not be less than 100mm.
- (h) The surface of clamp to be tightened by six bolts should be flat in shape so that it may be possible to open the nut bolts by normal spanners. Therefore any type of groove in the clamp body for fixing of nuts should be avoided.

- (i) The portion of clamp to hold the conductor should be flat and straight and not zig-zag in construction at both the sides so that heating of clamp by throttling action of current may be avoided.
- (j) Space of atleast 50% of diameter of nuts should be available after the hole at both the sides of conductor holding portion for better mechanical strength.
- (k) Size of terminal connector for which the clamp is designed and also rated current under site conditions shall be embossed / punched on each part of clamps, except hardware.
- (l) The clamp for twin moose ACSR conductor shall be made of three pieces so that each conductor may be tightened separately

5.1.7.8 Bidders are required to submit along with their bid typical drawings clearly indicating the above mentioned features of the wave traps, wave trap mounting arrangement and terminal connectors.

5.2 BASIC DESIGNS OF 220KV WAVE TRAPS:

5.2.1 The 220 KV out door type, wave traps shall be offered with suspension type mounting, complete main coil with tuning pot, lightning arrestor, protective device, bird barriers, set of clamps and connectors and associated hardwares and accessories. The wave traps shall be of 0.5mH ,1250A rating for 220KV system . However, it should be made explicitly clear that the wave traps are to be suitably designed to block any desired frequency in the range of 40 kHz to 500kHz by providing suitable tuning pot in such a manner that a minimum resistive component of 570 ohms is available. The tuning pot should be such that with the rating of wave trap i.e. 0.5mH, 250A for 220 KV, any frequency between 40 kHz to 500kHz may be blocked. The various blocking bands which could be offered with 0.5mH 220kv wave traps may please be stated in your offer. However, it may please be clearly confirmed that suitable strapping are provided for different blocking bands with each rating of wave traps offered.

5.2.2 The wave traps shall be suitable for out door suspension mounting and shall be mechanically strong to withstand the stresses due to maximum wind pressure of 260 kg per sq. meter.

For suspension mounting the bidder shall be required to coordinate the mounting arrangement with the existing arrangement. Non-magnetic suspension hook/link of adequate length and tensile strength to provide necessary magnetic clearance between the wave trap and the suspension hardware shall be supplied. The standard arrangement for suspension mounting of 220 KV wave traps shall be adopted. A drawing showing the standard suspension arrangement should be furnished for approval and the mounting arrangement should be provided as per the design approved by us.

5.2.3 The wave traps shall have the following specifications:

SNo	Particulars	For 220KV
1.	Nominal system voltage	220 KV
2.	Maximum voltage of the line on which the traps are to be used.	245 KV
3.	System frequency	50Hz
4.	Design ambient temperature	50 ⁰ C
5.	Nominal discharge current of the station class protective device	10KA
6.	Type of tuning	Broad band
7	Minimum resistive component of impedance within the blocking band	450 Ohms
8	Resistive component of impedance within its carrier frequency the blocking range shall not be less than	570 Ohms
9	Continuous current rating	1250Amps
10	Instantaneous symmetrical short circuit current capacity.	40KA(1Sec)
11	Tuning range	90-150 Hz & 150- 500 KHz
12	Change in resonant frequency due to ambient temperature variation not to exceed.	0.01% Per ⁰ C
13	Change in impedance due to ambient temperature variation not to exceed.	0.3% Per ⁰ C

5.2.4 TERMINAL CONNECTORS FOR 220 KV WAVE TRAP :

5.2.4.1 220KV Wave Traps shall be provided with terminal connectors suitable to receive Single Zebra ACSR conductor shall be provided with terminal connectors suitable to receive Single Zebra ACSR conductor on one side and single Panther conductor on other side with arrangement for both vertical as well as horizontal takeoff. The prices offered for each equipments should take into account the cost of set of clamps & connectors. Clamps shall be designed adequately to take care of any bimetallic effect. Temperature at the clamp shall not exceed 80⁰C. Terminal connectors shall be tested for short circuit current capability, temperature rise etc.

5.2.4.2 Terminal connectors shall also meet the following requirements:

- Terminal connectors shall be manufactured & tested as per IS:5561.
- Terminal connector should be made of Aluminium alloy Grade LM9 or LM 25 as per IS 5561 and shall be manufactured by by gravity die casting or by pressure die casting process. Sand casted terminal connectors are not acceptable.
- All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

- Terminal connector shall be designed to corona free as per relevant standard.
- No part shall be less than 12 mm thick.
- The nuts, bolts & washers used in the current path shall be of good quality HDG mild steel material only.
- Wherever necessary by bimetallic strips, copper aluminium liner /by metallic sleeve of minimum thickness of 2 mm shall be provided.
- All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- The terminal connectors should be tightened by six bolts. Conductor hold length must not be less than 100mm.
- The surface of clamp to be tightened by six bolts should be flat in shape so that it may be possible to open the nut bolts by normal spanners. Therefore any type of groove in the clamp body for fixing of nuts should be avoided.
- The portion of clamp to hold the conductor should be flat and straight and not zig-zag in construction at both the sides so that heating of clamp by throttling action of current may be avoided.
- Space of atleast 50% of diameter of nuts should be available after the hole at both the sides of conductor holding portion for better mechanical strength.
- Size of terminal connector for which the clamp is designed and also rated current under site conditions shall be embossed / punched on each part of clamps, except hardware.

5.2.4.3 It is essential that design of clamps i.e. details in this regard to dimensions, the number of bolts to be provided, material and manufacturing process should be submitted for our approval. Any modification in the design shall have to be carried out without any extra cost. Thus the clamps shall be manufactured finally as per design and drawing duly approved by us.

5.3 TECHNICAL SPECIFICATION FOR 132 KV WAVE TRAP

5.3.1 BASIC DESIGNS 132 KV WAVE TRAPS:

5.3.1.1 The Wave Traps shall be generally in accordance with the latest IEC 353 for Wave Traps and shall comprise of main coil, protective device and a tuning device, bird barrier, associated clamps, connectors, hardware and other accessories. The Wave Traps shall be epoxy impregnated type to ensure reliability in adverse field conditions. Each Wave Traps shall be supplied duly equipped with the following accessories;

- (i) One set of copper connectors, with fixing nuts and bolts for connection between main coil, tuning device and protective device.

- (ii) One set of hardware for suspension of the wave trap from the Substation gantry or the line conductor.

- 15 One set of connecting clamps for connecting the line trap to EHT Line and substation side equipment.

The above items shall not be supplied in loose but shall be duly fitted with the main coil of the Wave Trap.

5.3.1.2 Wave Trap shall be provided with a protective device in the form of surge arrester which shall be designed and arranged such that neither significant alteration in the protective function nor physical damage shall result from either temperature rise or magnetic field of the main coil at continuous rated current or rated short time current.

The lightning arrester shall be of standard design and of latest technology. Its rated discharge current shall be 10KA. The Lightning arrester provided with the wave trap shall fully comply with the requirements of IS : 3070 Part-I / IEC – 99 – I – Part I . It shall conform to type tests as applicable and type test certificates for the same shall be submitted by the bidder.

5.3.1.3 Out door type of wave traps shall be of 0.5mH, 630A rating for 132KV system. However, it should be made explicitly clear that the wave traps are to be suitably designed to block any desired frequency in the range of 40 kHz to 500kHz by providing suitable tuning pot in such a manner that a minimum resistive component of 570 ohms is available. The tuning pot should be such that with the rating of wave trap i.e. 0.5mH, 630A for 132 KV, any frequency between 40 kHz to 500kHz may be blocked. The various blocking bands which could be offered with 0.5mH 132 wave traps may please be stated in your offer. However, it may please be clearly confirmed that suitable strapping are provided for different blocking bands with each rating of wave traps offered.

5.3.1.4 The wave traps shall have the following specifications:

Sl. No	Particulars	For 132 KV
1.	Nominal system voltage	132 KV
2.	Maximum voltage of the line on which the traps are to be used.	145 KV
3.	System frequency	50Hz
4.	Design ambient temperature	50 ⁰ C
5.	Nominal discharge current of the station class protective device	10KA
6.	Type of tuning	Broad band
7	Minimum resistive component of impedance within the blocking band	450 Ohms
8	Resistive component of impedance within its carrier frequency the blocking range shall not be less than	570 Ohms

9	Continuous current rating	630 Amps
10	Instantaneous symmetrical short circuit current capacity.	20 KA (1Sec)
11	Tuning range	90-150 Hz & 150- 500 KHz
12	Change in resonant frequency due to ambient temperature variation not to exceed.	0.01% Per °C
13	Change in impedance due to ambient temperature variation not to exceed.	0.3% Per °C

5.3.1.5 The wave trap shall be suitable for out-door suspension mounting and shall be mechanically strong enough to withstand the stresses due to maximum wind pressure of 260 Kg per sq. meter.

5.3.1.6 For suspension mounting, the bidder shall be required to co-ordinate the mounting arrangement with the existing arrangement. Non-magnetic suspension hook / link of adequate length and tensile strength to provide necessary magnetic clearance between the Wave Trap and suspension hardware shall be supplied. The standard arrangement of suspension mounting of 132 KV Wave Trap shall be adopted. A drawing showing the standard suspension arrangement should be furnished for our approval and the mounting arrangement should be provided as per the design approved by us.

5.3.2 TERMINAL CONNECTORS FOR 132 KV WAVE TRAP :

5.3.2.1 Wave Traps shall be provided with terminal connectors suitable to receive Single Zebra ACSR conductor on one side and single Panther conductor on other side with arrangement for both vertical as well as horizontal takeoff. The prices offered for each equipments should take into account the cost of set of clamps & connectors. Clamps shall be designed adequately to take care of any bimetallic effect. Temperature at the clamp shall not exceed 800C. Terminal connectors shall be tested for short circuit current capability, temperature rise etc.

5.3.2.2 Terminal connectors shall also meet the following requirements:

- Terminal connectors shall be manufactured & tested as per IS:5561.
- No part of clamp or connector (including hardware) shall be of magnetic material.
- Terminal connector should be made of Aluminium alloy Grade LM9 or LM 25 as per IS 5561 and shall be manufactured by by gravity die casting or by pressure die casting process. Sand casted terminal connectors are not acceptable.
- All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- Terminal connector shall be designed to corona free as per relevant standard.
- No part shall be less than 12 mm thick.

- The nuts, bolts & washers used in the current path shall be of good quality HDG mild steel material only.
- Wherever necessary by bimetallic strips, copper aluminium liner /by metallic sleeve of minimum thickness of 2 mm shall be provided.
- All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- The terminal connectors should be tightened by six bolts. Conductor hold length must not be less than 100mm.
- The surface of clamp to be tightened by six bolts should be flat in shape so that it may be possible to open the nut bolts by normal spanners. Therefore any type of groove in the clamp body for fixing of nuts should be avoided.
- The portion of clamp to hold the conductor should be flat and straight and not zig-zag in construction at both the sides so that heating of clamp by throttling action of current may be avoided.
- Space of atleast 50% of diameter of nuts should be available after the hole at both the sides of conductor holding portion for better mechanical strength.
- Size of terminal connector for which the clamp is designed and also rated current under site conditions shall be embossed / punched on each part of clamps, except hardware.

5.3.2.3 It is essential that design of clamps i.e. details in this regard to dimensions, the number of bolts to be provided, material and manufacturing process should be submitted for our approval. Any modification in the design shall have to be carried out without any extra cost. Thus the clamps shall be manufactured finally as per design and drawing duly approved by us.

6.0 TECHNICAL REQUIREMENTS for 400 KV, 220 KV & 132 KV WAVE TRAPS:

6.1 The wave traps shall effectively block the high frequency currents but allow the 50 cycles current to pass without losses.

6.2 Wave trap shall be robust in construction with the metal parts made of non-magnetic materials to reduce heating due to induced heavy load and short circuit conditions. Sharp corners shall be avoided on the outer surface of the wave traps to minimise corona losses. Insulating material used shall be un-affected by the moisture. Suitable barrier shall be provided to prevent the entry of birds into the device. Suitable surge arrester shall be provided in the wave traps for protection. A set of clamps for wave trap of each rating shall be supplied along with the wave trap and prices offered for wave trap should take into account the cost of set of clamps. The clamps should be suitable for horizontal as well as vertical take off. It is essential that the design of clamps should be submitted for our approval. Any modification in the design shall have to be carried out without any extra cost. Thus the clamps shall be manufactured finally as per design and drawing duly approved by us.

6.3 The design of wave traps should be robust and maintenance-free without any need to tighten the coils to maintain inter-form spacing. The design

should ensure very high short circuit strength and mechanical strength. The performance of wave traps shall not get affected in the long run even if the same are utilised in polluted atmosphere. All terminal bolts and fasteners used shall be of HDG mild steel to avoid any risk of corrosion. The installation should not be very heavy in weight. The mounting arrangement i.e. suspension eye bolt shall be provided centrally at the top as well as at the bottom of the wave trap.

6.4 The bidders are requested to mention blocking bands of wave traps at suitable place on the outside of the wave traps in bold letters by paint, so that after its installation on gantry, the frequency band can be read out from ground. The paint should be such that it should not fade at a later stage. In order to avoid the risk to affect the performance in polluted atmosphere and also to ensure high electrical and mechanical strength, it may be noted that we will prefer wave traps of completely encapsulated design, where the equipment is fully encapsulated in epoxy impregnated fiber glass material. Any other design, which may offer equal or better performance, would also be acceptable.

7.0 GUARANTEED TECHNICAL PARTICULARS FOR 400 KV, 220 KV & 132 KV WAVE TRAPS :

Guaranteed technical particulars for 400 KV, 220 KV & 132KV Wave Traps called for shall be furnished along with the bid. Particulars which are subject to guarantee shall be marked clearly. Any other particulars considered essential may please also be furnished.

8.0 TESTS :

8.1 Type Test :

All the equipment offered, shall be fully type tested as per relevant Indian Standards or any Equivalent International Standard. In case the equipment of the type and design offered, has already been type tested, Bidder shall invariably furnish type test reports from the reputed and approved national/international laboratory/ Government approved test houses to prove that specifications of equipments offered conform to the relevant standard. Test certificates shall clearly indicate the type and model number etc., so that relevant details of offered equipments could be verified. While submitting bids the model and type etc., shall be clearly indicated. Type test reports so furnished should not pertain to the period earlier than five years from the date of opening of Bid. In case the type tests were carried out earlier than five years, the manufacturer will have to conduct these tests before commencement of supply. For any change in the design/type already type tested and the design/type offered against this bid, the Purchaser reserves the right to demand repetition of same or all type tests without any extra cost.

8.2 Acceptance And Routine Tests :

8.2.1 The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards or equivalent International Standards in presence of Purchaser's representative.

8.2.2 Immediately after finalization of the programme of type/ acceptance/ routine testing, the manufacturer shall give advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

9.0 INSPECTION :

- i. The Purchaser shall have access at all times to the works and all other places of manufacture, where the 400KV, 220KV & 132 KV Wave Traps Voltage are being manufactured and the Bidder shall provide all facilities for unrestricted inspection of the Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein. Purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. Supplier shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembled Wave Traps.
- ii. The successful Bidder shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of equipment of the 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. Successful Bidder shall within 30 days of placement of order, submit list of bought out accessories and the names of sub-suppliers.
- iv. The acceptance of any quantity of the equipment shall in no way relieve the successful bidder 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.
- v. In case for any reasons inspection is not completed or equipment is not found to be complete with all accessories as per confirmation given with the letter of inspection call, purchaser will reserve the right to recover the complete cost of deputation of inspecting team to the works of the manufacturer.

10.0 QUALITY ASSURANCE PLAN :

10.1 The Bidder must establish that they are following a proper quality assurance programme for manufacture of 400KV, 220 KV & 132 KV Wave Traps. The Bidder shall invariably furnish following information along with his offer. Information shall be separately given for individual type of equipment offered.

- ii) Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of Bidder's representative and copies of test certificates.
- iii) Information and copies of test certificates as mentioned in (i) above in respect of bought out items.

- iv) List of manufacturing facilities available.
- v) Levels of automation achieved and list of areas where manual processing exists.
- vi) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.
- vii) Special features provided in the equipment to make it maintenance free.
- viii) List of testing equipment available with the Bidder for final testing of equipment specified and test plant limitations, if any, vis-à-vis type test, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

10.2 The successful Bidder shall submit following information to the Purchaser.

- i) List of raw materials as well as bought out accessories and the names of sub supplier selected from the lists furnished along with offer.
- ii) Type test certificate of the raw material and bought out accessories.
- iii) Quality Assurance Plan (QAP) with hold points by Purchaser's inspection. The quality assurance plans and hold points shall be discussed between the Purchaser and Bidder before the QAP is finalized.

10.3 The successful Bidder shall submit the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

11.0 DOCUMENTATION :

11.1 All drawings shall conform to the latest version of International Standards Organization (ISO) 'A' series of drawing sheet/Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for micro testing. All dimensions and data shall be in SI Units.

12.0 LIST OF DRAWINGS AND DOCUMENTS:

- 12.1** The Bidder shall furnish four sets of following drawings along with his offer.
- a) General outline and assembly drawings of the equipment showing front & side elevation and plan views and all accessories, external features with detailed dimensions, net & shipping weights, size of lifting lugs, quantity of insulating oil .
 - b) Sectional views showing General Constructional Features, Pedestal mounting (for 400KV WT) lifting lugs, connectors, mounting details (in case of 400KV Wave Trap) etc.
 - c) Name plate drawing with terminal markings & connection diagram.
 - d) Schematic drawing.

- e) Dimensional drawing of terminal clamps and connectors showing material composition, permissible temperature rise, current carrying capability etc.
- f) Type Test reports
- g) Test reports, literature, pamphlets of the bought out items.

12.2 The successful Bidder shall within two weeks from signing of contract, submit four sets of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/approval on the drawings to the Bidder within reasonable time. The Bidder 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 Purchaser's comments. After receipt of Purchaser's approval, the Bidder shall within three weeks submit 20 prints and two good quality reproducible (Soft copy) of the approved drawings for Purchaser's use.

12.3 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 Bidder's risk.

12.4 The bidder shall submit nicely printed and bound volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment supplied for distribution, along with the equipments. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. The manual shall also contain a set of all the approved drawings and type test reports etc.

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

13.0 ENGRAVING, PACKING AND FORWARDING :

13.1 The details such as order no. and date, year of manufacture and "MPPTCL" should be engraved on each and every equipment. 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 Bidder shall be responsible for any damage during transit, due to improper and inadequate packing and handling. 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. Bidder shall supply, any material, found short inside the packing cases without any extra cost.

13.2 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.

13.3 The Bidder shall ensure that the packing list and bill of material is approved by the Purchaser before despatch.

14.0 SCHEDULE

Schedules, questionnaire and annexure attached with this specification are the integral part of the specification and shall be submitted duly filled in by the Bidders alongwith the offer. Bill of material for each equipment shall be submitted by the bidder separately. Makes of the equipment shall be clearly indicated. Bidders may please note that a general mention that the components shall be of reputed make will not be acceptable.

15.0 COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS

15.1 Bid shall be complete in all respects and shall include all minor component, accessories, small wiring etc., not specifically mentioned in the Schedule, specifications etc; but essential for the completeness of the system. Bidders shall not be eligible for extra charges in respect of such minor components, accessories, small wiring etc., though not included specifically in this specification but requires for satisfactory operation of equipment offered.

15.2 Bidders must furnish following information along with technical Bid.

15.2.1 Complete details of all the accessories which will be supplied

15.2.2 It is obligatory on the part of bidders to ensure that supply of all accessories along with Main equipment are simultaneously delivered to avoid any holdups. Responsibility for obtaining timely supplies of bought out items will rest on the bidders and only on this basis, delivery period will be offered in the Bid.

15.2.3 It may be noted that in case of damages/shortages due to improper packing or any other negligence ,replenishment shall be arranged within one months time. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and also in case defective supply of any item is reported, will rest on the bidders.

16.0 GUARANTEE FOR SUPPLY OF SPARES FOR 10 YEARS OPERATION:

As specified in the bid document, the bidder has to furnish an undertaking that the spares required for satisfactory operation of offered goods shall be made available at reasonable cost over a minimum period of 10 years from the date of

commissioning of goods in purchaser's system. In the absence of such an undertaking, the offer will be treated as non-responsive.

17.0 Please ensure the Bid document containing number of pages has been properly page numbered and signed by the bidder. All Bid documents including Schedules and Annexure should be indexed properly and index of the document should be enclosed/placed at the beginning of the document.

APPENDIX-A(I)**PRINCIPAL PARAMETERS FOR 400 KV WAVE TRAP**

SNo	Particulars	For 400KV
1	Rated Continuous current	2000 Amps
2	Nominal system voltage	400KV
3	Maximum continuous operating voltage	420KV
4	System frequency	50Hz (+/- 2%)
5	Design ambient temperature	50 ⁰ C
6	Rated short circuit current (1Second)	40 KA r.m.s.
7	Nominal discharge current of the station class protective device	10KA
8	Type of tuning	Broad band
9	Rated blocking band frequency or specific band width in the range	50 KHz to 500 KHz
10	Minimum resistive component of impedance within the blocking band	450 Ohms
11	Rated inductance of main coil	1.0 mH
12	Resistive component of impedance within its carrier frequency blocking range shall not be less than	570 Ohms
13	Change in impedance due to ambient temperature variation not to exceed.	0.3% Per ⁰ C

APPENDIX-A(II)**PRINCIPAL PARAMETERS FOR 220 KV WAVE TRAP**

Sl. No	Particulars	For 220KV
1.	Nominal system voltage	220 KV
2.	Maximum voltage of the line on which the traps are to be used.	245 KV
3.	System frequency	50Hz
4.	Design ambient temperature	50 ⁰ C
5.	Nominal discharge current of the station class protective device	10KA
6.	Type of tuning	Broad band
7	Minimum resistive component of impedance within the blocking band	450 Ohms
8	Resistive component of impedance within its carrier frequency the blocking range shall not be less than	570 Ohms
9	Continuous current rating	1250Amps
10	Instantaneous symmetrical short circuit current capacity.	40KA(1Sec)
11	Tuning range	90-150 Hz & 150-500 KHz
12	Change in resonant frequency due to ambient temperature variation not to exceed.	0.01% Per ⁰ C
13	Change in impedance due to ambient temperature variation not to exceed.	0.3% Per ⁰ C

APPENDIX-A(III)**PRINCIPAL PARAMETERS FOR 132 KV WAVE TRAP**

Sl. No	Particulars	For 132 KV
1.	Nominal system voltage	132 KV
2.	Maximum voltage of the line on which the traps are to be used.	145 KV
3.	System frequency	50Hz
4.	Design ambient temperature	50 ⁰ C
5.	Nominal discharge current of the station class protective device	10KA
6.	Type of tuning	Broad band
7	Minimum resistive component of impedance within the blocking band	450 Ohms
8	Resistive component of impedance within its carrier frequency the blocking range shall not be less than	570 Ohms
9	Continuous current rating	630 Amps
10	Instantaneous symmetrical short circuit current capacity.	20 KA (1Sec)
11	Tuning range	90-150 Hz & 150- 500 KHz
12	Change in resonant frequency due to ambient temperature variation not to exceed.	0.01% Per ⁰ C
13	Change in impedance due to ambient temperature variation not to exceed.	0.3% Per ⁰ C

SCHEDULE-I(A)**DESCRIPTION OF EQUIPMENT FOR SCHEDULE FOR RATES AND PRICES
TO BE FURNISHED IN VOLUME-VI**

SNo	Particulars of equipment/item	Qty.
A	400 KV WAVE TRAP 400KV, 2000A, 1.0 mH Wave Trap with auxiliary Pedestals mounting, insulators, support structure, associated hardwares & accessories, main coil Suitable Tuning Pot along with Strapping for Different Blocking Bands, Protective Device, Bird Barrier, Corona rings, and Set of Clamps and Connectors etc. meeting all technical requirement of the specification.	As per Price Schedule
B	220KV WAVE TRAP 220 KV, 1250 Ampere, 0.5 mH Wave Trap with suspension type of mounting accessories, main coil with Suitable Tuning Pot along with Strapping for Different Blocking Bands, Protective Device, Bird Barrier and Set of Clamps and Connectors etc. meeting all technical requirement of the specification .	
C	132 KV WAVE TRAP 132KV, 630 Ampere, 0.5 Millihenry Wave Trap with suspension type of mounting accessories, main coil with Suitable Tuning Pot along with Strapping for Different Blocking Bands, Protective Device, Bird Barrier and Set of Clamps and Connectors etc. meeting all technical requirements of the specification .	

- Note : 1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.**
- 2. The quantity of above equipments has been mentioned in Volume VI**

SECTION-II

2.2.3 TECHNICAL SPECIFICATION FOR POWER LINE CARRIER COMMUNICATION EQUIPMENTS i.e CARRIER CABINET, PROTECTION COUPLER & COUPLING DEVICE

1.0 SCOPE :

The scope of this bid covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipments/materials of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS :

2.1 Applicable Standards for the offered equipments /items shall be as per Section-I, Volume-II.

2.2 If the equipment offered by the Bidders conforms to any other standards, salient points of comparison between the standards adopted and the specific standards shall be clearly brought out in relevant schedule of technical deviation. It will be sole responsibility of Bidders to prove that the salient features of offered equipment are equivalent or better than IS.

2.3 ACCEPTANCE OF OTHER AUTHORITATIVE STANDARDS :

In the preceding paragraph relevant Indian standard / IEC standard bid have been shown. However, the equipment meeting any other authoritative international standard, which ensures equal or better quality than the standards, mentioned shall also be acceptable. Equipment for which Indian Standards are not available, the relevant British standards and IEC recommendations will be applicable. Please attach photocopy of all such standards according to which the equipment has been offered.

3.0 CLIMATIC CONDITIONS :

3.1 Applicable climatic conditions shall be as per Section-I, Volume-II.

3.2 AUXILIARY POWER SUPPLY :

Auxiliary Power Supply for offered EHV equipments shall be as per Section-I Volume-II.

4. DISCREPANCY IN TECHNICAL PARTICULARS :

Regarding discrepancy in technical particulars stipulation under Section-I Volume-II shall be applicable.

5.0 TECHNICAL SPECIFICATION FOR CARRIER CABINETS:

5.1 BASIC DESIGN :

Carrier cabinets shall be multipurpose PLCC terminals suitable for transmission of speech & Superimposed VFT channels for teleindication, telecontrol, teleprinting, tele-metering purposes etc. and for teleprotection purpose over power transmission lines. The PLCC offered shall be IC version, fixed frequency, single channel PLCC terminals working on SSB modulation principle.

Carrier cabinets shall be of latest technology, highly reliable and must have been type tested. Carrier cabinets shall render following services -

- i Telephone communication between the stations.
- ii Carrier links protective relaying.
- iii VFT facilities such as telemetering services, Telecontrol, telex/fax.
- iv Express channel.

While at present it is proposed to provide the carrier link with protection on some links, the equipments to be supplied and installed shall be such that the same can be inserted in the cabinet afterwards if required, without carrying out any modifications in the equipments. The supplier should provide in PLCC cabinet, sharp cut off filter for limiting the speech frequencies transmitted. Hence the Bidders shall clearly mention in his proposal for future development and the extent to which such additional facilities can be added at a later date. This is essential and the Bidder must clearly explain the same.

5.1.1 COMMUNICATION SYSTEM :

Bidders may offer power line carrier equipment according to their standard practice to fulfill the requirement of the specification. The equipment shall be manufactured according to frequency to be indicated by us. Each of the station of the carrier telephony system must be able to transmit and receive simultaneously during conversation, to enable calls in duplex principle.

5.1.2 Bidders may please note that it is mandatory requirement that carrier cabinet of both ends of transmission line shall be identical. In case of Line in Line out (LILO) lines, for matching of carrier cabinet at both ends of transmission lines bidder may offer same type of carrier cabinet as already provided at other end of lines. If in any case bidder offers different type of carrier cabinet than matching of carrier cabinet can be arranged by interchanging of carrier of other end and in this case the commissioning of carrier cabinet (both ends) shall be arranged by bidder without any extra cost to MPPTCL.

5.1.2 FREQUENCIES TO BE ADOPTED :

Frequencies to be employed may be confined to the band 40-500 KHz.

5.2 CARRIER FREQUENCY TRANSMITTER RECEIVER CABINET :

5.2.1 Carrier cabinets shall be made from 14/16 SWG sheet steel. It will be designed for efficient cooling with a cooling fan at the top inside the cabinet. The cabinet shall be suitable for floor mounting type with adequate arrangement for ventilation and provision to avoid dust getting in and to avoid any adverse effects from moisture during rainy season. The cabinet shall be finished with paints coated inside and outside according to standard painting procedure. It shall be Aircraft Grey as per colour shade No. 693 of IS:5 or equivalent BS-381 or matching colour and shade of other authoritative equivalent standard is also acceptable. Colour finish shall be applied as per above colour scheme on the exterior steel works of the cabinet. Exterior shall not be fully glossy. Interior of the cabinet shall be painted with "Egg Shell White". The height of the cabinet shall not be more than 2 meter. Bidder shall match the colour and height of the cabinet as specified. Normally the cable entry shall be from bottom. However, suitable provision shall be made for cable entry from top, which shall be covered by blanking plate at the time of supply.

5.2.2 All individual parts of the equipment shall be accessible from the front to permit testing and repair. The front shall have hinged doors equipped with handles and locks. Necessary testing and indicating devices shall be provided on the front panel to enable checking of important functions and circuits. The whole circuit shall be mounted on one panel, which is hinged at top and bottom of cabinet. This will facilitate approach to back side of the circuit. The cubicle shall be provided with foundation rail and holes for fixing the same on foundation.

5.2.3 10 mm Red LED & Green LED shall be provided on the top of the panel for visual and alarm indications to announce failure of power supply, absence of carrier signal for both receiver and transmitter etc. The audio alarm would be provided for this purpose, which should be audible from 8 meters distance. Three way HF co-axial clamp with terminal shall be provided inside the cubicle at rear side. A suitable Lightning Arrestor should be provided between HF main & earth terminals. One 8 way electrical connector, a three-pin plug with fuse shall be provided for 230V AC, 50 Hz. supply. 24 Nos disconnectable type terminals should be fitted in cabinet for inter connection with Distance Protection Relay. The cubicle shall be fully wired.

5.2.4 Equipment shall operate through 48 V DC supply with voltage variation from + 20% to - 10% and maximum ripple of 2%. The carrier power supply module shall be provided with a circuit breaker, which shall automatically trip due to over voltage to carrier equipment and / or over modulation. The miniature circuit breaker shall be provided in front of power supply module so that it is easily accessible. This miniature circuit breaker shall be provided with a facility to switch on and to switch off the same mechanically by hand, by pressing and releasing a push button switch. A fuse shall also be provided in series of this miniature circuit breaker, which shall operate in case of failure of the miniature circuit breaker.

5.2.5 Carrier cabinets shall be suitable for operation with private automatic exchange. In addition, two telephone sets shall be provided with each carrier set (one Jack telephone and one four wire telephone), for testing purposes and for carrying out emergency conversion without the help of the associated automatic exchange. It should have also facility to connect 2 wire telephone. Built in indicating meter and oscillator shall be provided on the panel with a selector switch to indicate voltage & current value and all-important signal levels (DC, VF, IF & HF). A built in "PLC

EQUALIZER” shall be provided to overcome effect of amplitude distortion due to mismatch etc. A supervision module with necessary circuitry shall be provided to monitor Transmitter, Receiver and Power Supply. The carrier set shall be provided with relay for blocking all other signals when the tripping signal is being transmitted to give more power for the transmission of the tripping signal.

5.2.6 Interfacing data modules should be supplied along with each Carrier Cabinet. The Bidders shall clearly confirm that prices for these interfacing modules are included in the offered price of Carrier Cabinet. It shall be possible to test the equipment locally by a dummy load. It is preferable that equipment is provided with facility to test transmitter and receiver locally by connecting them back-to-back. Built-in AGC Test for HF level variation of +14 dB/- 45 dB may be necessary. The local testing facility provided shall be described in detail by all the Bidders.

5.2.7 All the test points with standard values, indications etc. shall be provided in front of the cabinet and shall be easily accessible. The equipment shall be suitable for co-axial impedance of 75/125 ohm unbalanced or 150 ohm balanced. This should be programmable. Carrier Terminal shall be provided with 4 wire and jack telephone and 125-ohm load in loose. The equipment shall be provided with a nameplate indicating make, serial no., order no. with date, Transmit & Receive frequency and Station Direction.

5.2.8 Carrier cabinets offered shall have compandors as a built-in feature. If required the purchaser shall have the facility of disabling the same. The offered PLCC terminals shall be provided with the following built in features:

1. HF hybrid so that adjacent channel working is possible.
2. Necessary transit band pass filter for transit interconnection of teleoperation channels.
3. It should have remote subscriber facility to extend the subscriber of an EPAX to a remote end through PLCC.

5.2.9 PLC terminals shall be fully coordinated to match the existing equipment. Because of strict requirements of high speed of operation, security, reliability and efficient operation of protection channel along with the carrier terminal, Bidders shall ensure complete coordination between the PLC and protection equipment as specified in Clause 6. It shall therefore be necessary to have a provision of mounting the protection coupler in the same rack of PLC terminal without any mismatch or necessity of any wiring or any intermediate coordination unit. The PLC terminal shall use amplitude modulation with suppressed carrier, single side band, multipurpose, 4KHz and shall be site programmable for Audio frequency, Carrier Frequency, Pilot Frequency and the transit band pass filters. Please furnish ranges. The equipment shall be suitable for duplex working and shall use the latest technology using Digital Signal Processor. Further, the PLCC equipments shall employ the latest SMT technology.

5.2.10 Protection coupler to be supplied can be mounted in the same PLCC cabinet and necessary wiring should of standard type. In future, if any VFT is to be procured by the purchaser, the same could be mounted in the same carrier cabinet with standard wiring. PLCC terminal shall conform to the latest IEC 495. Carrier cabinets shall

conform to the voltage withstand and electromagnetic compatibility test as per the latest IEC standards.

Each PLCC channel shall be suitable for the following:

- a. Nominal bandwidth shall be 300 - 3600 Hz and shall be suitable for transmission of facsimile messages at 2400 baud.
- b. One speech channel 300 - 2000 Hz plus a band of 2160 -3600 Hz for the transmission of data. Data signaling rates of 50, 200,300,600,1200 baud shall be possible. The speech band and data band should be programmable either for speech or data over entire 4KHz bandwidth.
- c. Three 600-baud channels or one 2400-baud channel for full band of 300-3600 Hz.
- d. Protection couplers shall be based on frequency shift or coded signal principle for transmission / reception of protection signals. This has been described in detail in subsequent clauses.

5.2.11 PLC equipment may be required to be expanded by addition of channels to a link (i.e. upgrade to 2 or 4 channels as appropriate). The PLC equipment shall be modular in construction and shall permit such upgrading to be carried out even at a later date. The Bidder shall describe how the single channel equipment will be upgraded to more channels. The PLC terminal shall use multiple modulation/demodulation techniques (preferably 3 stage modulation) so as to have better selectivity and overall frequency response. The equipment shall be suitable for use with E&M signaling between telephone exchanges at both the ends of the line. Signaling shall be done by shifting the pilot frequency so that a separate band for signaling is not required. The output power of PLC equipment at coaxial terminal shall be 40 watts which can be adjusted if required at site to 20 watts. PLC equipment shall be designed to operate over a frequency band of 40 to 500 KHz. The spacing between transmitter and receiver shall be as follows for single channel as well as twin channel operation:

- i. Transmitter to adjacent transmitter \geq 8KHz
- ii. Transmitter to its own receiver \geq 4KHz

5.2.12 The return loss within the nominal carrier frequency band in the transmit direction shall not be less than 2dB. The maximum permissible level of spurious emission shall meet the requirements of IEC- 495. The generation of carrier frequencies shall be fully synthesized. It shall be possible to select any carrier frequency at site within the whole carrier frequency range in discrete steps of 4KHz. Carrier frequency stability shall be $\pm 10 \times 10^{-6}$ (5Hz). Further, there should be a synchronization between transmitter and receiver. Bidder shall describe how the synchronization is achieved between the PLC terminals.

5.2.13 Preferably the Krone type terminal strip in addition to conventional terminal strips should be provided for inter connection along with krone tool so as to have firm / tight connection.

5.3 Transmitter:

5.3.1 The transmitter shall have 2 wire/4wire interface. The nominal level of 2 wires shall be 0 dBr across 600 Ohms balanced impedance. The input level range shall be adjustable from -16dBr to -6dBr. Nominal input level for 4wire should be -3.5dBr across 600 Ohms balanced impedance. The input level range shall be adjustable from -20dBr to 10dBr. The AF band shall have the programming facility so that it can be programmed at site for any of the following bands:

- 300-2000 Hz
- 300-2200 Hz
- 300-2400 Hz
- 300-3400 Hz

The data band shall be adjusted accordingly for the following bands:

- 2160-3600 Hz
- 2400-3600 Hz
- 2640-3600 Hz

5.3.2 Care should be taken to use components used in the power amplifiers of adequate capacity.

5.4 RECEIVER:

5.4.1 The receiver shall have 2-wire/ 4-wire interfaces. The nominal output level for 2 wires should be -7dBr across 600 Ohms balanced. It shall be possible to adjust this level from -16dBr to +6dBr. The nominal output level for 4 wire shall be -3.5dBr across 600 Ohms balanced and shall be adjustable from -20dBr to + 10dBr.

5.4.2 The near and far end cross talk should be ≤ -50 dBm Op. The group delay distortion shall conform to IEC- 495. The compander shall be a built in function and shall have the characteristics as per ITU-T. Automatic gain control shall be provided so that AF output should remain constant within + 0.5 dB for a +14/-45dB variation in the RF input level. The local loop test facility shall be provided so that the equipment can be tested locally. The remote loop test facility shall be provided so that equalization can be done at site from one end by looping back the signal at the other end without the need of an engineer at the other end.

5.5 SUPERVISION AND ALARM:

5.5.1 The supervision facility shall be provided for supervising the PLC terminal so that it can automatically check the functioning of the PLC terminal and in case of any failure of module or any other condition affecting the correct operation of

individual components shall be displayed on the front panel with suitable error code. Alarm shall be given under following conditions:

- loss of transmitter signal
- loss of receiver signal
- high SNR in speech and telecontrol channels
- loss of auxiliary supply
- excessive impulse interference

A green LED to show healthy ness of 48V DC supply should be provided next to Alarm LED.

5.6 GENERAL REQUIRMENTS:

5.6.1 All cabinets having PLC terminal shall be provided with lamps of sufficient wattage for interior illumination with switch. The PLC terminal shall be suitable for remote subscriber application. The PLC terminal should have in built test meter for carrying out tests at site. It should have a facility to generate at least two tones of different frequency apart from 1 KHz tone.

5.6.2 The power supply of the offered PLCC carrier set shall be based on SMPS technique which ensures that in the event of a short circuit the power supply is switched off and hence there will be no damage to power supply circuit. It should also have over voltage protection.

5.6.3 For ease of maintenance, power amplifier unit should be supplied in one card. This unit should not be combined with filter & RF hybrid. In case of failure of power amplifier the same could be replaced by new one without disturbing filter and RF hybrid.

5.6.4 Specific confirmation regarding supply of following accessories with each Carrier Cabinet may please be positively indicated.

- i. Compander & expander print.
- ii. Test Meter Print.
- iii. Jack telephone hand set.
- iv. Transit band pass filter.
- v. 4 wire & 2 wire table telephone set with push button.
- vi. Dummy load with switch, so that, we can connect coaxial cable to carrier cabinet, or a dummy load representing the line to the cabinet. The switch provided for switching Dummy load / line should be of very good quality as it is being facility very frequency.
- vii. Print puller
- viii. Suitable lock with key for carrier cabinet
- ix. Exhaust fan
- x. A frequency tone generator of 1KHz and two tone generator of different frequency for measurement of various level of voice and

data signal and also for sending the calling signal at the other end. Therefore, above arrangement or any other equivalent arrangement for this facility during testing will be accepted.

5.6.5 Under clause 5.6.4, the essential accessories for carrier cabinet has been listed. However, it is desired and it would be obligatory on the part of the Bidder to include any such accessory also (i.e. over & above listed under clause 5.6.4) which may be necessary for proper and trouble free functioning of the carrier cabinet. Details of such additional accessory, if any, may be furnished. It may be noted that no additional cost shall be permitted for such additional accessory required for proper functioning of equipment. In nut shell cost of all such accessories described above should be included in the price of main equipment and this price only shall be mentioned in formats of price Schedule available at Section-II

6.0 TECHNICAL SPECIFICATION FOR PROTECTION COUPLERS:

6.1 BASIC DESIGN:

6.1.1 Bidders shall offer voice frequency transmission equipment which shall work on frequency shift or coded signal principle for transmission /reception of protection signals.

6.1.2 Bidders shall take cognizance of our following requirement;

- (i) The equipment shall be immune to a field strength of 10V/m expected to be caused by portable radio transmitters in the range of 20-1000 MHz.
- (ii) The voice frequency transmission equipment shall not only be insensitive to corona noise but shall also remain unaffected by impulse type of noise generated by electrical discharge and by opening and closing of circuit breakers, isolators & earth switches etc. In their offers,, bidders shall clearly explain as to what measures have been taken to make the equipment insensitive to corona noise, white noise and to impulse noise of an amplitude *larger than* the wanted signal and submit full field test and laboratory test reports. The guarantee on design data shall not be acceptable.
- (iii) Equipment shall be unaffected by spurious tripping signals. Bidders shall substantiate their claim.
- (iv) Offered Protection Couplers shall be suitable for transmission / reception of minimum four protection signals.
- (v) Overall PLC, VFT and transmission path for permissible trip / block shall be one cycle or 20 ms or less and for direct tripping, it shall be 30ms or less.

6.1.3 Protection couplers are to be used together with the PLC equipment, as such it shall comprise of modules which are directly plugged into reserved slots of PLC terminal so as to avoid any wiring / mismatch between PLC terminal and protection coupler. In a nutshell, the Protection Coupler shall be housed in PLC Cabinet and will not be acceptable in a separate cabinet. Protection couplers shall be suitable for at least one command for each of permissive tripping, blocking as well as direct trip signals.

6.1.4 Protection couplers shall be designed in accordance with IEC 834-1 and shall be complete with test and inter connection unit and counters. The offered couplers shall be suitable for transmission of four commands to take care of protection of double circuit lines and shall also be suitable for transmission/reception of four commands. The offered couplers may ensure very high reliability during fault conditions and shall not tend to operate due to spurious signals which may generate in electrical system. Loop testing facility shall be provided in each AF coupler. Bidders must explain the design with complete details and should justify reliability of their equipments.

6.1.5 The trip signal frequency should fall within the teleprotection band without any necessity of separate band for protection commands. Whenever the protection coupler receives the command, it shall disconnect the speech. This interruption will continue for a short period of the teleprotection command after which the normal operation of the carrier equipment will be restored. During transmission of teleprotection signals or when a fault has been detected by the protective relays the entire output power of the carrier set will be made available for transmission of teleprotection signals.

6.1.6 Protection couplers designed using logic circuitry to provide total transmission time for teleprotection signals shall not exceed 20 ms for permissive trip and 30 ms for direct trip. Protection coupler designed using logic circuitry to provide Transmission time of less than 20 ms for both direct and permissive trips is also acceptable. The protection coupler shall use microprocessor techniques with digital signal processing to meet the stringent requirements for command transmission over PLC links even under adverse channel conditions. Digital counters shall be provided for counting of transmitted and received commands. For each code, 6 No disconnectable type terminals may be fitted in cabinet for inter connection with Distance Protection Relay.

6.2 TEST FACILITIES:

Protection couplers shall be constructed such that operational reliability of protection channels may be checked over the carrier link by means of local and remote loop test. It shall be possible to carry out the above test from either end of the carrier link. During healthy condition of the transmission line the loop test shall not initiate a tripping command. In the event of a system fault, while loop test is in progress, protection signal shall over ride the test signal. While the loop test is in progress no false tripping command shall be generated. The remote loop test shall be initiated either automatically after a particular time interval or manually by means of test buttons.

7.0 TECHNICAL SPECIFICATION FOR COUPLING DEVICES :

7.1 BASIC DESIGN:

7.1.1 Coupling devices shall be housed in a weather proof non corrosive box and should be suitable for outdoor mounting on the pedestal support of coupling capacitor / CVT. Offered coupling devices should be suitable for phase to phase coupling arrangements. Coupling devices shall be interposed between the coupling capacitor/CVT and coaxial line to the PLC terminal. Coupling devices in conjunction

with the coupling capacitor/CVT shall ensure efficient transmission of carrier frequency signals between the carrier frequency connection and power line. In addition safety of personnel and protection of low voltage parts and installation, against the effects of power frequency voltage and transient over voltage shall be ensured. The complete coupling devices suitable for phase to phase coupling should be housed in two weather proof boxes. One box should contain high pass filter module, a drain coil, a surge arrester and an external earth switch. The other box should contain high pass filter module with balancing / hybrid transformer, a drain coil, surge arrester and a external earth switch. Apart from above an additional separate earth switch suitable for mounting on pedestal shall be supplied with each box of coupling device.

7.1.2 Coupling device shall be compact and modular in nature. In our system we have coupling capacitor/CVT of different capacitance value. Coupling devices offered should be site programmable type so that it is suitable for operation with coupling capacitor / CVT of different capacitance value without carrying out any modification at site and without any cost implications. This may please be confirmed.

7.1.3 Coupling devices shall comply with the latest issue of IS & IEC. Coupling device including the drainage coil, surge arrester and earthing switch shall conform to type tests and shall be subjected to routine tests as per latest IS & IEC. Bidders shall furnish along with his offer copies of all type and routine tests conducted earlier on similar coupling device in accordance with relevant standards.

7.1.4 Coupling devices in conjunction with coupling capacitor / CVT shall form an electronic filter of high pass type and shall have following features:-

- a. It shall match characteristic impedance of 132/220/400KV HT line to impedance of the carrier frequency connection (i.e. coaxial cable).
- b. It shall be possible to change coaxial cable side impedance simply by changing the straps at site. It should be suitable for 125ohm unbalanced, 75ohms unbalanced or 150ohm balanced as per site requirement.
- c. It shall be possible to tune coupling device by changing strapings at site to use with any coupling capacitor having different values.
- d. It shall be possible to use it as phase to ground device and phase to phase device with balancing /hybrid transformers.
- e. Power frequency currents derived by the CVT may be drained to the earth by drain coil of suitable rating.
- f. Voltage surges coming from the power line at the terminals of the coupling device shall be limited by a non-linear surge arrester of suitable rating in the primary side. The surge arrester of very good quality should be used and offer with good quality surge arrester shall be preferred. The details of surge arrester giving constructional features, design etc. shall be furnished.

- g. For direct and efficient earthing of its primary terminals, the coupling device shall be equipped with an earthing switch. The coupling device shall be designed such that it shall not be possible to remove the cover before the earthing switch is operated to the earthed position. Further, an additional earth switch shall be available for earthing of CVT-HT terminals, when the coupling filter units are removed from circuit for maintenance / replacement. The design shall take due regard of requirements for safety in accordance with the Indian Electricity Rules.

7.1.5 Two numbers phase to earth type coupling filters shall be used to achieve in, secure phase to phase coupling. Connection between secondary of the two phase to earth type coupling device shall be through a balancing/hybrid transformer such that reliable communication shall be ensured even when one of the coupled phase is earthed or open circuited on the line side.

7.1.6 Coupling device shall conform to latest IS/IEC-481 and shall have the following carrier frequency characteristics.

a.	Nominal line side Impedance	Characteristic impedance of 400/220/132KV line.
b.	Nominal equipment side Impedance	125/75 Ohms (unbalanced) or 150 Ohm balanced
c.	Composite loss	Not more than 2 dB
d.	Return Loss	Not less than 12 dB
e.	Bandwidth	Shall suit the frequency plan
f.	Nominal peak envelope power (For inter- modulation product 80 dB down)	Not less than 650Watt

7.1.7 Coupling devices shall withstand an insulation voltage of 10KV RMS 50Hz for one minute and impulse withstand voltage (1.2/50 micro secs) of 10KV Peak.

7.1.8 All the elements of coupling devices shall be housed in a weather proof non corrosive box. The general arrangement, weight and dimensional details of box shall be furnished. Bidders shall submit detailed drawing indicating general arrangement, interconnection and all other details for approval.

7.1.9 Coupling device shall have at least two terminals for carrier equipment connection. Bidder shall confirm that such a parallel connection to coupling device directly will not result in any additional attenuation.

8.0 TESTS:

8.1 TYPE TEST:

All the equipment offered, shall be fully type tested as per relevant Indian Standards or any Equivalent International Standard. In case the equipment of the type and design offered, has already been type tested, Bidder shall invariably furnish type test reports from the reputed and approved national/international laboratory/

Government approved test houses to prove that specifications of equipments offered conform to the relevant standard. Test certificates shall clearly indicate the type and model number etc., so that relevant details of offered equipments could be verified. While submitting bids the model and type etc., shall be clearly indicated. Type test reports so furnished should not pertain to the period earlier than five years from the date of opening of Bid. In case the type tests were carried out earlier than five years, the manufacturer will have to conduct these tests before commencement of supply. For any change in the design/type already type tested and the design/type offered against this bid, the Purchaser reserves the right to demand repetition of same or all type tests without any extra cost.

8.2 ACCEPTANCE AND ROUTINE TESTS:

9.2.1 The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards or Equivalent International Standards in presence of Purchaser's representative.

8.2.2 Immediately after finalization of the program of type/ acceptance/routine testing, the manufacturer shall give advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

9.0 INSPECTION :

- i. The Purchaser shall have access at all times to the works and all other places of manufacture, where the Carrier Cabinet with Protection Coupler are being manufactured and the Bidder shall provide all facilities for unrestricted inspection of the Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein. Purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. Supplier shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembled Wave Traps.
- ii. The successful Bidder shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of equipment of the 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. Successful Bidder shall within 30 days of placement of order, submit list of bought out accessories and the names of sub-suppliers.
- iv. The acceptance of any quantity of the equipment shall in no way relieve the successful bidder 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.
- v. In case for any reasons inspection is not completed or equipment is not found to be complete with all accessories as per confirmation given with the letter of inspection call, purchaser will reserve the right to recover the

complete cost of deputation of inspecting team to the works of the manufacturer.

10.0 QUALITY ASSURANCE PLAN :

10.1 The Bidder must establish that they are following a proper quality assurance programme for manufacture of Carrier Cabinet, Protection Coupler & LMU. The Bidder shall invariably furnish following information along with his offer. Information shall be separately given for individual type of equipment offered.

- i) Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of Bidder's representative and copies of test certificates.
- ii) Information and copies of test certificates as mentioned in (i) above in respect of bought out items.
- iii) List of manufacturing facilities available.
- iv) Levels 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 equipment available with the Bidder for final testing of equipment specified and test plant limitations, if any, vis-à-vis type test, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

10.2 The successful Bidder shall submit following information to the Purchaser.

- i) List of raw materials as well as bought out accessories and the names of sub supplier selected from the lists furnished along with offer.
- ii) Type test certificate of the raw material and bought out accessories.
- iii) Quality Assurance Plan (QAP) with hold points by Purchaser's inspection. The quality assurance plans and hold points shall be discussed between the Purchaser and Bidder before the QAP is finalized.

10.3 The successful Bidder shall submit the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

11.0 DOCUMENTATION :

11.1 All drawings shall conform to the latest version of International Standards Organization (ISO) 'A' series of drawing sheet/Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for micro testing. All dimensions and data shall be in SI Units.

12.0 LIST OF DRAWINGS AND DOCUMENTS:

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

- a) General outline and assembly drawings of the equipment showing front & side elevation and plan views and all accessories, external features with detailed dimensions, net & shipping weights, size of lifting lugs, quantity of insulating oil .
- b) Sectional views showing General Constructional Features, lifting lugs, etc.
- c) Name plate drawing with terminal markings & connection diagram.
- d) Schematic drawing.
- e) Dimensional drawing of terminal clamps and connectors showing material composition, permissible temperature rise, current carrying capability etc.
- f) Type Test reports
- g) Test reports, literature, pamphlets of the bought out items.

12.2 The successful Bidder shall within two weeks from signing of contract, submit four sets of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/approval on the drawings to the Bidder within reasonable time. The Bidder 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 Purchaser's comments. After receipt of Purchaser's approval, the Bidder shall within three weeks submit 20 prints and two good quality reproducible (Soft copy) of the approved drawings for Purchaser's use.

12.3 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 Bidder's risk.

12.4 The bidder shall submit nicely printed and bound volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment supplied for distribution, along with the equipments. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. The manual shall also contain a set of all the approved drawings and type test reports etc.

12.5 Approval of drawings by Purchaser shall not relieve the Bidder of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall

have the power to reject any work or material, which in his judgment is not in full accordance therewith.

13.0 ENGRAVING, PACKING AND FORWARDING :

13.1 The details such as order no. and date, year of manufacture and “MPPTCL” should be engraved on each and every equipment. 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 Bidder shall be responsible for any damage during transit, due to improper and inadequate packing and handling. 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. Bidder shall supply, any material, found short inside the packing cases without any extra cost.

13.2 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.

13.3 The Bidder shall ensure that the packing list and bill of material is approved by the Purchaser before despatch.

14.0 SCHEDULE

Schedules, questionnaire and annexure attached with this specification are the integral part of the specification and shall be submitted duly filled in by the Bidders alongwith the offer. Bill of material for each equipment shall be submitted by the bidder separately. Makes of the equipment shall be clearly indicated. Bidders may please note that a general mention that the components shall be of reputed make will not be acceptable.

15.0 COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS

15.1 Bid shall be complete in all respects and shall include all minor component, accessories, small wiring etc., not specifically mentioned in the Schedule, specifications etc; but essential for the completeness of the system. Bidders shall not be eligible for extra charges in respect of such minor components, accessories, small wiring etc., though not included specifically in this specification but requires for satisfactory operation of equipment offered.

15.2 Bidders must furnish following information along with technical Bid.

15.2.1 Complete details of all the accessories which will be supplied

15.2.2 It is obligatory on the part of bidders to ensure that supply of all accessories along with Main equipment are simultaneously delivered to avoid any holdups. Responsibility for obtaining timely supplies of bought out items will rest on the bidders and only on this basis, delivery period will be offered in the Bid.

15.2.3 It may be noted that in case of damages/shortages due to improper packing or any other negligence ,replenishment shall be arranged within one months time. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and also in case defective supply of any item is reported, will rest on the bidders.

16.0 SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS AND TECHNICAL QUESTIONNAIRE :

Bidders shall furnish Guaranteed Technical Particulars and Technical Questionnaire for offered equipments in the format provided in Section-III.

17.0 GUARANTEE FOR SUPPLY OF SPARES FOR 10 YEARS OPERATION :

As specified in the bid document, the bidder has to furnish an undertaking that the spares required for satisfactory operation of offered goods shall be made available at reasonable cost over a minimum period of 10 years from the date of commissioning of goods in purchaser's system. In the absence of such an undertaking, the offer will be treated as non-responsive.

18.0 Please ensure the Bid document containing number of pages has been properly page numbered and signed by the bidder. All Bid documents including Schedules and Annexure should be indexed properly and index of the document should be enclosed/placed at the beginning of the document.

APPENDIX-A(I)
**PRINCIPAL PARAMETERS FOR CARRIER CABINETS (SINGLE CHANNEL/
TWIN CHANNEL)**

1	Mode of transmission	Amplitude Modulation single side band with suppressed carrier
2	Carrier frequency range	40 to 500KHz
3	Nominal carrier frequency bandwidth	4kHz for Single Channel terminal 8kHz for Twin Channel terminal
4	Oscillator for generating carriers	Crystal controlled oscillator with frequency divider
5	Frequency stability	Less than ± 5 Hz
6	Effectively transmitted speech frequency band	300-2000Hz or 300-2400Hz
7	Available band for super imposed signals	Depends on the speech cut off frequency
8	Signaling frequency	3780 \pm 30Hz(options available)
9	HF Power Output	20/40 Watt PEP for single channel Adjustable at site.
10	Nominal impedance	
i.	Carrier frequency side	75/125 Ohms unbalanced
ii.	V.F. side	600 Ohms
11	Return loss	
i	Within the nominal Carrier frequency band at the line output.	≥ 20 dB
ii	Within the effectively transmitted frequency band at AF input/output points	≥ 20 dB
12	Relative VF levels across 600 Ohms (Balanced)	
i	4 Wire transmit	-3.5dBr
ii	4 Wire receive	-3.5dBr
iii	2 Wire transmit	0dBr
iv	2 Wire receive	-7dBr
13	Details of power supply required.	48V DC + 20% -15%
14	Power Consumption	100Watts approx. for single channel
15	Spurious emissions	As per IEC 495
16	Receiver Sensitivity	-24dBm referred to the Test Tone level at the RF I/P
17	Automatic volume control	AF O/P level remains within ± 0.5 dB for a +14/-26dB variation of RF I/P level
18	Signal to Noise ratio over carrier channel	<40dB
19	Permissible limit for variation of overall loss of speech channel relative to 800Hz for back to back operation of one pair of terminals	As per IEC 495
20	Frequency difference between voice frequency transmitted and received in a pair of PLCC terminal	0Hz

APPENDIX-A(II)

PRINCIPAL PARAMETERS FOR PROTECTION COUPLER

- 1) The equipment shall be immune to a field strength of 10V/m expected to be caused by portable radio transmitters in the range of 20-1000 MHz.
- 2) The voice frequency transmission equipment shall not only be insensitive to corona noise but shall also remain unaffected by impulse type of noise generated by electrical discharge and by opening and closing of circuit breakers, isolators & earth switches etc. In their offers,, bidders shall clearly explain as to what measures have been taken to make the equipment insensitive to corona noise, white noise and to impulse noise of an amplitude *larger than* the wanted signal and submit full field test and laboratory test reports. The guarantee on design data shall not be acceptable.
- 3) Equipment shall be unaffected by spurious tripping signals. Bidders shall substantiate their claim.
- 4) Offered Protection Couplers shall be suitable for transmission / reception of minimum four protection signals.
- 5) Overall PLC, VFT and transmission path for permissible trip / block shall be one cycle or 20 ms or less and for direct tripping, it shall be 30ms or less.

APPENDIX-A(III)**PRINCIPAL PARAMETERS FOR COUPLING DEVICE**

1	Maximum temperature limit for satisfactory operation of coupling device mounted outdoor	50°C (satisfactory operation up to 65 Deg.C)
2	Nominal primary side Impedance	240/320 Ohms (Phase to Ground)
3	Nominal secondary side impedance	75/125 Ohms Unbalanced, 150 ohms balanced
4	Composite loss within passband.	Not more than 2dB
5	Return loss within passband	Not less than 12dB
6	Available bandwidth	4400 pF:78-500KHz 6600 pF:70-500KHz 8800 pF:52-500KHz
7	Nominal peak envelope power	
i	At 50KHz	≤400Watts
ii.	At 100KHz	≤1000Watts
8	Power frequency impedance between primary terminal and earth terminals of coupling device	Less than 20 Ohms
9	One minute power frequency insulation level between primary and secondary terminals of coupling device	10KV rms
10	Impulse(1.2/50 micro sec) withstand Level between primary and secondary terminals of coupling device	10KV peak
11	DRAIN COIL:	
A	Continuous current	≤1.5 A (rms)
B	Short time current for 0.2sec	50A
c	Inductance of drain coil with tolerance(at 50Hz)	Primary of Matching transformer acts as a Drainage Coil, 0.2 to 0.7m H.
d	Impedance at mains freq.	≤1.5Ω
15	SURGE ARRESTOR :	
a	Power frequency spark over voltage	Min 1300 volts rms
b	Type of construction	Non linear resistor type
c	Maximum permissible short time current (2.2 micro sec)	As per IS:3070 (Part-I)
d	Impulse spark over voltage 1.2/50 μsec	As per IS:3070 (Part-I)
e	Rated voltage	As per IS:3070 (Part-I)
f	Power frequency discharge current for 0.2 sec	50A
16	EARTHING SWITCH :	
a.	Rated voltage	Withstand voltage is 10KV
b.	Rated current	≥200A rms continuous
c.	Short time current	16kA, 1 sec.

SCHEDULE-I (A)**DESCRIPTION OF EQUIPMENT FOR SCHEDULE FOR RATES AND PRICES
TO BE FURNISHED IN VOLUME-VI**

SNo	Particulars of equipment/item	Qty.
A	Carrier Cabinet with Protection Coupler (Single Channel)	As per Price Schedule
	Carrier Cabinet with Protection Coupler meeting all technical requirements as described in the specification .	
B	Carrier Cabinet without Protection Coupler (Single Channel)	
	Carrier Cabinet without Protection Coupler meeting all technical requirements as described in the specification .	
C	Coupling Device (LMU)	
	Coupling Device (LMU) for phase to phase coupling meeting all technical requirements of the specification .	

- Note :**
1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.
 2. The quantity of above equipments has been mentioned in Volume VI.

SECTION –II

2.2.4 TECHNICAL SPECIFICATION FOR EXCHANGES, TELEPHONE SETS

1.0 SCOPE :

The scope of this bid covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipments/materials of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS:

2.1 The specifications of above equipments / Materials shall conform to the requirement of the latest issue of relevant Indian Standards/ International Electromechanical Commission (IS/ IEC) except as detailed out for each equipment in subsequent paras.

The EPAX / Telephone sets shall have approval of Telecom Engineering Center or Department of Telecom of India. The equipments / materials having equivalent International standards are also acceptable. Equipment meeting any other authoritative standard which ensures an equal or better quality than the standard mentioned above, is also acceptable. The photocopy of such standards duly signed by the bidder will have to be furnished.

2.2 When the equipment/materials offered by the Bidder conforms to other standards, salient points of difference between standards adopted and the standards specified in this specification shall be clearly brought out in the relevant schedule. Four copies of such standards with authentic translation in English shall be furnished along with the offer.

2.3 In this bid, the Bidders will have to furnish confirmation in regard to compliance of our entire technical requirement. The bid should clearly describe various technical particulars of the equipments/ materials as per details given in this specification. Based on above information all details required in Schedule-II to Schedule- XII should be furnished so that we may be able to examine whether the Bid submitted is technically acceptable or not. Also all details and confirmation required as per Schedule-II to XII will form part of technical bid.

3.0 CLIMATIC CONDITIONS :

3.1 Applicable climatic conditions shall be as per Section-I, Volume-II.

3.2 AUXILIARY POWER SUPPLY :

Auxiliary Power Supply for offered EHV equipments shall be as per Section-I Volume-II.

4. DISCREPANCY IN TECHNICAL PARTICULARS :

Regarding discrepancy in technical particulars stipulation under Section-I Volume-II shall be applicable.

5.0 TECHNICAL SPECIFICATION FOR ELECTRONIC PRIVATE AUTOMATIC EXCHANGE (EPAX) :

5.1 Basic Design:

5.1.1 The Bidder shall offer the latest digital based Microprocessor EPAX suitable for direct connection to the Power Line Carrier Communication (PLCC) terminals without the need of any four wire interconnecting device. The EPAX shall employ stored programmed technique and utilize Time Division Multiplexing. The EPAX shall be suitable for internal communication between the local subscribers as well as for selective communication over tie lines.

5.1.2 The special features of the EPAX shall be as follows :

- a.** EPAX shall be of latest microprocessor based design which employs Pulse Code Modulation/Time Division Multiplexing principle and shall have high traffic handling capacity (fully non blocking type).
- b.** Self checking diagnostics facility as a built in feature of the EPAX shall be preferred.
- c.** The design of the software structure should be very flexible. Using any standard telephone instrument, the following programming shall be done at site without requirement of any additional testing equipments:
 - Modification of local subscriber number
 - Modification of subscriber priority
 - Modification of subscriber facilities i.e. Access to Tie lines and Follow Me
 - Modification of Tie line number
 - Modification of Tie line groups
 - Modification of Exchange number
 - Allocation of Alternate route
 - Transit call barring
- d.** Built-in main distribution frame with Protective devices such as surge arresters and fuses for all limbs of subscriber lines and tie lines to

protect the sophisticated electronic circuitry of the exchange from damage due to external surges/spikes may be provided.

- e. The EPAX may be suitable for easy expansion if required at a later date.

5.1.3 EPAXs should be equipped with 16 subscriber lines and 8 trunk lines (PLCC directions E&M trunks) for 16/8 line exchange and 32 subscriber lines and 16 trunk lines trunk lines for 32/16 line exchange and both EPAX should be wired for 48 subscriber lines & 24 trunk lines (E&M trunks).

5.1.4 The EPAX shall have facility to expand either the number of subscriber lines or tie lines if required, at a later date. The EPAX should be microprocessor based and be programmable at site. The software shall support E & M signaling.

5.1.5 The EPAX shall be fully automatic and should function without the help of an operator. The site programming facility with telephone or operator console shall be provided.

5.1.6 The exchange shall be self protecting against transients in the input DC supply and against failure of any component or cable in the entire communication system. The additional central processing unit (CPU) and Power Supply Unit (PSU) of exchange should also be supplied extra with each exchange for more reliability. In the event of one of main CPU or PSU card failure, the additional CPU / PSU card can be used to minimize any break down time. The EPAX shall be supplied with Krone type MDF with protection for both the subscriber and tie (PLCC)lines. All the lines shall be provided with surge arrestors and fuses for protection from transients. The krone type protective units shall be housed in a suitable wall mounted junction box & krone insertion tool shall be supplied for erection / maintenance of EPAX without any extra cost.

5.1.7 The EPAX shall have the following facilities:

- a) Follow me / call forward
- b) Call transfer & Conference
- c) Automatic alternate route selection (hunting)
- d) Ring when free
- e) Line Lock out
- f) Either party release
- g) Real time clock
- h) Call pickup facility
- i) Audible and visual alarm on all fault conditions & with auto restart facility.
- j) The priority facility should be such that it should work in trunk busy condition as well as subscriber (local) busy condition i.e. by applying the priority button / priority code the subscriber will come in conversation with the called party (subscriber / Trunk).
- k) Reset button (to reset the EPAX in case of hang condition)

5.1.8 The EPAX shall be self-contained and provide its own ringing current and tones. Visual display with LED's shall be available on each line and trunk card to display call status. Visual and audible alarms shall be provided on all fault conditions based on the self diagnostic routines will be preferred. The exchange shall be housed in a sheet steel cabinet and shall be sturdy, impact resistant, dust, and damp proof. The EPAX shall operate on 48V DC +15% -10% supply. The loop resistance for subscriber lines is 1200 ohms maximum and for tie lines 1500 ohms maximum. The exchange should be housed in with cooling fan.

5.1.9 The system software shall be posted on flash memory as per the latest International standards for fast and reliable operations. The EPAX shall also support a minimum dialing of .16 digits at a time and a maximum of 20 digits.

5.1.10 The EPAX should be provided with universal ports/slots for peripheral cards so that any combination of subscribers and trunks can be selected by the user by inserting suitable interface cards. It may please be noted that subscriber & trunk cards are equipped for maximum of 8 subscribers & 8 trunk per card.

5.1.11 The EPAX shall support the system software to work as an exclusive PLCC exchange. The EPAX shall work in conjunction with the existing EPAXs of other makes in the grid.

5.1.12 The exchange should have facility to adjust the transmitter and receiver voice and data level on trunks so that proper audible communication could be established with out-stationed subscriber.

5.1.13 The offer EPAX should support Telephone billing software. EPAX should be equipped with Operator Console so that programming done at site may be viewed on the screen of the Operator Console.

5.1.14 The EPAX must have been EMI/ EMC tested as per IEC-495. The exchange should be approved by TEC. A copy of certificate of TEC approval for the type of exchange offered must be enclosed.

6.0 TECHNICAL SPECIFICATION FOR TELEPHONE SET :

6.1 Basic Design :

The specification covers supply of ordinary push button telephone set. The Technical requirement of telephones are as follows:

6.1.1 The ordinary electronic push button telephone should be of desk top type and shall have approval of Telecom Engineering Center or Department of Telecom of India. In this connection, a photo copy of documentary evidence must be submitted along with the bid. In absence of documentary evidence the offer shall be non-responsive. The telephone shall support dialing on 2 wire loop mode and should be compatible for operation with all type of electronic exchanges being used by DOT of all technologies (indigenous & foreign). The telephone instrument must be suitable for climatic conditions stated in Clause no.3 of Section-II mentioned above. The instrument should be sturdy and should have good appearance. The instruments

should be supplied in different pleasant colours based on our approval. The telephone shall be provided with following features:

- i. Tone / pulse switchable
- ii. User selectable dialing mode operation like Tone/DTMF.
- iii. Automatic last number redial facility up to maximum of 32 digits
- iv. Ringer indication with ringer volume control.
- v. Electronic speech circuitry with regulated speech levels.
- vi. Pause insertion for intermediate tones.
- vii. Automatic gain control for long line attenuation.
- viii. Good quality of transmitter transducers.
- ix. Extreme temperature resistant components for operation reliability.
- x. Digit pulses during dialing are muted.

6.1.2 Apart from above, telephones offered should meet following specifications

- i System voltage 48V DC \pm 10%
- ii Pulse rate 10 PPS
- iii Break-make ratio 66:33/60:40
- iv Inter-digit pause 800 m sec(minimum)

6.1.3 The push button telephone, should be supplied complete in all respect. Any accessory/ feature which is not specifically mentioned but is considered necessary for satisfactory operation of the equipment have to be included and the instrument incorporating such facility shall be supplied without any extra cost. The telephone sets shall be procured preferably from reputed and experienced manufacturer of telephones.

7.0 Acceptance And Routine Tests:

7.1 The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards or Equivalent International Standards in presence of Purchaser's representative.

7.2 Immediately after finalisation of the programme of type/ acceptance/routine testing, the manufacturer shall give advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

8.0 INSPECTION:

- (i) The Purchaser shall have access at all times to the works and all other places of manufacture, where the equipments are being manufactured and the Bidder shall provide all facilities for unrestricted inspection of the Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.

- (ii) The successful Bidder 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 arrangements could be made for inspection.
- (iii) No material shall be despatched from the works of manufacturer unless the material has been satisfactorily inspected and tested.
- (iv) The acceptance of any quantity of the equipment shall in no way relieve the successful bidder 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.

9.0 QUALITY ASSURANCE PROGRAMME :

9.1 The Bidder must establish that they are following a proper quality assurance programme for manufacture of equipments. The Bidder shall invariably furnish following information along with his offer. Information shall be separately given for individual type of equipment offered.

- i) Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of Bidder's representative and copies of test certificates.
- ii) Information and copies of test certificates as mentioned in (i) above in respect of bought out items.
- iii) List of manufacturing facilities available.
- iv) Levels 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 equipment available with the Bidder for final testing of equipment specified and test plant limitations, if any, vis-à-vis type test, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

9.2 The successful Bidder shall within 30 days of placement of order, submit following information to the Purchaser.

- i) List of raw materials as well as bought out accessories and the names of sub supplier selected from the lists furnished along with offer.
- ii) Type test certificate of the raw material and bought out accessories.

- iii) Quality Assurance Plan (QAP) with hold points by Purchaser's inspection. The quality assurance plans and hold points shall be discussed between the Purchaser and Bidder before the QAP is finalised.

9.3 The successful Bidder shall submit the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

10.0 DOCUMENTATION :

10.1 All drawings shall conform to latest version of International Standards Organization (ISO) 'A' series of drawing sheet/Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for micro testing. All dimensions and data shall be in S.I. Units.

11.0 LIST OF DRAWINGS AND DOCUMENTS :

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

- a) General outline and assembly drawings of the equipment.
- b) Sectional views showing General Constructional Features.
- c) Name plate.
- d) Schematic drawing.
- e) Type Test reports
- g) Test reports, literature, pamphlets of the bought out items.

11.2 The successful Bidder shall within two weeks from signing of contract, submit four sets of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/approval on the drawings to the Bidder within reasonable time. The Bidder 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 Purchaser's comments. After receipt of Purchaser's approval, the Bidder shall within three weeks submit 4 prints and two good quality reproducible (Soft Copy in CD) of the approved drawings for Purchaser's use.

11.3 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 Bidder's risk.

11.4 The successful Bidder shall furnish nicely printed and bound volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment alongwith the equipments. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. The manual shall also contain a set of all the approved drawings and type test reports etc.

11.5 Approval of drawings by Purchaser shall not relieve the Bidder of his responsibility and liability for ensuring correctness and correct interpretation of the

latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material, which in his judgment is not in full accordance therewith.

12.0 ENGRAVING, PACKING AND FORWARDING :

12.1 The details such as order no. and date, year of manufacture and “MPPTCL” should be engraved on each and every equipment. 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 Bidder shall be responsible for any damage during transit, due to improper and inadequate packing and handling. 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. Bidder shall supply, any material, found short inside the packing cases without any extra cost.

12.2 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.

12.3 The Bidder shall ensure that the packing list and bill of material is approved by the Purchaser before despatch

13.0 SCHEDULE

Schedules, questionnaire and annexure attached with this specification are the integral part of the specification and shall be submitted duly filled in by the Bidders alongwith the offer. Bill of material for each equipment shall be submitted by the bidder separately. Makes of the equipment shall be clearly indicated. Bidders may please note that a general mention that the components shall be of reputed make will not be acceptable.

14.0 COMPLETENESS OF EQUIPMENT/MATERIAL AND BOUGHT OUT ITEMS

14.1 Bid shall be complete in all respects and shall include all minor component, accessories, small wiring etc., not specifically mentioned in the Schedule, specifications etc; but essential for the completeness of the system. Bidders shall not be eligible for extra charges in respect of such minor components, accessories, small wiring etc., though not included specifically in this specification but requires for satisfactory operation of equipment offered.

14.2 Bidders must furnish following information along with technical Bid.

14.2.1 Complete details of all the accessories which will be supplied

14.2.2 It is obligatory on the part of bidders to ensure that supply of all accessories along with Main equipment are simultaneously delivered to avoid any holdups. Responsibility for obtaining timely supplies of bought out items will rest on the bidders and only on this basis, delivery period will be offered in the Bid.

14.2.3 It may be noted that in case of damages/shortages due to improper packing or any other negligence ,replenishment shall be arranged within one months time. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and also in case defective supply of any item is reported, will rest on the bidders.

15.0 SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS AND TECHNICAL QUESTIONNAIRE:

It is obligatory on the part of bidders to furnish Guaranteed Technical and Technical Questionnaire for offered equipments in the format provided under Section-III duly filled in complete in all respects.

16.0 GUARANTEE FOR SUPPLY OF SPARES FOR 10 YEARS OPERATION:

As specified in the bid document, the bidder has to furnish an undertaking that the spares required for satisfactory operation of offered goods shall be made available at reasonable cost over a minimum period of 10 years from the date of commissioning of goods in purchaser's system. In the absence of such an undertaking, the offer will be treated as non-responsive.

17.0 Please ensure the Bid document containing number of pages has been properly page numbered and signed by the bidder. All Bid documents including Schedules and Annexure should be indexed properly and index of the document should be enclosed/placed at the beginning of the document.

SCHEDULE-I(A)**DESCRIPTION OF EQUIPMENT FOR SCHEDULE FOR RATES AND PRICES
TO BE FURNISHED IN VOLUME-VI**

SNo	Particulars of equipment/item	Qty.
A	Epax & Telephone sets	As per Price Schedule Section-I Vol.-II,
1	32/16 LINES ELECTRONIC PRIVATE AUTOMATIC EXCHANGE (EPAX) meeting all technical requirements of the specification.	
2	16/8 LINES ELECTRONIC PRIVATE AUTOMATIC EXCHANGE (EPAX) meeting all technical requirements of the specification	
3	Telephone sets meeting all technical requirement of the specification	

- Note :**
1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.
 2. The quantity of above equipments has been mentioned in Volume VI

SECTION –II

2.2.5 TECHNICAL SPECIFICATION FOR HF COAXIAL CABLE & TELEPHONE CABLES

1.0 SCOPE :

The scope of this bid covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipments/materials of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS :

2.1 Applicable Standards for the offered equipments /items shall be as per Section-I, Volume-II.

2.2 If the equipment offered by the Bidders conforms to any other standards, salient points of comparison between the standards adopted and the specific standards shall be clearly brought out in relevant schedule of technical deviation. It will be sole responsibility of Bidders to prove that the salient features of offered equipment are equivalent or better than IS.

2.3 ACCEPTANCE OF OTHER AUTHORITATIVE STANDARDS :

In the preceding paragraph relevant Indian standard / IEC standard bid have been shown. However, the equipment meeting any other authoritative international standard, which ensures equal or better quality than the standards, mentioned shall also be acceptable. Equipment for which Indian Standards are not available, the relevant British standards and IEC recommendations will be applicable. Please attach photocopy of all such standards according to which the equipment has been offered.

3.0 CLIMATIC CONDITIONS :

3.1 Applicable climatic conditions shall be as per Section-I, Volume-II.

3.2 AUXILIARY POWER SUPPLY :

Auxiliary Power Supply for offered EHV equipments shall be as per Section-I Volume-II.

4. DISCREPANCY IN TECHNICAL PARTICULARS :

Regarding discrepancy in technical particulars stipulation under Section-I Volume-II shall be applicable.

5.0 TECHNICAL SPECIFICATION OF HF COAXIAL CABLE

5.1 Basic Design :

5.1.1 The Coaxial cable or HF cable shall be used for connections between the line matching unit and the transmitter receiver set. The insulation of the cable shall be of very high quality to minimise leakage at the carrier frequencies. The cable shall be screened by means of tinned braided copper and armoured with G.I. wire & finally overall PVC sheathed. The capacitance of the cable shall be low so as to minimize the attenuation in the carrier frequency range. The size, details of insulation etc. shall be furnished in the bid. The cable length may be laid in ducts or directly imbedded in ground. Thus the cable offered should be suitable to be laid in duct or imbedded in ground. The characteristic impedance of the cable should be 125 ohm unbalanced. The impedance of the cable shall match with the output impedance of the PLC terminals and the impedance of the coupling unit over the entire frequency range of 40- 500 KHz. The attenuation per kilometer for high frequency range of 40-500 KHz should be furnished. The dimensions and materials used for conductors, insulation, copper braiding, inner PV sheath(Jacket), PVC tape, G.I. wire & final PVC sheath shall be as indicated below. The conductor material should use highly annealed electrolytic tinned copper. The insulation material should be of high quality and should not deteriorate even if imbedded in ground for 10 years or more. There should be no action of chemical and moisture on it. The outer covering of the cable should be free from attack by termites.

5.1.2 The cable shall be designed to withstand a test voltage of 4 KV between the conductor and outer sheath for one minute. The voltage withstand test and the test to ascertain the attenuation figures offered shall be carried out at the manufacturer's work.

5.1.3 The HF cable shall be supplied in non-returnable wooden drums having lengths between 500 Meters and 525 meters. Please note that, non standard length are not acceptable & same should not be supplied. A quantity variation of $\pm 2\%$ on total ordered quantity will only be acceptable.

5.1.4 A drawing showing constructional details indicating dimension and other details of each component used for manufacturing the cable is enclosed along with this specification. In order to clarify the Bidders regarding our exact requirement and also for the purpose of submitting various technical details of the cables, the following additional information is furnished.

- i.** As far as possible characteristic impedance of the cable should be 125 ohm. However, a variation of $\pm 5\%$ on 125 ohm shall be permitted.
- ii.** Minimum diameter of the bare copper conductor should be 0.8mm.
- iii.** The bare copper conductor should be wrapped with PE thread of 1.6mm diameter.
- iv.** Over the bare copper conductor wrapped with PE thread, extruded tube of PE with minimum wall thickness of 1.75mm should be provided, diameter of extruded tube should be approximately 7.6mm.
- v.** Over PE tube single braid of tinned copper wire(diameter 0.2mm)of size 24x8x0.2(i.e 24 spindle with 8 wire per spindle and diameter of each wire

- should be 0.2mm) with 50mm lay shall be applied. Diameter over braiding should be approximately 8.5mm.
- vi. Over the copper braiding a PVC/Melinex tape of thickness 0.15/0.025mm shall be applied.
 - vii. A PVC inner jacket with nominal wall thickness of 1.2mm shall be applied over PVC/Melinex tape.
 - viii. After PVC inner jacket tape, lap armouring of GI wire of diameter 0.5mm of size 48x1x0.5 with 100mm lay approximately shall be provided.
 - ix. A PVC/Melinex tape of thickness 0.15/0.025mm shall be applied over armouring.
 - x. Finally outer jacket of PVC with wall thickness of 1.4mm shall be provided. Over all diameter of cable shall be about 16mm (17mm max).
 - xi. On the above basis, please furnish drawing, showing complete constructional details of the cable and also thickness of various sheath/tape used for the cable shall be specified keeping in view of our minimum requirements as furnished above.

6.0 TECHNICAL SPECIFICATION OF TELEPHONE CABLE:

6.1 Basic Design for 2 Pair, 6 Pair, 10 Pair PVC Unarmoured and 10 Pair PVC Armoured Telephone Cable.

The multicore telephone cables suitable for overhead and underground system are required for Purchaser's departmental telephone system. The telephone cable shall generally conform to specification No.G/WIR-06/02 with latest amendment. The cable shall be manufactured as per following specifications.

6.1.1 Requirement and Size of Cables:

2 Pair, 6 Pair and 10 Pair PVC unarmoured cable required should be suitable for over head system and 10 pair PVC armoured telephone cable suitable for under ground system. In case of armoured cable armouring and outer sheath should be provided as per IS-1554.

6.1.2 Type of Conductor, Insulation of Conductor and Twinning:

- (a) The conductor must consists of bright clean and scale free solid wire (round) of annealed high conductivity tinned copper. The surface of the conductor shall be smooth and untarnished.
- (b) The diameter of conductor should be 0.60mm.
- (c) Maximum average resistance of conductor at 20 degree centigrade should be 64 ohm /km.
- (d) The conductor must be insulated with PVC. The minimum thickness of insulation should be 0.2+0.05 mm-0.02mm. The cable insulation must be flame retardant and shall not support own combustion and must be self extinguishing. PVC used must be high resistant to ageing and fading of colours. The insulation shall be applied by extrusion process and shall form a compact homogenous body uniformly enclosing the copper conductor. It shall be possible to strip the insulation readily from the copper conductor without damaging them.
- (e) Two insulated conductors must be uniformly twisted together to form a pair. The lays of the twists of the pairs must be different for all pairs so that cross talk is kept to a minimum.

6.1.3 Identifications, Sheathing & other requirements:

- (a) The conductors should be laid such that each pair can be identified easily. The colour should be readily identifiable under the normal lightning conditions. The range of pigment used for colouring PVC shall be such that the colour should not fade out. The colour code must be clearly mentioned in offer and lapping of PVC tape should be applied.
- (b) All insulated cores are first twisted in to pairs. All the 10 pair / 6 pair / 2 pair should be bunched to form a unit. The cable thus formed shall be tightly lapped with a PVC tape of 0.13 mm thickness with a 30% overlap. Alternatively, the cable shall be lapped with polythene teraphthalate tape of 0.013 mm thickness, having an overlap of not less than 30% or two such tapes may be applied over breaking joint. Finally an outer sheathing of PVC of thickness of 0.65mm for 6 pair and 2 pair and 0.75 mm for 10 pair unarmoured PVC cable shall be provided. For 10 pair armoured PVC cable, minimum thickness of outer sheath should be 1.4mm. The armouring should be done with wire / strip as per IS 1554.
- (c) The telephone cable shall be supplied in non returnable wooden drums having lengths between 500 meters and 525 meters or 1000 meters and 1050 meters. Please note that non standard length should not be supplied. A quantity variation of $\pm 2\%$ on total ordered quantity will only be acceptable.

7.0 GUARANTEED TECHNICAL PARTICULARS :-

It is obligatory on the part of bidders to furnish guarantee technical particulars and technical questionnaire of offered cables in the format provided under Section-III duly filled in complete in all respects.

8.0 TESTS :

8.1 Type Test :

All the cables offered, shall be fully type tested as per relevant Indian Standards or any Equivalent International Standard during the last **five** years from the date of bid opening. In case the equipment of the type and design offered has already been type tested, the Bidder shall furnish four sets of the type test reports 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 representatives. For this purpose, the Bidder may quote unit rates for carrying out each type test. This will not be considered for price evaluations. For any change in the design/type already type tested and the design/type offered against this bid, the Purchaser reserves the right to demand repetition of same or all type tests without any extra cost. Non compliance of this requirement will make the bid non responsive.

8.2 Acceptance And Routine Tests:

8.2.1 The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards or Equivalent International Standards in presence of Purchaser's representative.

8.2.2 Immediately after finalisation of the programme of type/ acceptance/routine testing, the manufacturer shall give advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

9.0 INSPECTION:

- (i) The Purchaser shall have access at all times to the works and all other places of manufacture, where the cables are being manufactured and the Bidder shall provide all facilities for unrestricted inspection of the Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.
- (ii) The successful Bidder shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of cables in its various stages, so that arrangements could be made for inspection.
- (iii) No material shall be despatched from the works of manufacturer unless the material has been satisfactorily inspected and tested.
- (iv) The acceptance of any quantity of the cables shall in no way relieve the successful bidder of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection if such cables are later found to be defective.

10.0 QUALITY ASSURANCE PROGRAMME :

10.1 The Bidder must establish that they are following a proper quality assurance programme for manufacture of cables. The Bidder shall invariably furnish following information along with his offer. Information shall be separately given for individual type of cable offered.

- i) Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of Bidder's representative and copies of test certificates.
- ii) Information and copies of test certificates as mentioned in (i) above in respect of bought out items.
- iii) List of manufacturing facilities available.
- iv) Levels 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 to make it maintenance free.

- vii) List of testing equipment available with the Bidder for final testing of cable specified and test plant limitations, if any, vis-à-vis type test, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

10.2 The successful Bidder shall within 30 days of placement of order, submit following information to the Purchaser.

- i) List of raw materials as well as bought out accessories and the names of sub supplier selected from the lists furnished along with offer.
- ii) Type test certificate of the raw material and bought out accessories.
- iii) Quality Assurance Plan (QAP) with hold points by Purchaser's inspection. The quality assurance plans and hold points shall be discussed between the Purchaser and Bidder before the QAP is finalised.

10.3 The successful Bidder shall submit the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

11.0 DOCUMENTATION :

11.1 All drawings shall conform to latest version of International Standards Organization (ISO) 'A' series of drawing sheet/Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for micro testing. All dimensions and data shall be in S.I.Units.

12.0 LIST OF DRAWINGS AND DOCUMENTS :

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

- a) General outline drawings.
- b) Sectional views showing General Constructional Features.
- c) Marking on the cables
- d) Type Test reports
- e) Test reports, literature, pamphlets of the bought out items.

12.2 The successful Bidder shall within two weeks from signing of contract, submit four sets of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/approval on the drawings to the Bidder within reasonable time. The Bidder 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 Purchaser's comments. After receipt of Purchaser's approval, the Bidder shall within three weeks submit 4 prints and two good quality reproducible (Soft Copy in CD) of the approved drawings for Purchaser's use.

12.3 The manufacturing of the cables shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of

the Purchaser. All manufacturing work in connection with the cable prior to the approval of the drawing shall be at the Bidder's risk.

12.4 The successful Bidder shall furnish nicely printed and bound volumes of manuals in English Language, for each type and rating of equipment/materials alongwith the equipments.

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

13.0 ENGRAVING, PACKING AND FORWARDING :

13.1 The details such as order no. and date, year of manufacture and " MPPTCL" should be engraved on each and every cable. The cable 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 Bidder shall be responsible for any damage during transit, due to improper and inadequate packing and handling. 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. Bidder shall supply, any material, found short inside the packing cases without any extra cost.

13.2 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.

13.3 The Bidder shall ensure that the packing list and bill of material is approved by the Purchaser before despatch.

14.0 SCHEDULE

Schedules, questionnaire and annexures attached with this specification are the integral part of the specification and shall be submitted duly filled in by the Bidders alongwith the offer. Bill of material for each equipments shall be submitted by the bidder separately. Makes of the equipment shall be clearly indicated. Bidders may please note that a general mention that the components shall be of reputed make, will not be acceptable.

15.0 COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS

15.1 Bid shall be complete in all respects and shall include all minor component, accessories, small wiring etc., not specifically mentioned in the Schedule, specifications etc; but essential for the completeness of the system. Bidders shall not be eligible for extra charges in respect of such minor components, accessories, small wiring etc., though not included specifically in this specification but requires for satisfactory operation of equipment offered.

15.2 Bidders must furnish following information along with technical Bid.

15.2.1 Complete details of all the accessories which will be supplied

15.2.2 It is obligatory on the part of bidders to ensure that supply of all accessories along with Main equipment are simultaneously delivered to avoid any holdups. Responsibility for obtaining timely supplies of bought out items will rest on the bidders and only on this basis, delivery period will be offered in the Bid.

15.2.3 It may be noted that in case of damages/shortages due to improper packing or any other negligence ,replenishment shall be arranged within one months time. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and also in case defective supply of any item is reported, will rest on the bidders.

16.0 GUARANTEE FOR SUPPLY OF SPARES FOR 10 YEARS OPERATION:

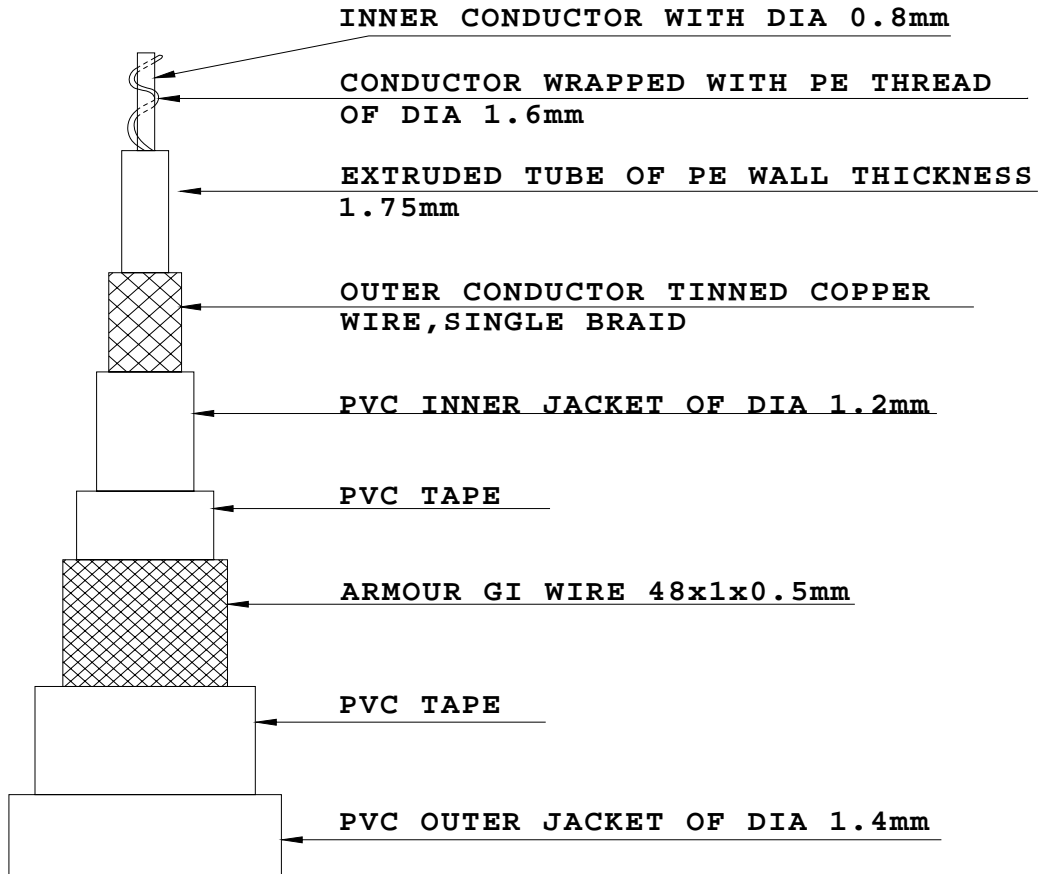
As specified in the bid document, the bidder has to furnish an undertaking that the spares required for satisfactory operation of offered goods shall be made available at reasonable cost over a minimum period of 10 years from the date of commissioning of goods in purchaser's system. In the absence of such an undertaking, the offer will be treated as non-responsive.

17.0 Please ensure the Bid document containing number of pages has been properly page numbered and signed by the bidder. All Bid documents including Schedules and Annexure should be indexed properly and index of the document should be enclosed/placed at the beginning of the document.

APPENDIX-B

S.No	Drawing No.	Description
1	JICA/MPPTCL/TR-101 TO 107/HF COAXIAL CABLE	Constructional details of HF Coaxial Cable

CONSTRUCTIONAL DETAILS OF HF COAXIAL CABLE



DRAWING NUMBER :-

JICA/MPPTCL/TR-101 TO 107/HF COAXIAL CABLE

SCHEDULE-I(A)**DESCRIPTION OF EQUIPMENT FOR SCHEDULE FOR RATES AND PRICES
TO BE FURNISHED IN VOLUME-VI**

SNo	Particulars of equipment/item	Qty.
A	HF COAXIAL CABLES & TELEPHONE CABLES	As per Price Schedule
1.	HF Coaxial Cable conforming to technical specifications and meeting all design, constructional features and technical particulars as described in bid document.	
2	Telephone Cables of following sizes, conforming to technical specification of the bid document and meeting all design, constructional features and technical particulars as described in bid document.	
a)	10 Pair PVC Armoured	
b)	6 Pair PVC Armoured	

Note : 1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.

2. The quantity of above equipments has been mentioned in Volume VI.

2.2.6 TECHNICAL SPECIFICATION FOR REMOTE TERMINAL UNIT

Scope :

This document contains the specifications, cover design, engineering, manufacturing & testing before supply, packing & dealing of Remote Terminal Units (RTUs) and associated equipment to be supplied to the employer along with the installation work. Information concerning employer's objectives is presented in the form of acceptable design approaches.

1.1 Scope of Supply:

The contractor shall provide the complete RTUs, interface cabinets, transducers, multi Function meters, cabling, installation and implementation and associated support requirements defined in this Specification.

Employer may not initially procure all capabilities specified with this document, Regardless of the RTU configuration purchased; the RTUs shall be capable of all functions specified herein with the addition of the necessary hardware and software modules in the field when required by employer.

Should the contractor elect to subcontract manufacturing, installation or any other work defined herein, it shall remain the contractor's responsibility to manage the complete procurement.

The contractor shall be responsible for supplying all hardware, software, installation, and field implementation as defined in this Specification. The contractor shall also provide complete documentation, training and testing to fully support the hardware and software provided.

The RTUs, interface cabinets, transducers, cables and all associated hardware and software procured with this Specification will be installed at substations which will be supervised by employer's representative.

It is employer's intent that the contractors use as much standard hardware and software as possible, however, all of the functional requirements of this Specification must be satisfied. The use of the contractor's standard hardware and software may cause the contractor to conclude that there is need for additional items not specifically mentioned in this Specification. The contractor shall supply all such items and provide a complete RTU design that meets all of employer's functional requirements defined in this Specification.

The RTUs are used for real-time monitoring and control of the MP power system and will be located in transmission substations. The control systems will include the capability for control of substation, although it may not be implemented initially.

The Remote Terminal Units and Associated Hardware & Accessories offered shall be complete with all component necessarily for their effective and trouble free operation. Such component deemed to be within the scope of supply of tenderer irrespective of whether these are specifically brought out in this specification and / or in the commercial order or not.

2.0 CLIMATIC CONDITIONS:

2.1 The equipments / materials shall be suitable for continuous satisfactory operation under climatic conditions listed below:

1	Location	In the state of Madhya Pradesh
2	Maximum Ambient Air Temperature	50 ^o C
3	Minimum Ambient Air Temperature	1 ^o C
4	Average daily Ambient Air Temp.	30 ^o C
5	Maximum relative humidity	95%(sometime approaches to saturation)
6	Average no. of thunderstorm days per annum	50
7	Average no. of rainy days per annum	90
8	Average annual rainfall	125 cm.
9	Months of tropical monsoon condition in the year.	June to October
10	Maximum wind pressure.	150 Kg/sq.m.
11	Altitude not exceeding	1000 meters
12	Seismic level (horizontal acceleration)	0.3 g

Note: Moderately hot and humid tropical climate is conducive to rust and fungus growth. The climatic conditions are also prone to wide variations in ambient conditions. Smoke is also present in the atmosphere. Heavy lightning also occurs during June to October.

3.0 SYSTEM PARTICULARS:

3.1 The equipments/materials offered under this specification shall be used in the substations having following system parameters:

S.No	PARTICULARS	SYSTEM PARAMETERS
1	Nominal system voltage	400KV 220KV 132KV 33KV
2	Highest system voltage	420KV 245KV 145KV 36KV
3	Frequency	----- 50 Hz -----
4	Number of phases	----- Three -----
5	Earthing	---Effectively earthed---
6	Basic insulation level (kV peak)	1425 1050 630 170

4.0 TECHNICAL SPECIFICATION FOR REMOTE TERMINAL UNIT REQUIREMENTS

This section describes the overall functions to be performed by the RTUs. Each function is presented in sufficient detail to provide the contractor with as much insight as possible into both the initial and future requirements of the RTUs. All functional capability

described herein shall be provided by the contractor even if a function is not initially implemented.

As a minimum, the RTUs shall be capable of performing the following function :

- (a) Collecting, processing and transmitting status changes, accumulated values and analog values.
- (b) Receiving and processing digital and analog commands from the master station(s)
- (c) Accepting polling messages from the master station(s)
- (d) Supporting data transmission rates from 50 to 9600 bits per second.
- (e) Supporting upto six communication ports and multiple concurrent protocols, including the IEC 60870-5-101 protocol.

4.1 Communication Interface :

The RTUs shall have minimum capability to support simultaneous communications with multiple independent master's stations and a local user maintenance inter-phase.

The RTU shall have minimum communication ports as follows:

- (a) Two ports for multiple master stations connectivity in case of non-critical RTUs 'or' four ports for multiple master stations connectivity in case of critical RTUs.
- (b) One port for RTU maintenance and configuration terminal.

Critical RTUs (see Appendix A) shall have redundant communication ports and non-critical shall have a non-redundant communication port, for master station connectivity. Therefore, each critical RTU shall have minimum six communication ports and each non-critical RTU shall have minimum four communication ports. It should be possible to add communication port in future to interface with a local SCADA/Human Machine Interface(HMI), without any change in RTU software/firmware.

The communication interface to the master stations shall allow scanning and control of defined points within the RTU independently for each master station. The RTU shall simultaneously respond to independent scans and commands from employer's master stations. The RTU shall support the use of a different communication data exchange rate (bits per second), scanning cycle and / or communication protocol to each master station. Also each master station's data scan and control commands may be different for different data points within the RTU's database.

All communication ports shall use CCITT V.24 and V.28 signal specifications to interface to the modems. All ports shall be accessible to employer to attach the interface equipment and to provide access for the maintenance, test and monitoring equipment.

4.1.1 Master station communication Interface :

The RTU shall provide multiple communication ports for possible concurrent communication to SCADA system master stations. Two of the ports shall provide redundant communication to a single master station (Critical RTUs), while additional ports may serve other master station(s). Data sent to each master station shall be independent, with different scan groups and different data points as definable from the RTU database.

Employer will supply communication channels between the RTUs and the SCADA system master stations. Use of dedicated or party-lined communication channels shall be supported. The RTU data transfer rate for each RTU is specified in Appendix-A. The communication channels provided by employer will consist of power line carrier, optical fiber and cable communication channels during the modems specified below.

4.1.2 Modems :

The contractor shall supply two (2) number modems alongwith each critical RTU (at RTU end) and one number modem alongwith each non-critical RTU (at RTU end) for communicating with the master station identified in Appendix-A. The identical counterpart of respective two nos. Modem for each critical RTU and respective one no. Modem for each non critical RTU at the control center end/ Wide band node also shall be supplied for each RTU data channel. These modems can be located either at the FEP or at wideband node. In case the modem is located at wideband node, then it shall be stand-alone type.. A single modem combining all of the characteristics defined below is preferred such that changing the communication data rate shall only require reconfiguration of the RTU modem.

The modems shall not require manual equalization and shall include self-test features such as manual mark / space keying analog loop-back and digital loop back. The modems shall provide for convenient adjustment of output level and receive sensitivity. The configuration of tones and speed shall be programmable and maintained in non-volatile memory in the modem.

The Modems at wideband nodes shall be housed in 19'inches rack with suitable capacity power supply module .The connections from PLCC/Wideband communication equipment shall be terminated at the rear side of the Modem.

The modems shall meet the following requirements :-

- a) Use CCITT Standards including V.24, V.28, V.52 and V.54
- b) Communicate data rates of 200, 300, 600 and 1200 bits per second.
- c) Use CCITT V.21, V.23, R35, R37, R38 and R.38b and standard tones for the selected RTU data rate.
- d) Use frequency shift keying (FSK) modulation
- e) Use both 2-wire and 4-wire communication lines
- f) Receive level adjustable from 0 to -40 dBm@600 ohms
- g) Transmit level adjustable from 0 to -24 dBm@600 ohms
- h) Have a minimum sensitivity of -48 dBm

- i) PLCC modem shall use bandwidth upto 4khz and shall accommodate multiple data channels over and above voice channels. It shall conform to CCITT-38 standards.

4.1.3 Local user Maintenance Interface :

The RTUs shall include the interface to support the portable configuration and maintenance terminal defined in Section 4.8.3. The interface shall provide easy access to allow employer to use the maintenance terminal at the RTUs installed in the field.

4.2 Master Station Communication Protocol :

The Contractor shall provide a communication protocol for communicating with employer's master stations using the IEC 60870-5-101 communication standard. The communication protocol shall support all the requirements of this standard. The communication protocol shall be non-proprietary and the contractor shall provide complete description and documentation of the protocol to employer for future implementation on additional RTUs from any supplier and in the master stations. The configuration of the protocol shall be as per the "interoperability Matrix" which shall be provided by the employer.

The RTU shall also be capable of supporting other communication protocols that may be required to communicate with additional master stations in the future. The offered RTU will not require any software/firmware change to support additional master stations. The only change could be addition of communication ports and re-configuration of RTU.

4.2.1 Communication Channel Control :

The RTU shall perform as a slave on the communication channel to employer's SCADA systems. All communication shall be initiated by the SCADA system master stations. Where the RTU must notify the master stations of an unusual condition at the RTU (such as a power fail/restoration or RTU malfunction) or must initiate the transfer of changed data, the notification shall be accomplished with the framework of the periodic data acquisition exchanges.

4.2.2 Scan Groups :

Analog and digital input points (including points reported by exception) shall be assignable to scan groups. A scan group shall be a specified set of data points within the RTU's central database which will be communicated to a master station when requested by a specific (addressed) scan request. A scan group size shall only be limited by the communication protocol message length. Any RTU input point shall be assignable to any scan group. The RTUs shall support at least sixteen scan groups and all scan groups per communication port (i.e. master station / maintenance terminal interface).

The contractor shall provide a convenient and flexible scheme for assigning points in the RTU to scan groups. The contractor shall provide all special equipment necessary to configure the RTU and assign points to scan groups.

4.2.3 Exception Reporting :

The RTU communication protocol shall report status changes by exception. The communication protocol shall also support an update demand scan of all status data by master stations regardless of the lack of any change data. The update scan will report the status of all RTU data assigned to the scan group.

The reply to an exception scan request for status points shall consist of an indication of the presence or absence of a change of the status indication points in the RTU. A master station will then request the input of the changed points. The RTU shall continue to indicate exception changes until the master station acknowledges successful receipt of the changed data. The RTU shall report the current state of all status indication points to the master station in response to an update scan even if data has not changed.

Analog points shall only reply to a scan request for the analog points whose scan group contains the assigned points. No exception scanning of analog point shall be allowed.

4.2.4 Message Security :

Each RTU communication message shall include an error code, the use of which shall result in a very low probability of an erroneous message being accepted as valid. The error code shall be determined and appended to the message for all messages transmitted by the RTU and verified by the RTU for all messages addressed and received by the RTU. Cyclic error detection codes such as CRC are required.

High data integrity and consistency is required of the RTU protocols. The protocols used shall provide an adequately low Residual Error Rate (RER) depending on the Bit Error Rate (BER) of the line in use. The minimum required RER is as specified for the IEC 60870-5-101 protocol with the T-101 profile. This requires the following integrity:

<u>BER</u>	<u>RER</u>
10^{-5}	10^{-14}
10^{-4}	10^{-10}
10^{-3}	10^{-6}

The implemented protocol shall ensure satisfactory performance at Bit Error Rate of 1×10^{-4} .

4.2.5 Control Security :

Operation of control outputs shall use a true select-check-before-execute command sequence between the RTU and the SCADA system master station. The sequence shall include as a minimum, the following functional capabilities :

- a) The master station shall transmit a control selection message addressing the proper RTU and control point within the RTU and indicate the control action desired (such as Close).
- b) The RTU shall initialize its control logic, reassemble the control selection message received in (a) above, and transmit the reassembled message to the master station. The information in the message sent to the master station shall be generated by the RTUs point-selection logic indicating the point and control function selected. It shall not be a simple repeat of the master station's message transmission.
- c) The master station will verify the returned message with the message sent in (a) above and, if valid, shall issue an execute control message to the RTU.
- d) The RTU shall only operate the control point selected after the check-before-execute sequence above has been performed without error or interruption by any other messages. The RTU shall reset its control logic upon any error in the sequence or if the execute message is not received within a set time (user adjustable 2 – 20 seconds) after the command message is received at the RTU.

4.3 Analog Inputs :

The RTU shall accommodate analog current inputs which are isolated, unipolar or bipolar, 2-wire ungrounded differential signals with full resolution as follows :

- (a) +4 to + 20 mA
- (b) 0 to + 10 mA
- (c) -10 to +10 mA

The analog input accuracy shall be 99.8% or better at 25°C ambient temperature. Mean accuracy shall drift no more than 0.002% per°C with the temperature range of -5 to 55°C. Determination of accuracy shall be made while the analog multiplexer is operating at rated speed. The analog-to-digital converter shall have a minimum resolution of ± 2048 counts (sign plus 11 data bits).

Each input shall have surge protection and filtering to provide protection against voltage spikes and residual current: at 50 Hz, 0.1 ma (peak-to-peak). Overload of upto 50% of the input shall not sustain any failures to the input.

The RTU shall make all appropriate signal level conversion and conditioning to allow full utilization of analog inputs and meaningful reasonability checking. Including signal conditioning components, the input impedance shall not be greater than 250 Ω . Input scaling shall allow for 20% over range.

RTU shall also accommodate the analog points MW, MVAR, Voltage& Frequency. The OLTC transducers shall be of 4-20 mA output type and Active Power, Reactive Power, Bus Voltage & Bus Frequency output shall be obtained from Multi Function Meter/transducers.

4.4 Digital Status inputs :

The digital inputs interface shall be capable of accepting isolated wet or dry contact status inputs. The contractor shall supply necessary sensing voltage, current limiting, optical isolation galvanic protection, surge protection and debounce filtering independently for each digital status input. The contractor supplied sensing voltage shall not exceed 48 V DC. The sensing voltage source shall be isolated from that of the RTUs logic power such that any noise or a short circuit across the sensing supply's output terminals would not dispute the RTU operation other than the shorted digital status input.

The RTU shall store all status changes detected for retrieval by the master stations. For communication delays or short-term failure of communications with a master station, the RTU shall store a minimum of 300 status change events. The RTU shall report any overflow of this status change buffer to the master stations.

4.4.1 Two-State Devices :

All switching devices (breakers) shall be supported by a dual-contact status indication. Breakers with reclosing capability shall also be supported with momentary change detection (MCD). All other status indications shall be two-state single-contact status points without MCD.

Single contact two-state status point inputs will be from a single normally-open (NO) or normally closed (NC) contact. Dual-contact two-state status point inputs will be from two complementary contacts (one NO and one NC). A switching device status is valid only when one contact is closed and the other contact is open. Invalid states shall be reported when both contacts are open or both contacts are closed. The state definition shall be set by employer for each contact position.

The RTU shall be set to capture contact operations of 20 ms or more duration. Operations of less than 20 ms duration shall be considered no change (contact bounce). The duration used to determine change versus bounce shall be adjustable from 4 to 25 ms in increments of 1 ms.

4.4.2 Momentary Change Detection :

Two-state status input points with momentary change detection shall be used by employer for points where multiple operations (changes of state) can occur between RTU scans (e.g. breakers with reclosing devices that operate faster than the scan rate). The RTU shall capture and maintain all of the momentary changes, upto 4 per MCD digital status point. The MCD status input points shall be set to capture operations of greater than 20 ms duration. Operation of less than 20 ms shall be considered no change (contact bounce). The capture duration shall be adjustable between 4 and 25 ms in increments of 1 ms.

4.4.3 Pulse Accumulators :

The RTUs shall be capable of counting and storing the number of contact closures generated by a kWh metering device external to the RTU. The device will supply either an isolated Form. A normally open or Form C contact. The accumulator shall be incremented

one count for each cycle of the input (operation of the normally open and normally closed contact of the Form C contact). Each accumulator shall have a 24-bit counter for counting input operations before rolling over. The accumulator shall be capable of accepting counts at a rate of ten counts per second. The count shall be “frozen” (transferred to a buffer register) when commanded by the master station or when commanded by locally generated contact inputs.

4.4.4 Digital Telemetry :

Digital telemetry input points shall be provided for sixteen-bit inputs from employer telemetry contacts. The digital telemetry may use BCD (4-bit decimal characters without sign) and / or binary (16 bit) codes

4.4.5 RTU Sequence of Events (SOE) Collection :

The RTU shall collect digital status input data and time-of-operation from fast-acting power system devices. The RTU shall maintain a clock and shall time-stamp the data with a time resolution of one millisecond. The time resolution will enable employer’s operating and engineering personnel to determine the sequential operation device state changes throughout the power system.

All dual contact two-state status input points (Appendix-A) in addition to being scanned as digital status points, shall be assigned as SOE points. Any digital status input data point in the RTU shall be assignable by Employer as an SOE point.

Each time a SOE status indication point changes state, the RTU shall time-tag the change and store the change (open, close) and the time tag of the event in SOE buffers within the RTU. Separate and independent SOE data storage buffers shall be provided in the RTU for each master station. Each SOE buffer shall be sized to store, as a minimum, a number of events equal to three times the number of SOE points in the RTU (Appendix ‘A’).

The time-tag recorded with each event shall be generated from a clock internal to the RTU. The time tagging of events within RTU shall have an accuracy of one millisecond (1 ms). The accuracy of the internal clock for SOE time-tagging shall maintained by messages from the master station.

When requested from a SCADA system master station, the RTU shall transmit the SOE data stored in its buffer corresponding to that master station. An acknowledgement of receipt by the master station shall be made prior to the loss of any data in the RTU SOE buffer. Data not received at the master station shall be retransmitted. An indication that SOE storage at an RTU is approaching capacity (at 80%) shall be transmitted to the master station in the normal periodic scan so that a priority scan can be sent by the master station to retrieve the SOE data. An additional indication shall provide the status of RTU SOE data buffer overflow.

The RTU shall be capable to monitor Status of all circuit breakers, all isolators and Sequence of events.

4.5 Digital Control Outputs :

The RTU shall provide the capability for a master station to select and change the state of digital output points. Device control will be used by employer to control power system devices including :

Two-state Devices :

Circuit breakers, motor-operated switches, auto/manual switches, relay disable/enable and other two-state devices.

Variable Output Devices :

Transformer load-tap-changers (LTC) and other variable output devices.

The RTUs shall have the capability for control outputs as described in the following sections.

4.5.1 Two-state Momentary Control :

A pair of outputs shall be supplied for each two-state (open/close) control output point that drive control relays. One output shall be supplied for open, the other for close. Upon command from a master station using the check-before-execute sequence, the appropriate control output shall be operated for a preset (momentary) time period. The operation period shall be adjustable for each point from 0.1 to 2 seconds.

4.5.2 Raise/Lower Pulse Outputs :

The raise / lower output controls will also be used for transformer tap position settings.

A pair of outputs shall be supplied for each (raise/lower) control output point that drive control relays. One output shall be supplied for raise, the other for lower. When commanded from the master station, the appropriate raise or lower output shall be operated for the selected time interval. The closure time interval for raise/lower pulse output points shall be specified in the operate command from the master station. The raise/lower output for each point shall operate over a range of 0.1 to 4 seconds in a minimum of eight equal increments.

4.5.3 Control Outputs Relays (Double Contact Digital Output) :

Control output interposing relays shall be supplied by the Contractor for each control output described above. Each control relay shall consist of two isolated single-pole double throw contacts. The output contacts shall be rated 10 Amps at 110V / 220 V DC and shall provide arc suppression to permit interruptions of an inductive load. Relay coils shall be shunted with diodes to suppress inductive transients associated with energizing and de-energizing of the relay coils. The relays shall conform to the IEC 255-1-00 and IEC 255-5 requirements.

4.5.4 RTU Control Security and Safety Requirements :

The RTU shall include the following security and safety features as minimum:

- (a) Select-check-operate sequence for control output. The verification message for check-before-operate control sequences shall be obtained by re-encoding the verification message directly from the control point selection lines. Thus, a simple reflection of the received message is not acceptable.
- (b) No more that one control point shall be selected at any given time. A detection and lockout method shall be provided that prevents a control operation if more than one control point has been selected.
- (c) The control selection shall be automatically canceled if after receiving the “control selection” message, the “operate” command is not the next received message and is not received within the set time period.
- (d) If between the time of a select and execute command, a status related to any point monitored by the RTU, changes state, the received execute command shall not be completed by the RTU. No false output shall result from a single point of failure in the RTU.
- (e) No false output shall result during power up or power down. No false output shall result form inadvertent connections to a circuit card.
- (f) All connections with a voltage of fifty (50) volts or more shall have a protective cover.
- (g) All control output connections shall have protective covers.

4.5.5 Control Disable :

A manual Local / Remote switch shall be provided for each RTU to disable all control output interposing relays by breaking the power supply connection to the control output interposing relays. When in the “Local” position, the Local / Remote switch shall allow testing of the control outputs without activating the interposing control relays.

A status input indication shall be provided for the Local / Remote switch to allow the SCADA system to monitor the position of the switch. This point is in addition to the point count defined in Appendix ‘A’.

4.6 Time Facility :

The Internal RTU time base shall have a stability of 1 ppm that is 3.6 milli seconds per hour or better. The RTU will be set from time synchronization messages received from master station.

However, the RTU shall also be capable of receiving synchronization signals from local GPS terminal. The RTU shall synchronize its internal clock with the master station system clock when time synchronization messages are available.

4.7 Analog Data Update with Master Station:

The RTUs Analog data update with the Master Station shall be 10-15 seconds .It is estimated that 40 analog points shall be updated in 15 seconds at 300 bps.

4.8 Support facilities :

The RTUs shall provide all support hardware and software to allow maintenance access to the RTU database, configuration and functional operation. The maintenance access shall be used by employer to define the structure of the RTU configuration and to maintain the operation of the RTU.

Employer intends to be self-reliant for both RTU hardware and software maintenance. To this end, the Contractor shall provide the support hardware, software and documentation necessary to maintain repair, configure and document the configuration of the RTU. The support facilities shall include but not be limited to spare parts, portable RTU configuration and maintenance terminals, maintenance manuals, and any other support facilities as they are applicable to the Contractor’s RTU design.

4.8.1 Spare parts :

The contractor shall provide spare parts for the RTUs purchased. 1 sets of following essential mandatory spare parts is to be provided by the bidder.

S. No.	Item	Qty. for each location	Total Qty.
1.	Power supply unit for the RTU	2	2
2.	CPU for the RTUs	2	2
3.	Analog input card	2	2
4.	Digital Input card	2	2
5.	Modem set (including power supply unit) separate quantity for RTU & master end	1	1
6	Signal conditioning module if required	2	2
7	Communication interface module for RTU (if required)	2	2
8	Communication interface module for communication with Multi Function Meter (MFM)	2	2
9.	Multi Function Meter (MFM)	4	4
10	OLTC (on line tap changer) transducer	1	1

The bidder shall submit in the technical bid a list of recommended spare parts along with the quantities that the bidder deems necessary to achieve the specified system

availability for a period of 5 years. A list of recommended spare parts shall be submitted to the Employer.

On review of the submitted list, employers will categorize the items on the list as either mandatory spare parts or optional spare parts. The mandatory spare parts will be included where as the optional spare parts will not be included, as part of proposal evaluation. The Employer shall have the option of placing an order for any of the optional parts for the respective system at the price quoted in the price bid up to six months after the system is taken over by the employer.

The contractor shall hand over all the required spare parts after completion of the system availability tests. Any other spare parts needed to support availability testing shall be arranged by the contractor to be on hand in advance. If necessary, the required spare parts may be used to maintain the system during its availability tests. Such parts, however, shall be replenished within a month.

Prior to handling over, all spare parts shall be installed and tested at the employer sites, wherever possible.

4.8.2 Maintenance Support hardware :

The contractor shall provide one set of maintenance support hardware to repair and maintain the RTUs. The minimum support hardware to be provided shall include at least one of each of the following for each master station card extenders with test points for each connector pin, Field simulator device, test cables to connect any test equipment, and any other RTU test equipment as applicable to the Contractor's RTU design.

4.8.3 Portable RTU Configuration & Maintenance Terminals :

Portable configuration and maintenance terminals shall be provided by the Contractor along with all software and hardware needed to interface to the RTU and provide the configuration capabilities. The Contractor shall also provide all database and software interfaces (RTU diagnostics, database compiler, PROM programmer, software listings, RTU configuration listings, etc.) required for employer to maintain and configure the RTUs. The local RTU interface defined in Section 4.1.3 shall be used for the configuration and maintenance terminal. One portable RTU configuration and maintenance terminal with protective covering case and suitable sets of chargeable batteries together with battery charger per set shall be provided .

The RTU configuration and maintenance terminal shall have diagnostics for the RTUs processor(s), memory, I/O ports and any other functional areas of the RTU. The configuration and maintenance terminal shall also provide display and setting of memory table contents and provide debugging tools for the RTU software.

The portable RTU configuration and maintenance terminals shall also be used to monitor and test RTUs operation and communication interfaces. The configuration and maintenance terminals shall be capable of emulating both the master station and the RTU. The configuration and maintenance terminals shall have the capability of interfacing to either the analog or digital side of the modem.

The configuration and maintenance terminal shall be capable of receiving single and repeated messages using the supplied RTU communication protocol. Each received message shall be checked for validity, including the check code. The configuration and maintenance terminals shall maintain and display error counters so that the number of errors during a period of unattended testing can be accurately determined. The configuration and maintenance terminals shall be capable of formatting and transmitting, both as one-time and periodic transmissions, any master station-to-RTU command. It shall also be possible to operate illegal messages, such as messages having invalid check codes, for transmission. After the configuration and maintenance terminal has received for transmitted a message, it shall be possible to immediately “turn around” and transmit or receive a response message.

The configuration and maintenance terminals shall also be capable of passively monitoring all communication traffic on a channel without interfering with channel operation. Channel traffic captured in the active or passive modes of configuration and maintenance terminals operation shall be displayed. All fields of a message shall be displayed. A pass / fail indication for the security check code shall be included with each code displayed.

The supplier shall provide a service over the lifetime of this contract, follow-on-contracts, and the life of the RTU that enables the Purchaser to upgrade the firmware in the RTUs and test set.

If and when an RTU firmware change is required, as a result of correcting problems, the Supplier shall provide at no charge, a master PROM IC and a working PROM IC of the new firmware revision or alternately the supplier may also provide the configuration file loadable into the RTU firmware, configuration & maintenance terminal. The Supplier shall also provide a written description of the change(s) and shall recommend if the change must be implemented immediately or can be scheduled during routine maintenance.

4.9 Consumables:

The contractor shall supply, at its own expense, all consumables required for use during all phases of the project through completion of the system availability tests. A complete itemized list of proposed consumables, including quantities shall be submitted with the technical proposals.

All consumable shall be readily available off – the –shelf with a storage life i.e. virtually unlimited.

4.10 Power Supply :

The RTU will be powered from the employer station battery power system; either by battery, battery charger or a battery / battery charger in parallel. The RTU shall accept power from the DC system with the following characteristics:

- a) Nominal voltage of 48 V DC with operation between 38 and 58 V DC. The voltage may vary during normal operation between these limits with duration not less than 1 ms.
- b) Maximum AC component of frequency equal to or greater than 100 Hz and 0.012 times the rated voltage peak-to-peak.
- c) Reversed polarity protection.

The contractor shall supply any hardware required to convert RTU input voltage to the required internal voltages for the RTU hardware. The RTUs shall operate with grounded input power from employer. The RTU shall not place a ground on the input power.

Each RTU shall have the capability of automatic startup and initialization following restoration of power after an outage without need of master station intervention. All restarts shall be reported to the connected master stations.

Secondary power shall be provided to the RTU at 230V AC, 50 Hz, single-phase for non-critical auxiliary equipment including heaters, internal lighting and internal maintenance outlets.

4.10.1 Power Supply Protection :

Over voltage and under voltage protection shall be provided within the power supply to prevent the RTU internal logic from being damaged as a result of a component failure in the power supply and to prevent the RTU internal logic from becoming unstable and causing misoperations as a result of voltage fluctuations.

4.10.2 Power Supply Failure Indicators :

The RTU shall have a status point which shall be set if the power to the RTUs has been cycled (off-on) for any reason (including maintenance). The master station shall reset the power fail status point. This point is not included in the RTU point count in Appendix 'A'.

4.11 Interface Cabinets :

4.11.1 The contractor shall provide interface cabinets between the RTU and the employer field equipment. The interface cabinet shall house all Multi Function Meters, transducers, interposing control relays and interface terminal blocks. Generally the interface cabinet shall be mounted adjacent to the RTU cabinet. However, in a few cases, the interface cabinet may be mounted separately at different places. All RTU signals shall be connected to the transducers, Multi Function Meter, interposing relays and field signals in the interface cabinet.

The interface cabinet shall house various pieces of equipment that are needed to interface to the RTU. It shall be of modular type. The equipment shall be rail/wall mounted or plug in type. The connections shall be on the front end for incoming or outgoing circuits and on the rear end for internal connections between different subassemblies of the interface cabinet.

Prewired and standardized solutions for cabling shall be used. This shall enable a few standardized designs for the interface cabinet to be developed all of which shall have identical provision for various types of plug-in boards / modules (e.g. position indication; MW and MVAR measuring signals).

The interfacing components for each typical bay shall comprise typical modules and subassemblies logically sorted by type of interface. For example, interface components associated to a double bus bar type feeder shall consist of a module for the circuit breaker position indication, a module for the associated bus bar isolators position indication, a module associated to power measurements and a module associated to position control. Each module or subassembly shall be provided with all testing (switching, disconnecting and inserting) facilities allowing easy maintenance.

Wireways not more than 50% full for the maximum RTU configuration shall be provided to route the necessary conductors from the Purchaser's choice of top or bottom access to the I/O terminations. For wireway sizing purposes, the RTU Supplier shall assume that each point uses an independent cable. Analog and digital inputs shall be shielded.

RTU hardware may be mounted in the interface cabinet, provided that all future expansion needs as per specifications are being met.

4.12 Enclosures :

The Contractor shall provide enclosures for the RTU and interface cabinets meeting the following requirements:

- (a) The enclosures shall be finished inside and out. All cabinet metal shall be thoroughly cleaned and sanded and welds chipped to obtain a clean, smooth finish. All surfaces shall be treated to resist rust and to form a bond between the metal and the paint. RTU enclosures shall be finished a semi-gloss smoke gray color.
- (b) The enclosures shall be free standing, floor mounted and shall not exceed 220 cm in height.
- (c) The enclosure shall be built up as a 48.26 cm (19-inch) rack-mounted system with hinged units provided as necessary.
- (d) Maintenance access to the hardware and wiring shall be through lockable, full height, front doors.
- (e) Provisions for top and bottom cable entry shall be provided with wiring gaskets and stuffing glands on cabinet mounting plates.
- (f) Signal and safety ground networks within the enclosure shall be provided. The safety ground shall be insulated from the signal ground and shall be connected by the Contractor to the ground network and to the ground wire of the ac power input.

The signal ground shall terminate at a separate stud connection sized for a lugged 16 mm² ground wire. Each ground network shall be a copper bus bar, braid or cable. Use of the enclosure frame, skins or chassis mounting hardware for the ground network is not acceptable.

- (g) All enclosures shall be supplied with 230 V AC, 50 Hz, single-phase convenience out-lets compliant with local Indian standards.
- (h) All enclosures shall be provided with an internal maintenance lamp, gaskets and eyelets for bundling and routing internal wiring.
- (i) All enclosures shall be indoor, dust-proof with rodent protection, and meet ISO-IP41 class specifications.
- (j) Wherever operating voltages within the enclosures exceed 50 Volts the equipment shall be covered or shielded from accidental contact and shall be labeled accordingly.
- (k) There shall be no sharp corners or edges. All edges shall be rounded to prevent injury.
- (l) Material specified in the design of the enclosures shall be fire resistant and approved by the Purchaser as consistent with safety codes.
- (m) Document Holder shall be provided inside the cabinet so as to keep test report, drawing, maintenance register etc.

4.13 Equipment Packaging :

All materials shall be new and of the best commercial grade used in the manufacture of all RTU equipment. All electronic components shall be solid-state. All wire and cable connection and terminators shall be permanently labeled for identification. All connection points for external cables and wires shall be easily accessible for connection / disconnection and shall be permanently labeled. All components and equipment shall be of current production from component manufacturers. To facilitate expansion and maintenance, modularity shall be employed through out the hardware equipment. All wiring shall be neatly laced or clamped. Materials that are susceptible to corrosion shall not be used.

Each RTU chassis backplane shall be prewired to accept the ultimate capacity of plug in I/O modules (180% as per Clause 4.21). The hardware shall be sufficiently sturdy to withstand placement and start-up without damage.

4.14 Interconnections :

All cabling between component units of the RTU, RTU to interface cabinet, and to the employer control and relay panels (located in the sub-station control house) shall be supplied and installed by the Contractor and shall be shown on Contractor supplied

drawings. Plug-type connectors with captive fasteners or compression type connectors shall be used for all internal interconnections. The connectors shall be polarized to prevent improper assembly. Each end of interconnection cables shall be identified by a marker which includes the cable number and the identifying number and location of each of the cable's terminations; this information shall match with the Contractor's drawings.

Contractor wiring within enclosures shall be neatly arranged and shall not be directly fastened to the enclosures frame. All internal interconnection wiring and cables shall be routed separately from field wiring to the RTU terminals. All wiring shall use copper conductors and have flame retardant insulation. Conductors in multi-conductor cables shall be individually color coded.

The use of nonflammable, self-extinguishing, plastic wire troughs is permissible. Metal clamps must have insulating inserts between the clamps and the wiring. Wiring between stationary and movable components such as wiring across door hinges or to components mounted on extension slides, shall allow for full movement of the component without binding or chafing of the wiring.

The Contractor shall supply all signal / control wiring between the interface cabinet and Employer's control and relay panels. Adequate space and hardware shall be provided for routing of the field wiring within the enclosures. The Contractor shall describe the recommended shielding for such cable connections to provide satisfactory protection of the I/O points from noise and electromagnetic interface.

4.15 WIRING TECHNICS:-

The following techniques, materials and practices shall be used in the internal wiring of the RTUs.

(a) Terminations :

All connections for interconnecting wiring integral to the Supplier's equipment shall be of a durable and reliable type.

(b) Signal Separation :

All wires that carry low-level signals shall be adequately protected and separated as far as possible from power wiring.

(c) Pin and Socket Identification :

Each pin and its associated socket connection shall be clearly identified by a coding scheme that is uniform within each system.

(d) Connector Alignment Features :

Plugs and receptacles shall have keys, aligning pins, or other devices to indicate and ensure proper insertion of connectors.

(e) Mating to Adjacent Connectors :

Plugs and matching receptacles shall be physically positioned or constructed to preclude improper mating with adjacent plugs or connectors.

- (f) **Plug and Receptacle Accessibility :**
All plugs and receptacle shall be mounted and positioned for ease of replacement or repair.
- (g) **Cable Harnesses :**
Wherever possible, wires shall be bundled into harnesses formed by plastic or nylon cable ties.
- (h) **Cable Routing :**
Cables shall be routed so that wires or insulation can not be over-flexed, pinched or damaged by doors, drawers, disassembly, or by other operations required for installation, testing and maintenance.
- (i) **Cable Accessibility :**
Cables and wiring shall be easily accessible by maintenance personnel and shall be installed in conspicuous location.
- (j) **Cable Bending :**
Cables shall connect or disconnect easily without bending or crimping.
- (k) **Cable Mounting :**
Cables or wiring shall be mounted on stationary panels where practical, stress points shall not occur on connectors. Cable glands shall be provided wherever required.
- (l) **Cable Protection :**
Grommets or other protective devices shall be used to protect cables or wires that are routed through panel holes or over sharp-edged surfaces.
- (m) **Card Edge Connectors :**
All printed circuit card edge connectors shall have gold plated contact surfaces and shall have positive contact wiping action.

4.16 Terminal Blocks :

Terminal Blocks shall be screw-type/ stud type/ cage clamp type/ self stripping type/ spring type with full depth insulating barriers made from molded self-extinguishing material. Rust proofing of metallic components shall be provided by means of the metal used or a suitable coating. Terminal blocks shall be appropriately sized and rated for the electrical capacity of the circuit and wire used.

The surface for the wires shall be flat with only slight ridges for maintaining the integrity of the connection. The mechanical design shall be such that the wires maintain a tight connection to the terminals. All terminals and blocks shall be clearly labeled.

No more than two wires shall be connected to any terminal. The Contractor shall provide two input terminals and a shield termination for each analog input signal. Contact

input and output signals shall require two terminals per point plus a shielded termination for each group of signals.

Test Terminal block shall be grouped according to the circuit functions & each terminal block group shall have at least 20 % spare terminal for accommodating additional wires if required.

4.17 Assembly and Components Identification :

Each assembly (to the level of printed circuit cards) shall be clearly marked with the manufacturer's part number, serial number and the revision level of the component. Changes to assemblies shall be indicated by an unambiguous change to the marked revision level.

All electronic parts (such as capacitors, resistors and integrated circuits) shall be marked either with the characteristics of the part or with an industry standard part number. Where custom parts are provided (such as read-only memories), the part shall be marked such as to specifically identify the part when similar parts may exist.

All printed circuit card cages and all slots within the cages shall be clearly labeled. Printed-circuit cards shall be keyed for proper insertion. It is desirable that printed cards be keyed to prevent insertion into incorrect locations.

4.17.1 Assembly of Equipment :

The following requirements shall be met :

(a) Component Mounting :

Mounting of components shall be on plug-in printed circuit cards of epoxy glass or equivalent quality. Cards and their associated slots shall be plainly identified so that they can be readily associated with information on drawings and in Supplier furnished manuals.

(b) Plug-In Assemblies :

Plug-in assemblies and subassemblies shall be employed wherever possible, using as few mounting screws as possible consistent with stress and vibration requirements.

(c) Guide Pins :

Guide pins or other devices shall be provided for alignment of subunits during connecting and disconnecting so that pin and socket connectors are protected.

(d) Sub-unit Replacement :

Replacement of one modular sub-unit shall not require removal of other modular sub-units.

(e) Mounting Hardware :

Fasteners for modular sub-units shall require no specialized tools, mounting Hardware shall be interchangeable, using as few sizes as practical.

(f) Limit Stops :

Positive limit stops with manual unlatching shall be used on all swing-out and roll out racks and drawers.

(g) Grounding :

Each cabinet provided under these Specifications shall be grounded.

(h) Equipment Assembly :

Equipment shall be assembled to allow for easy access without disassembly of components contained within enclosures; slide-out or hinged mountings shall be employed where enclosures would otherwise prevent access to equipment. Equipment shall be mounted so as to provide easy access to test points, fuses, switches, and all items requiring replacement, adjacent or calibrations.

(i) Wireways :

Wireways and I/O cabling shall not interface with removal, repair or adjacent or RTU power supplies, circuit cards and terminations.

4.17.2 Equipment Components:

Components shall be selected which have quality levels that conform to standard engineering and industry requirements for comparable equipment. Solid state and other electronic components shall be applied within their specified operating ranges. No components which have been selected for special characteristics from a group of the Supplier's standard product shall be used unless specifically authorized by the Purchaser. If such components are authorized, detailed selection procedures, along with a list of specific test equipment which is needed for the selection, shall be provided in the equipment manual.

No single source components shall be supplied unless specific written permission is given by the Purchaser.

4.17.2.1 Integrated Circuits :

Integrated circuits shall operate within normal temperature range characteristics.

4.17.2.2 Discrete Components :

All discrete components, including semiconductors, resistors, capacitors, fuses and lamps, shall be selected in accordance with standard commercial and industrial quality assurance methods.

4.17.2.3 Circuit Breakers :

All circuit protection breakers shall be of the manually operated, moulded-case type and shall provide thermal over-current and instantaneous short-circuit protection in each pole. All circuit breakers for 48V DC circuits or less shall be rated at not less than 125 V DC. 240-V AC circuit breakers shall be rated at not less than 480-VAC.

4.18 Noise Level :

The audible noise generated by the RTU equipment shall not exceed 50 dbA one meter from the enclosure.

4.19 Environment Requirements :

The RTUs will be installed in control buildings without temperature or humidity control. The RTUs shall be capable of operating in ambient temperature from -5 to $+55^{\circ}\text{C}$ and relative humidity from 5 to 95%, non-condensing with rate of temperature change of $20^{\circ}\text{C}/\text{hour}$.

4.20 Availability :

The RTUs will perform data acquisition and control of important equipment necessary for the operation of Employer's power system. Any failure of RTU to perform its functions will adversely affect power system operations. An availability of 99.9% is required exclusive of communication channel availability. The RTU shall be considered unavailable when:

- (a) Any function is lost for all points of a single type.
- (b) One entire data scan group fails
- (c) More than one input card or output card of the same type fails
- (d) One input card or output card of each type fails
- (e) Failure of any modem

4.21 RTU Size and Expandability :

RTUs associated transducers, Multi Function Meters and support equipment will be procured with this Specification as defined and equipped as provided in Appendix 'A', . Twenty percent (20%) of each RTU point type shall be provided in the RTU as wired available reserve capacity which can be used with no further hardware additions including circuit board terminals and terminal blocks.

The RTU delivered shall have the capability to add additional point modules to expand the overall point count of the RTU by a minimum of fifty percent (50%) i.e. 180% of the actual RTU count. Expansion shall be accomplished in the field by employer by only adding additional distributed input / output modules within the main unit.

4.22 Maintainability :

The RTU design shall facilitate isolation and correction of all failures. The following features which promote rapid problem isolation and replacement of failed components shall be provided:

- (a) Self-diagnostic capabilities within each RTU which can be initiated at the RTU site.
- (b) On-line error detection capabilities within the RTU and detailed reporting to the connected stations of detected errors.
- (c) Local indication of major RTU failures.

4.23 Life Span :

Each RTU shall have a design life of 15 years from the date of final acceptance. The Contractor shall make available at no cost to employer the manufacturing drawings and rights to manufacture those subassemblies which the manufacturer will not support or discontinues support for during this life span including subassemblies not included in the original RTU procurement. For each subassembly, the specific parts supplied shall be identified and referenced in supplied documentation.

5.0 TRANSDUCER/

The contractor shall provide the Multi Function Meters, transducers and cabling as specified in the following section.

5.1 Transducers

5.1.1 Transducers :

The Contractor shall supply transducer for the analog points to monitor MW ,MVAR of all feeders ,Transformers ,transfer buscoupler, bus tie and All Bus Voltages, Frequencies of respective substn. The Transducer shall include Transformer Tap Position indicator. The transducers procured with this Specification will be installed in the RTU for each sub-station by the Contractor.

The transducers shall use state-of-the art solid-state technology. The transducers shall comply with the latest standards including the IEC 688.

5.1.1.1 Sockets :

The transducers shall be either modular surface mounted or plug-in printed circuit board type. Plug in transducer units shall include a safety socket keyed to prevent plugging in the wrong transducers and shall be easily removable and replaceable. The transducers using current sources shall be shorted, not allowing an open circuit, when removed.

All transducers shall be mounted on 48.26 cm (19-inch) panels or the walls of the interface cabinet. Plug-in transducers shall be in their own rack.

5.1.1.2 Socket Terminal Blocks :

Electrical socket connections shall be screw-type/stud type/ cage clamp type/ self stripping type/ spring type terminals with indirect wire pressure. The terminals shall accept upto 2.5 mm² or one 4 mm² wires.

(a) Top Row :

Measured voltage (or other non-current quantity) inputs, auxiliary supply voltage, and output current loop.

(b) Bottom Row :

Measured current inputs and neutral.

5.1.1.3 Transducer Identification :

Each transducer shall have an externally visible label that complies with the IEC 688 standards.

5.1.1.4 Transducers Auxiliary Power Supply :

Transducers shall use a 48 V DC auxiliary power supply as specific in Section 4.10. The transducers shall have a maximum power consumption of three watts.

5.1.1.5 Transducer Protection:

All input, output and auxiliary circuits shall be isolated from each other and earth ground. The transducer output shall be ungrounded with short circuit and open circuit protection. The transducers shall be tested with the following requirements without damage to the transducer.

(a) Voltage :

Voltage test and other safety requirement compliance as specified in IEC 688 and IEC 414.

(b) Impulse Withstand :

IEC 688 compliance is required.

(c) Electromagnetic Compatibility :

IEC 688 and IEC 801-3, level 1 compliance is required.

(d) Permanent Overload Protection:

IEC 688 compliance is required.

(e) **Temporary Overload Protection :**

IEC 688 compliance is required.

(f) **High Frequency Disturbance :**

IEC 688 compliance is required.

5.1.1.6 Other Characteristics:

The transducers shall comply with the following general characteristics:

(a) **Shock Resistance:**

Minimum severity 50 A, IEC 68-2-27 requirements

(b) **Vibration Strength:**

Minimum severity 55/05, IEC 68-2-6 requirements.

(d) **Reference Conditions For accuracy Class :**

IEC 688 compliance is required.

(e) **Temperature Rise :**

IEC 688 compliance is required.

5.1.1.7 Transformer Tap Position Transducer:

The existing transformer tap position indications shall be normally of Variable resistance type.

The conductor shall provide suitable resistance tap position transducers which shall have the following characteristics:

(a) The input measuring ranges shall be from 0 to 1000 ohms per step, which is tunable at site with at least 16 steps.

(b) Dual output signal of 4 to 20 mA DC, 0.5% accuracy class as per IEC 688 shall be provided. One output will be used for driving a local digital indicator (to be provided by the contractor) and the other will be used for interfacing with the RTU. These Transducers shall be mounted on OLTC panel with local digital indicator.

5.2 Contact Multiplying Relays (CMRS)

The description of Contact Multiplying Relays as under is substituted in place of hardware requirement at SLDC & Sub LDC:

(i) Contact Multiplying Relays (CMRs) are required to multiply the contacts of breaker and isolators etc. The contacts of these relays shall be used to provide status inputs to the RTUs.

(ii) The relays shall be DC operated, self reset type. The rated voltage for relay operation shall be 220V DC / 110V DC depending on the station DC supply.

(iii) The relay shall operate for a voltage range of 80% to 120% for 220V/110V DC rated voltage.

(iv) The relay shall have a minimum of two change over contacts, out of which one shall be used for telemetry purposes.

(v) The relay shall conform to following requirement.

Power Frequency withstand voltage of 2kV for 1 minute as per IEC 255-5.

Insulation Resistance of 100M ohms for a voltage equal to 500V DC.

(vi) The relays must be protected against the effects of humidity, corrosion & provide with a dust tight cover. The connecting terminals shall be screw type & legibly marked. The relays shall have a visual operation indicator. The relays are to be mounted in existing Control & Relay (C&R) panels and therefore shall be equipped with suitable mounting arrangements.

6.0 Software requirement :

The software provided to support the functions of the RTUs shall meet the characteristics described in this section. The term “software” is used throughout this Specification to mean either software or software implemented in firmware.

6.1 Design Characteristics :

All software shall be implemented according to the Contractor’s established design and coding standards. Employer reserves the right to reject any software that does not conform to these standards. Complete and comprehensive documentation shall be provided for all software.

At the time the RTU is accepted, all software delivered must be up to date and in final form, including all standard software changes and field changes initiated by the Contractor or the Contractor’s suppliers prior to acceptance. The software documentation must reflect these changes.

6.2 Operating System :

The Contractor shall use a non-proprietary operating system capable of managing the distributed applications of the RTU. If a proprietary system is offered then contractor shall provide the corresponding source code. The operating system shall support multi-

tasking and multi programming. The minimum real-time facilities to be provided shall include process, job database and memory management, process, synchronizing, message services for communication between jobs and device and interrupt handling.

6.3 Initialization / Restart Program

Software shall provide automatic restart of the RTU upon power restoration, memory parity errors, hardware failures and upon manual request. The software shall initialize the RTU and begin execution of the RTU functions without intervention by master station. All restarts shall be reported to the connected master stations.

6.4 RTU Operations Monitoring:

Software shall be provided to continuously monitor operation of the RTU and report RTU hardware errors to the connected master stations. The software shall check for memory, processor and input / output errors and failures.

6.5 RTU Configuration Support :

The Contractor shall supply a database compiler which will enable to configure and document each RTU's database.

A compiler shall be provided to completely generate or modify the database of the RTUs. The database compiler shall provide error detection services and shall produce a printed listing of the input data and the resulting RTU configuration. It shall be possible to maintain the RTU database locally and from a master station.

6.6 Diagnostic Software :

The Contractor shall supply diagnostic software which monitors and individually tests each of the components of the distributed RTU. The diagnostics shall provide comprehensive user interaction and printout capabilities.

7.0 INSTALLATION REQUIREMENTS :

The contractor shall be responsible for the complete adaptation and installation of the RTUs, interface cabinets, Multi Function Meters, transducers & relays in the employer substations. This includes the following requirements:

- a) Preparation of all input and output signals to interface with the substation power system equipment.
- b) Installation of all RTUs, Multi Function Meters transducers, interface cabinets and associated equipment.
- c) Sizing of all cables and wiring to meet the specified requirements and meet standards.

- d) Installation of all signal, communication and power cables required to interface the RTUs, interface cabinets and transducers with Employer's substation facilities.
- e) Wiring and termination of all power, communication and signals in the RTUs, in the interface cabinets, at the transducers and on the control and relay panels in the control house.
- f) Proper sizing and installation of grounding to the RTUs and interface cabinets.

7.1 RTU Interfaces :

The Contractor shall locate and install the RTUs in the employer substation control houses. All cabling shall be run and wiring connected to the power source and communication interface. Cables shall be run and connected to the interface cabinets for the input and output signals & local interfaces.

The RTU cabinet shall be properly grounded to the substation grounding system through the facilities specified in Section 4.12 (f).

7.2 Interface Cabinet:

The Contractor shall locate and install the interface cabinet in the employer substation control house. All cabling shall be run and wiring connected to the Power source, RTU and field devices.

The interface cabinet shall gather all signals from and to the field devices located in the substation bays and on the control board in the substation control house. Exhibit 7.1 provides a summary of the functions to be performed within the interface cabinet including:

- a) Termination of all I/O signals between the interface cabinet and field devices.
- b) Conditioning of signals through control output interposing relays, isolating transducers and signal transducers.
- c) Housing all signal conditioning, decoupling and transducer & MFM equipment.
- d) Grouping of signals by equipment bays for routing to the control and relay panels by signal types for routing to the RTU I/O points.
- e) Termination of all I/O signals between the RTU and interface cabinet.

The interface cabinet shall be properly grounded to the substation grounding system through the facilities specified in Section 4.12 (f).

Cabling between the RTU and the interface cabinet shall use shielded cables. Cables to the field equipment shall use a separate cable for each bay. Cables to the field equipment shall be armoured type with an inductive shield.

7.2.1 Interface Cabinet Signal Marshalling Requirements:

The marshalling of signals in the interface cabinet shall include:

- a) Routing of all I/O signals from each substation bay to a common location on field interface terminal blocks in the interface cabinet.
- b) Routing of all I/O signals from common termination points in the RTU enclosure to a common location on RTU interface terminal blocks in the interface cabinet.
- c) Cross-connection of the above signals on a terminal block distribution frame.

The arrangement of the interface terminal blocks shall include consideration for the best location to pick up signals from the field devices and route them to the RTU. The Contractor shall review the existing substation wiring and shall access the required signals at the closest location (equipment bay, control board or other). Some of the substations have the signals available on terminal blocks in anticipation of the addition of RTU to the substation. These should be used where available.

8.0 INSPECTION AND TEST :

All material, hardware and software to be furnished and all work to be performed under this Specification shall be subject to inspections and tests. No equipment shall be shipped until all required inspections and tests have been made, demonstrating that the equipment conforms to the Specification and that the hardware and software have been approved for shipment by employer.

Approval of inspection and test results, acceptance of hardware and software or the waiving of inspection and tests thereof, shall in no way relieve the Contractor of the responsibility for furnishing equipment which meets the requirements of this Specification, nor shall such actions invalidate any claim which employer may make because of defective or unsatisfactory hardware and software, employer reserves the right to request additional tests on the equipment at no extra charge on any work employer determines not to be in accordance with this Specification.

Whenever the results of any inspections or tests performed or requested by employer in accordance with the requirements of this section indicate that specific hardware, software or documentation does not meet the specification requirements, the Contractor shall replace, modify or add at no cost to employer, hardware, software, or documentation as necessary to correct the noted deficiencies.

8.1 Inspection :

Representatives of employer shall have free entry into the shops of the manufacturer at any time while design, fabrication or testing of the equipment is taking place and into any mill, shop or factory where the hardware or software described in this specification is being produced.

The Contractor shall provide to Employer's representatives, free of cost, all reasonable facilities, equipment and documentation necessary to satisfy Employer's representatives that the hardware is being fabricated in accordance with the Specification. The inspection rights described above shall apply to the facilities of the Contractor or the Contractor's subcontractor where the hardware is being manufactured. The inspection rights shall not apply to the facilities of subcontractors supplying unit components to the manufacturer. Such items will be inspected and tested by Employer's representatives at the manufacturing site.

Inspections by employer will include visual examination of the physical appearance of the hardware, cable dressings and equipment and cable labeling. Contractor documentation will also be examined to verify that it adequately identifies and describes all hardware, software and spare parts, employer shall have access to inspect the Contractor's and manufacturer's quality assurance standards, procedures, and records which are applicable to this project. Inspection shall not relieve the Contractor of the responsibility for furnishing material and equipment conforming to the requirements of the Specification, nor shall such inspection invalidate any claim which employer may make because of defective or unsatisfactory hardware or software.

The Contractor 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 arrangements could be made for inspection.

No material shall be dispatched from the works of manufacturer unless the material has been satisfactorily inspected and tested.

The acceptance of any quantity of the equipment shall in no way relieve the Contractor 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.

8.2 Test Procedures :

The Contractor shall submit the test procedures for approval twelve weeks prior to the start of factory tests. Fully approved test procedures shall be submitted to employer at least four weeks prior to the documentation of the tests employer will only approve test procedures if they are inclusive thoroughly testing each section of the equipment. The Contractor shall use IEC standards as a guide in preparing the test procedures. The test procedures shall include the following :

- a) The test schedule, including provision for eight hours of unstructured tests to be performed by employer.

- b) The purpose of each test
- c) The function to be tested
- d) The plans / procedures to be followed
- e) Specific references to project documentation for correlation with the
- f) procedures and for verification of the documentation.
- g) The test setup, equipment and conditions for each part of the test
- h) All test inputs and outputs
- i) Test software descriptions and listings
- j) A copy of any certified test data to be used in lieu of testing
- k) Expected results
- l) The acceptance criteria
- m) A procedure for handling the variances that are identified during testing

8.3 Test Records :

The Contractor shall maintain a complete record of the results of all tests. This record shall be keyed to the steps enumerated in the previously approved test procedures. The record shall include the following items :

- (a) Reference to the appropriate section of the test procedure
- (b) Description of any special test conditions or special action taken
- (c) Test results, passed / failed

A copy of the test records shall be delivered to employer and cabling elements of the RTU procurement shall be tested in two parts :

1) Type Testing :

The Tenderer must give the Type test report of complete integrated units shall be fully tested to assure full compliance with the functional and technical requirements of the Specification. The testing report shall include one of each of the device types (transducers, MFT, modems, relays etc.)

2) Routine Testing :

Each complete RTU / interface cabinet unit shall undergo functional and sample point testing.

All hardware and software shall successful pass testing before being accepted. In the event the hardware is delivered in stages (more than one delivery date), employer shall have the option to require complete testing on all hardware for each delivery. This complete testing shall include both Type and Routine testing.

8.4.1 Type Testing :

Type testing certificate must be submitted to the employer. Contractor shall commence commercial production of RTUs / SICs after showing type test report and approval from Employer.

The Type Testing certificate shall include testing of complete RTU and interface cabinet hardware, software and functionality (Clause 4), transducers, Multi Function Meters and cables (Clause 5) and standard software (clause 6) to demonstrate full compliance with all specified requirements, standards and functional capabilities including:

- (a) Inventory check and inspection for general construction, cabling, connectors, drawing conformance and labeling.
- (b) Tests of proper functioning of all hardware and software by a thorough exercising of all RTU functions both individually and collectively.
- (c) Test operation of all RTU analog inputs including using convenient test panels, which allow each input to be varied over its entire range.
- (d) Test operation of all RTU digital input points.
- (e) Test operation of all RTU control outputs.
- (f) Test SOE and RTU time synchronization and accuracy with multiple master stations.
- (g) Test power supply voltage margins, ripple levels and short circuit protection.
- (h) Tests analog accuracy, temperature coefficient, noise rejection and over-voltage protection on 10% of all analog points.
- (i) Test of RTU power failure and recovery
- (a) Test the operation and accuracy of all transducer devices
- (b) Test the operation and accuracy of Multi Function Meter devices
- (k) Test overload protection, impulse withstand capability and protection from electromagnetic fields as specified for all RTU and interface cabinet wiring termination types, including transducers, RTU I/O points, communication channels, input power and field interface terminal blocks.
- (l) Tests of communications, including all communications ports, modems, local interfaces and communications with multiple master stations.
- (m) Test of equipment spares through substitution
- (n) Verify completeness and accuracy of hardware and software documentation.
- (o) Test the operation of all functions of the configuration and maintenance terminal with the RTU including verification of the communication protocol capabilities and modification of the database, point configuration, point

additions and point deletions. Test operation of all diagnostic software and confirm issuance of meaningful messages for all type of error condition.

- (p) Test under full-power, simulated environmental conditions and operation for 48 hours. Twelve hours of this test shall be at the specified high temperature limit. The RTU shall demonstrate continuous operation without any failures. This operation shall include periodic scanning of all points and demonstration that all RTU functions operate properly.

RTU shall successfully pass the following tests in which all functionally is demonstrated using a test set. The following functional tests shall demonstrate the capabilities and features of RTU and RTU test set :

- (q) Verification of RTU Test Set capabilities
- (r) Verification of Field Device Simulator capabilities
- (s) Verification of Maintenance RTU configuration and capabilities
- (t) A test verifying that the RTU is capable of the ultimate point count specified.
- (u) One RTU shall be temperature tested over the RTU defined temperature range.
- (v) A configuration test where by additional I/O cards will be added and verified that they work.
- (w) A test to show changing of the protocol prom ICs, inserting an alternate protocol and that the RTU functions per the alternate protocol.
- (x) IEEE Surge Withstand Capability (SWC) tests shall be performed on all field-wiring terminals of the RTU to be protected against surges with the equipment energized and de-energized. This test shall neither cause erroneous operations nor erroneous input data readings, any component failures, nor shall any stored data values be modified. One complete SWC test shall be performed. The Purchaser will select the RTU that shall be tested.
- (y) Dielectric Test as per IEC-65.
- (z) Insulation Resistance Test as per IEC-255, 50 Hz Voltage withstand test for 60 seconds at 2 KV.
- (aa) One RTU shall be placed in a room having an ambient temperature of 55° C with the RTU connected to a data channel and to equipment simulating actual field equipment to be monitored or controlled. It shall remain

energized at this temperature for a minimum period of 48 hours. During this 48-hour burn-in period the RTU shall have its various modes of operation exercised periodically. At the completion of the 48-hour period and with the RTU shall energized and subjected to the ambient temperature of 55° C, the functional tests described shall be performed at normal power supply voltages. After completion of the burn-in at 55° C the RTU shall be operated at normal ambient temperatures for an additional continuous period of 240 hours. The functional tests shall be performed at least once in each 80-hour period to demonstrate that the RTU is functioning correctly. If any failures occur, the failures shall be corrected, using modules that have been burned-in as specified and the test restarted until 240 hours of continuous operation is achieved.

If failures, occurring during functional testing, indicate that temperature-related design problems exist, the Purchaser shall have the right to insist on complete temperature testing of the RTU type, even if the requirement has been waived.

- (bb) Fast Transient Burst Test as per IEC-870-2-1 level-3.
- (cc) Damped Oscillatory Wave Test as per IEC-870-2-1 level 3-4.
- (dd) Electrostatic Discharge test as per IEC-870-2-1 level-4
- (ee) The RTUs and associated equipment installed in their enclosures, shall operate without disruption in the presence of the following electromagnetic fields :
 - (1) Power Frequency Magnetic Field and Damped Oscillatory Magnetic Field Test as per IEC-870-2-1 level-3.
 - (2) Radiated Electromagnetic Field Test as per IEC-870-2-1 level-3.
- (ff) The supplier shall demonstrate all functions on the IEC-870-5-101 RTU protocol at the latest revision level using the system and the RTU test set.
- (gg) Connection of high-voltage sources to input and output terminals may occur during the life of the equipment. No damage shall occur to any input or output due to continuous normal mode overload of upto 250 V DC or 250 V DC peak at 50 Hz or due to imposition of upto 300 V DC or 300 V DC peak at 50 Hz, between any terminal and ground. Recovery from either type of overload to nominal accuracy shall require less than 5 minutes. The effect on analog accuracy of either type of overload on any adjacent analog channel shall be less than 0.1% of full scale.

Overloads greater than specified above, but less than 600 V DC or 600 V DC peak at 50 Hz, may damage some components but shall not result in

propagation of any damage beyond the single input, output or communications circuit at which the overload has occurred.

8.4.1.1 Type Testing of other Components :

The contractor shall submit type test certificate and published specifications of the transducers, Multi Function Meters, Modems and interposing relays for review and approval by MPPTCL. In the event, the type test reports for Multi Function Meters transducers, modems, interposing relays etc. are not meeting the requirements as per RTU specification, the Employer may ask for the type testing of any or all of the above at no additional cost.

8.4.2 Routine Testing :

The Routine Testing shall include testing of employer selected RTU hardware, interface cabinet hardware, Multi Function Meters and transducer to demonstrate compliance with specified requirements, standards and functional capabilities including:

- (a) Inventory check and inspection for general construction, cabling, connections, drawing conformance and labeling.
- (b) Tests of proper functioning of hardware and software by a thorough exercising of all RTU functions, both individually and collectively.
- (c) Test operation and accuracy of all RTU analogue inputs including using convenient test panels, which allow each input to be varied over its entire range.
- (d) Test operation of all RTU control outputs.
- (e) Test SOE and RTU time synchronization and accuracy.
- (f) Test power supply voltage margins, ripple levels and short-circuit protection.
- (g) Test of RTU power failure and recovery.
- (h) Test the operation and accuracy of all transducer devices.
- (i) Tests of communications, including all communications ports, modems and local interfaces.
- (j) Test of equipment spares through substitution.
- (k) Test operation of all RTU digital input output points
- (l) Verify completeness and accuracy of hardware and software documentation.
- (m) Test the operation of the configuration and maintenance terminal with the RTU.

For any variations in the configuration, hardware components used or variations from the Type accepted equipment, Employer has the right to perform any of the Type Testing before successful completion of the Routine Testing.

8.4.3 Field Performance Tests :

The Contractor shall be responsible for providing field installation and testing. All hardware will be installed, aligned and adjusted, interfaces to all employer field inputs and outputs established, operation, verified and all test readings recorded. Upon completion, a field performance test shall be performed to exercise all functions of the RTUs and duplicate selected factory acceptance tests to the extent possible. This testing will include, but not be limited to the following test :

- a) RTU initialization
- b) Proper functioning of hardware and software by exercising of selected RTU functions using the master plan
- c) Proper RTU communications interface.
- d) Test operation of all diagnostic software and confirm issuance of meaningful messages for all types of error conditions.
- e) Test time synchronization and accuracy of the RTU from the master plan.
- f) RTU database verification including point-to-point operation and scaling accuracy using the master station.

The test procedures shall be submitted at least 12 weeks prior to installation of RTUs.

9.0 TRAINING AND SUPPORT SERVICES :

The Contractor shall provide training and support services to create Employer's in-house maintenance and support capabilities for the hardware and software. The training program shall be comprehensive and provide for interdisciplinary training hardware and software. The required training of Employer's personnel shall be conducted by the Contractor in English.

9.1 FREE RTU Maintenance Training :

The Contractor shall provide RTU hardware, software and operation maintenance training. The courses shall familiarize Employer's course participants with RTU installation, card/circuit board level troubleshooting and repair procedures, and the recommended preventive maintenance procedures for the RTU equipment. Courses shall include use of the RTU configuration and maintenance terminal and shall demonstrate all facets of its operation. Courses shall also include hands-on trouble-shooting experience with the RTUs supplied by the Contractor and shall cover any special equipment required for maintenance. Actual RTUs to be supplied under this procurement shall be used for training.

The Contractor shall also provide RTU software training in the following areas:

- a) RTU configuration, modification and expansion
- b) RTU database generation and maintenance
- c) RTU software and operation including data flow.

9.1.1 Attendance :

RTU maintenance training course participants details shall be furnished to the purchaser .

9.1.2 Training Schedule :

The training schedule shall coincide with the delivery of the RTUs to employer. Training shall be provided in at least three different sessions to accommodate personnel attendance. The training course shall be an optimum mix of classroom and laboratory training.

9.1.3 Training course Requirement :

Employer's Training course requirement are described below in terms of the contents of each course to be provided. Training shall be provided on MPPTCL Data base for the application of soft ware course, the dispatchers training course and the associate training course.

9.1.3.1. Data base and Display building course :

The Data base and display building course shall be first course to be given in the overall training sequence, it shall be a hands-on course using the development systems (DS). The course shall be given immediately following delivery and installation of the DS. The course shall be designed to train employer personnel in how to use the DS to development the data bases, displays, reports for each SC & C computer system.

Course objectives shall include :-

- a. How to set up a display development system.
- b. How to identify data base fields , entries, records , table and contents.
- c. How to structure RTU table defination.
- d. How to build table , arrays and reports formats.
- e. How to build displays.
- f. How to perform data base maintenance.
- g. How to generate data base from source information.
- h. How to maintain symbol libraries, display colour group and display string lists.

On course completion, all participants shall be able to prepare the necessary in put data to define the system operating environment, build the system data base and displays, and prepare the data base administrator to maintain and modify the data base and its structures.

9.1.4 RTU Course :

The contractor shall provide an RTU course that covers the following subjects as a minimum:

- a. Theory of operation of all RTUs function.
- b. Operational procedures for various mode of operation, including diagnostic tests and interpretation of the associated tests results.
- c. Implementing and maintaining multiple communication course.
- d. Converting an RTU from one protocol to a different protocol.
- e. Demonstration of complete RTU tests set use, including tests sets connection and set up for all possible modes of operation, all operational procedures, the exercise of each command or feature associates with each mode of operation the interpretation of results , and how to use the tests set to diagnose and isolate RTU problems.
- f. Disconnection and replacement of all RTU equipment, including all modules within the RTU.
- g. Diagnosing and isolating problems in contractor provided hard ware associated with RTUs example transducers , multifunction meters and marshalling cabinet wiring.

9.1.5 Training Location and Classrooms :

The RTU maintenance courses shall be given at the Contractor's facility in India, or optionally at Employer's facility. The Contractor shall provide training to minimum 16 Participants in two batches.

9.2 Manuals, Equipment and Audio / Video Recordings :

Training manuals shall be prepared by the Contractor and submitted to employer at least 30 days prior to the start of any course. It is desirable that the manuals used for training be prepared for use at training aids. The use of maintenance or reference manuals as the only training manuals is unsatisfactory, although their use as supplementary material is encouraged.

Each course participant shall receive an individual copy of the training manuals and other pertinent material. One additional master copy of all training manuals and materials shall be provided to employer at the time of training. The master copy shall be suitable for reproduction by employer. Upon completion of each course, training manuals shall become the property of employer. The contractor shall also provide softcopy of the study material.

The Contractor may utilize prerecorded lectures as supplemental training material. These lectures shall not use serve as a replacement for the classroom instructor or as a primary training material. A copy of any course material on audio or video tape shall be

provided by the Contractor to employer for retention, playback and reference documentation.

The Contractor shall provide all special tools, equipment, training aids, and any other material required to train Employer's participants effectively. The number of special tools and other training equipment shall be adequate for the number of participants attending the course.

9.3 Continuing Support Services:

All training courses shall be available to employer from the Contractor for a minimum of ten years after RTU delivery. Subsequent to final acceptance, the Contractor shall provide continuing technical support of the RTUs for a minimum ten-year period. This requires that both consultation with knowledgeable Contractor technical personnel and support by trained field service personnel be readily available to assist employer engineers in correcting difficult RTU malfunctions.

10.0 DOCUMENTATION :

This Section describes the requirements for design approval and documentation.

10.1 Substation Design Document:

The supplier shall provide an engineer with substation design experience to work with the Purchaser's personnel to develop a Substation Design Document. This document shall be completed before the Supplier orders any RTU materials. The Substation Design Document shall include:

- (a) Wiring practices to be adhered to for all wiring (location, markings, connection methods etc.)
- (b) Equipment installation method and order of installation identification of each equipment as to where it should be placed.
- (c) A scaled drawing showing the location of CTs and PTs per substation and expected wire runs to the transducer cabinets, Multi function Meters, trenching methods and placement practice of wires.
- (d) A total installation program with approval as key milestones is completed.
- (e) Verify the wire types to purchase the quantity.
- (f) Verify the interposing relay configuration to be purchased.

The supplier shall provide the engineer for a length of time to complete this evaluation to prepare the document and to obtain concurrence from the Purchaser.

10.2 Documentation Approval :

To ensure that all RTUs, interface cabinets and interconnecting wiring (cables) to be supplied for each remote site conform to the specific provisions and general intent of the Specification, the Contractor shall submit hardware and software documentation to employer for review and approval. Employer will document their approval or submit comments to the Contractor within thirty working days after receipt of the documents. Corrected documents must be resubmitted by the Contractor to employer for approval as soon as possible. Employer will review the resubmitted documents and record their approval or submit additional comments to the Contractor within thirty working days after receipt of the resubmitted document.

Documentation for the Contractor's standard hardware and standard software shall be furnished to employer for review and approval by employer only to determine that this standard hardware and standard software is in full conformance with the Specification, that it is consistent with other hardware and software being provided and that the documentation is complete and correct in all respects. In cases where the Contractor's standard hardware or standard software does not conform to the requirements of this Specification and modifications are required, the standard documentation along with documentation of the modification shall be submitted for Employer's approval.

Any purchasing, manufacturing, or programming implementation initiated prior to Employer's approval of the relevant documents of drawings shall be performed at the Contractor's risk. Employer shall have the right to request additional support documents, and require the Contractor to make any necessary changes to construct the RTUs in conformance with the provisions and intent of the Specification without additional cost to employer. Review and approval by employer does not relieve the Contractor of the overall responsibilities to satisfy Specification requirements.

10.3 Documentation :

The Contractor shall provide complete documentation for the equipment. The following documentation requirements shall pertain to all documentation, including documentation produced by subcontractors. All documentation is subject to review and approval by employer, as described in clause 10.2.

10.3.1 Hardware Documentation:

The Contractor shall provide documentation for all hardware supplied to employer. Documentation describing the circuitry, operation of the circuitry and troubleshooting and maintenance procedures shall indicate the revision level of the hardware to which the documentation applies. General manuals are not acceptable unless they clearly show what is supplied and what is not supplied. This documentation shall satisfy the following requirements :

- (a) An inventory of the hardware to be supplied, including the manufacturer's

Name, model number, serial number and other pertinent data.

- (b) The physical planning/site-preparation documents, containing detailed mechanical drawings of all cabinets and related hardware. Information shall be provided on size and weight, detailed installation instructions and mounting details, clearance requirements and environmental restrictions, as well as the electrical requirements of the hardware.
- (c) The installation, wiring and cabling diagrams. Terminations for all connections shall be clearly identified with adequate space for employer cable and wire identifiers. Any special precautions associated with cabling shall be identified on this drawing.
- (d) The internal wiring diagrams, oriented toward input and output wiring termination points.

The drawing shall include:

1. The identification of the terminal block and pin numbers
 2. Space for employer to add the point name for each input and output point (at least twenty characters).
 3. Point type
 4. The point's I/O card location
 5. The point's address within the protocol
 6. The point's signal conditioning (filtering, scaling, isolation etc.) and the location of the conditioning (if not on the point's I/O card)
 7. All jumper / strap positions.
- (e) The enclosure assembly drawings showing the locations of the components, such as power supplies, transducers, Multi Function Transducer, interposing relays, termination facilities, printed - circuit card chassis, and the sub assembly comprising the components to the level of printed circuit card. The drawings shall identify each component and sub assembly by part number and revision level. An individual drawing shall be produced for each enclosure's equipment and a copy of the appropriate drawing shall be stored in side each enclosure, preferably on the enclosure's door.
 - (f) All maintenance documentation, including manuals and other descriptive material, which will enable employer personnel to maintain all contractor- supplied equipment.

The maintenance documentation shall include description, specifications, theory of operation (including software listing where applicable), printed circuit module schematic and lay-out drawings showing components and position, mother board schematic showing inter-module-connections, back-panel and assembly wiring diagrams, pin lists, and other data on all electrical, electronic and mechanical hardware. All schematic diagrams show signals sources and destinations by

drawing number and area. All schematic (including back panel wiring) shall include a signal name list alphabetically listing each signal, its source, normal waveform and value, and all destinations.

Instructions shall be included for preventive maintenance procedures consisting of examinations, tests, adjustments and cleaning that should be performed periodically under normal operating conditions for the purpose of preventing failure or impairment of the equipment.

The manuals shall provide guidelines for isolating the cause of the hardware mal-function. The discussions should contain concise information on how the hardware operates, trouble shooting guides for localizing fault, listing of possible sources of trouble, symptoms, probable causes, use of test equipment, use and interpretation of built-in RTUs test functions, and instructions remedying faults. User configuration options must be described as well as their normal position. Instructions shall be provided for the removal, repair and replacement of all hardwares.

Complete parts list and breakdowns, description sufficient to identify each component and altering information for these parts, shall be provided in conjunction with maintenance manuals. Every component sub-assembly and assembly shall have a unique part number assigned to it. This part number shall co-inside with the marking on the hardware itself and shall be used in the documentation whenever the hardware element is referenced. Where standard components are used, standard part number or the identification used by the components supplier shall be shown. Alternate sources and part numbers shall be supplying for non-standard components. Where applicable, the characteristics of a component shall also be shown to aid in obtaining substitute parts (such as the value and rating resistors).

- (g) A thorough description of the RTUs communication protocol including sequential procedure as implemented for the project. The data formats used and the relationship of I / O card location / addresses to message fields must be clearly presented.
- (h) Operation & maintenance documentation for the portable RTU configuration and maintenance terminal, similar in content and detail to the above specified documentation.

The documentation described by item (a) through (e) above is required by the employer for RTU installation and shall be provided within two months after contract award.

- (i) A proforma / recommended procedure for keeping performance record of the equipment by the user shall be provided with the documents.

10.3.2 Software documentation :

The contractor shall supply documentation for all software provided with the RTUs. This documentation shall include the following documentation as a minimum :

- (a) An inventory of all programs and modules to be provided and a cross reference Index to the software documentation.
- (b) A functional overview document which describes the software on a sub-system basis and include a brief description of the hardware interfaces. This document shall functionally describe all software to be provided with simplified block and data flow diagram. The relationship among each problem, the database and the system hardware shall be included. This document shall be provided within four months after contract award and prior to the issuance of any individual software document.
- (c) Software documentation standards, manuals which define in details the documentation format for items (d) and (e) below. Within four months after the contract award, the contractor shall provide the documentation standards for employer's review.
- (d) Existing design documentation and user's manual for the contractor's standard software that satisfies the requirements of the specification submitted to employer in their existing form.

Standard software which requires some modification to fulfill employer's requirement shall be subject to employer's review and approval. The standard documentation and the changes documents shall be submitted prior to the implementation of the changes by the contractor. All changes to the contractor's software shall be identified.

10.3.3 Test documentation :

The contractor shall provide documentation for all factory and field tests. clause – 8.2 describes the test documentation requirements.

10.3.4 Final documentation :

Final documentation shall consist of the documents necessary to satisfy the requirements in clause 10.3.1, 10.3.2, 10.3.3 and the other documents described herein or requested by the employer. The documents will be used by the employer personnel for the RTUs operation and maintenance after their acceptance. Final documentation must be delivered within three weeks after the RTUs are shipped. The final hardware documentation shall include one set of reproducible tracing of all RTUs drawing and external connection diagram prepared specifically for employer's RTU.

Each document shall be identified by a contractor document number. Where a document is revised due to change in design (or for any other reason), each revision shall be indicated by a number, date, subject in a revision block and some indication of approval by the contractor's project manager. Additional notation shall be made on the document to permit rapid location of the revision. A final Index of system documentation shall be included. All final documentation supplied by the contractor shall be easily reproducible by the employer.

All final documentation shall also be provided on magnetic media in the file format on the latest version of Microsoft Word Software. Alternately, if another word processing system is used by the contractor, the final documentation shall be provided in the contractor word processing format alongwith word processing software and documentation.

All drawing larger than A3 size (297 mm x 420 mm) shall be supplied as Mylar reproducible tracings in addition to the paper prints. All drawings prepared specifically for employer shall also be provided on floppy disk media in the DXF format of the latest version of the AutoCAD software.

The contractor shall be responsible for supplying documentation revisions or changes due to inaccuracies, installation requirement, omission determined by usage, and design or production alternations of the RTUs. Changes shall be issued in the form of replacement for the effected drawings, diagrams, charts, graphs, table, list and pages in the various manuals prior to the start of the field performance test.

10.4 Document quantities :

The quantity to be supplied for each document is shown exhibit 10-1. Copies of documentation provided at training courses are in addition to these quantities. Where the contractor supply documentation organization defers from the items in the list, the contractor shall provide the maximum quantity of documents for the functional area covered by the document.

11.0 QUALITY ASSURANCE PLAN:

11.1 The Contractor must establish that they are following a proper quality assurance program for manufacture of equipments. The Contractor shall invariably furnish following information along with his offer. Information shall be separately given for individual type of equipment offered.

- a) Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of Bidder's representative and copies of test certificates.
- b) Information and copies of test certificates as mentioned in (i) above in respect of bought out items.

- c) List of manufacturing facilities available.
- d) Levels of automation achieved and list of areas where manual processing exists.
- e) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.
- f) Special features provided in the equipment to make it maintenance free.
- g) List of testing equipment available with the Bidder for final testing of equipment specified and test plant limitations, if any, vis-à-vis type tests, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

11.2 The successful Bidder shall within 30 days of placement of order submit following information to the Purchaser.

- a) List of raw materials as well as bought out accessories and the names of sub supplier selected from the lists furnished along with offer.
- b) Type test certificate of the raw material and bought out accessories.
- c) Quality Assurance Plan (QAP) with hold points by Purchaser's inspection. The quality assurance plans and hold points shall be discussed between the Purchaser and Bidder before the QAP is finalized.

11.3 The successful Bidder shall submit the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

12.0 ENGRAVING, PACKING AND FORWARDING :

12.1 The details such as order no. and date, year of manufacture and "MPPTCL" should be engraved on each and every equipment. 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 Bidder shall be responsible for any damage during transit, due to improper and inadequate packing and handling. 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. Bidder shall supply, any material, found short inside the packing cases without any extra cost.

12.2 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.

12.3 The Bidder shall ensure that the packing list and bill of material is approved by the Purchaser before despatch.

EXHIBIT-10.1
RTU DOCUMENT QUANTITIES

S.No.	Document	Review of approval quantities	Final Document quantities
HARDWARE DOCUMENTATION			
1.	Inventory of Hardware	4	4 per RTU
2.	Site preparation manual	4	4 per RTU
3.	Installation, wiring & cabling diagram	4	4 per RTU
4.	Internal wiring diagram	4	4 per RTU
5.	Assembly Drawings	4	4 per RTU
6.	Maintenance Manuals for RTUs	4	4 per RTU
7.	Test set Documentation	4	4 per RTU
SOFTWARE DOCUMENTATION			
1.	Inventory of software	4	4 per RTU
2.	RTU Functional Overview	4	4 per RTU
3.	Software Documentation standard	4	4 per RTU
4.	Standard software	4	4 per RTU
5.	Modified Standard software	4	4 per RTU
TEST DOCUMENTATION			
1.	Testing Plans	4	4 per RTU
2.	Test Records	4	4 per RTU

Note: One set of document shall be delivered at RTU site, concerned T&C circle, sub LDC &SLDC.

Appendix A

RTU CONFIGURATION AND POINT COUNT

Legend

RTU Name	The site name of the substation and RTU.
Data Rate	RTU communication channel data rate (300 to 1200 bits per second).
Comm Type	The RTU to Master Station Communication channel requirements: NCr = Single channel to the master station (Non-critical RTU) Cr = Dual-redundant channel to the master station (Critical RTU).
AI	The number of analog input points
DI 1 Bit	The number of single contact digital status input points (without momentary change detection).
DI 2 Bit	The number of double contact digital status input point.
DI 2MCD	The number of double contact digital status input points (with momentary change detection).
DI 1 bit	The number of sequence of events (SOE) digital status input points (in addition to DI-2 bit point counts).
DO PLSE	The number of raise / lower pulse output points.
AO	The number of set point analog output points.

ANNEXURE-I
TECHNICAL PARTICULARS FOR REMOTE TERMINAL UNIT(RTUs)

Sl. no.	Item Description	Value	Remarks
1	Data transmission rate	300 to 9600 bps for serial port	
2	Communication ports	As required	As per specification
3	Communication protocol with Master stations	IEC 60870-5-101	
4	Communication Protocol with MFTs / Energy-meters	MODBUS	
5	Analog accuracy of the RTU	atleast 99.8%	at 25 ⁰ C
6.	Maximum limit for mean accuracy drift	Less than 0.002% per degree centigrade	Within the range of -5 ⁰ to 55 ⁰ C
7	Analog-to-digital converter resolution	+/- 2048 counts(sign plus 11data bits)	
8	No. of Scan Group Support	16	
9	Event buffer size	atleast 300 events	No. of events store equal to atleast three times the no. of SOE points
10	Analog/Status data transfer to Master station	By exception	Shall support periodic polling & on demand
11	Analog input impedance (for current inputs)	Less than 250Ω.	
12	Analog input overload withstand capability	Up to 150% of the input	
13	RTU shall be set to capture contact operations	of 20 ms or more duration.	
14	SOE buffer size	2048.	
15	Time stamping accuracy for SOE points	1 millisec	
16	Supporting Control of Devices	Two state	
17	RTU internal clock stability	Atleast 1 ppm	
18	Nominal Power supply voltage	48V DC(+ve Earthed)	

SCHEDULE-II**Guaranteed Technical Particulars of RTU**

Sl.No.	Item Description	Value
1	Data transmission rate	
2	Communication ports	
3	Communication protocol with Master stations	
4	Communication Protocol with MFTs / Energy-meters	
5	Analog accuracy of the RTU at 25 ⁰ C	
6.	Maximum limit for mean accuracy drift (Within the range of-5 ⁰ to 55 ⁰ C)	
7	Analog-to-digital converter resolution	
8	No. of Scan Group Support	
9	SOE buffer size	
10	Analog/Status data transfer to Master station	
11	Analog input impedance (for current inputs)	
12	Analog input overload withstand capability	
13	RTU shall be set to capture contact operations	
14	SOE buffer size	
15	Time stamping accuracy for SOE points	
16	Supporting Control of Devices	
17	RTU internal clock stability	
18	Nominal Power supply voltage	

SIGNATURE OF TENDERER

2.2.7 Optical Fiber Equipments

1.1 Scope

This document contains the General/ Technical specifications of communication equipments required for Fiber Optic Communication. The scope covers all required equipments and associated accessories for establishing Fiber Optic Communication as briefed hereunder.

- i. SDH Equipment along with suitable optical line interfaces & tributary cards.
- ii. Craft Terminal based Network Management System (NMS).
- iii. All cabling, wiring, Digital Distribution Frame patch facilities and interconnections to the supplied equipment at the defined interfaces.
- iv. System integration of the supplied subsystems and also integration with existing communication equipment such as SDH.
- v. Integration of supplied system with the User equipments such as RTUs, SCADA system etc.

All other associated works/items described in the technical specifications for a viable and fully functional communication network.

1.2 General Requirements

The Bidder is encouraged to offer standard products and designs. However, the Bidder's must conform to the requirements and provide any special equipment necessary to meet the requirements stated herein.

It should be noted that preliminary design information and bill of quantity (BoQ) specified in this specifications are indicative only. The Bidder's shall verify the design data during the site surveys & detail engineering and finalise the BoQ as required for ultimate design & system performance which covers Speech, Data and Protection.

The Bidder's proposal shall address all functional and performance requirements within this specification and shall include sufficient information and supporting documentation in order to determine compliance with this specification without further necessity for enquiries.

An analysis of the functional and performance requirements of this specification and/or site surveys, design, and engineering may lead the Bidder's to conclude that additional items are required that are not specifically mentioned in this specification. The Bidder's shall be responsible for providing at no added cost to

the Employer, all such additional items and services such that a viable and fully functional communication equipment system is implemented that meets or exceeds the capacity, and performance requirements specified. Such materials and services shall be considered to be within the scope of the contract. To the extent possible, the Bidders shall identify and include all such additional items and services in their proposal.

All equipment provided shall be designed to interface with existing equipment and shall be capable of supporting all present requirements and spare capacity requirement identified in this specification

The communication equipment shall be designed and provisioned for expansions and reconfigurations without impairing normal operation, including adding and removing circuits. The offered items shall be designed to operate in varying environments. Adequate measures shall be taken to provide protection against rodents, contaminants, pollutants, water & moisture, lightning & short circuit, vibration and electro-magnetic interference etc.

Network Configuration and Equipment Characteristics

1.3 Introduction

This section describes the Fiber Optic Communication network configuration and the equipment characteristics for communication system to be installed under the project.

The sub-systems addressed within this section are:

- (1) Fiber Optic Transmission System (FOTS)
- (2) Craft Terminal based Network Management System (NMS)
- (3) DDF and Cabling

The requirements described herein are applicable to and in support of network requirements.

The security related requirements of the equipment shall be as per DoT (Department of Telecommunication) guidelines and all similar security requirements as amended by DoT on time to time basis shall be followed/complied by the vendor.

The manufacturer shall allow the Employer and/or its designated agencies to inspect the hardware, software, design, development, manufacturing, facility and supply chain and subject all software to a security /threat check any time during the supplies of equipment. The contractor shall ensure that the supplied equipments have been got tested as per relevant contemporary Indian or International Security Standards e.g. IT and IT related elements against ISO/IEC

15408 standards, for Information Security Management System against ISO 27000 series Standards, Telecom and Telecom related elements against 3GPP security standards, 3GPP2 security standards etc. from any international agency/ labs of the standards e.g. Common Criteria Labs in case of ISO/IEC 15408 standards until 31March 2013. From 1 April, 2013, the certification shall be got done from authorized and certified agency/lab in India.

The Contractor shall also ensure that the equipment supplied has all the contemporary security related features and features related to communication security as prescribed under relevant security standards. A list of features, equipments, software etc. supplied and implemented in the project shall be given for use by the Employer.

The contractor shall get the Employer's equipment audited from security point of view once a year from a network audit and certification agency as identified by DoT. The audit of the equipment shall be carried once in a financial year till the maintenance service contract in the bid.

In case of any deliberate attempt for a security breach at the time of procurement or at a later stage after deployment/installation of the equipment or during maintenance, liability and criminal proceedings can be initiated against the Contractor as per guidelines of DoT and any other Government department.

1.4 General Network Characteristics

1.4.1 Description

The Fiber optic network shall be based on the Synchronous Digital Hierarchy (SDH) having bit rate of STM-4/STM-16 as indentified in the BoQ. The network shall consist of overhead Fiber optic links with a minimum bit rate of Synchronous Transport Module-4/STM-16 (STM-4/16). The Contractor can propose a system based on higher bit rate systems, if required, so as to meet the link budget requirements or any other specification requirement. The detailed BOQ is described in appendices.

1.4.2 Functional Requirement

The primary function of the communication network is to provide a highly reliable voice and data communication system for grid operation in support of the SCADA/EMS/RTUs/PMUs. The communications support requirement for SCADA/EMS/RTUs/PMUs system is for low & high speed data, express voice circuits and administrative voice circuits as defined in appendices. A brief summary of the communication system requirements is as follows:

- a. High speed E1 channel support

- b. Data transport supporting Network Management channels
- c. The connectivity envisaged between RTUs and Control Centre over TCP-IP using Ethernet interface.

1.4.3 General Systems Requirements

Required characteristics are defined and specified herein at the system level, subsystem level, and equipment level.

1.4.3.1 System Synchronization

The Contractor shall synchronize the existing equipments and all the new equipments under the contract using existing Master clock. The Contractor shall provide the additional clocks as required under the set of clock indicated in BoQ. In addition to GPS input reference, the synchronization clock must have provision to take INPUT reference coming from other clock. The contractor shall submit the synchronisation plan as per standard ITU-TG.811. All sync equipments proposed under this contract should meet ITU-TG.811 criterion. The holdover quality of slave clock, if any, shall meet ITU-TG.812 standard requirements.

The Contractor shall provide system wide synchronization fully distributed throughout the telecom network and connected to all equipments new & existing. The Contractor shall submit the synchronization plan for the entire network meeting the requirement of ITU-TG.803. The synchronization plan shall clearly indicate the requirement of additional clocks with full justification.

The system equipment requiring "clock" shall be connected to the master clock using external clocking. For this purpose, appropriate interfaces(s) in the transmission & termination equipment being supplied and all other associated hardware shall be provided by the Contractor.

1.4.3.2 System Maintainability

To facilitate performance trending, efficient diagnosis and corrective resolution, the system shall permit in-service diagnostic testing to be executed both locally and from remote locations, manually and/or initiated under NMS control. Such testing shall not affect the functional operation of the system.

1.4.3.3 System Upgradeability and Expandability

Equipment supplied shall be sized (though not necessarily equipped) to support system/ subsystem expansion to full capacity as provided by specified aggregate transmission rates. Equipment units provisioned for equipped subunits shall be terminated at appropriate patching facilities or termination blocks. Power supplies and NMS shall be sized for maximum equipped system capacity.

1.4.3.4 Equipment Availability

The calculated availability of each Fiber optic link (E1 to E1) shall be at least 99.999%. The calculated availability is defined as the theoretical availability determined by a statistical calculation based on the mean-time-between-failure (MTBF) and the mean-time-to-repair (MTTR) of the components and subsystems comprising the FOTS. For this analysis, an MTTR of atleast 4 hours shall be assumed. The down time of the Fiber optic cable shall not be considered in the aforesaid availability calculations. The calculated failure rates of the units and the calculated availabilities of the equipment being offered shall be provided by the Contractor during detailed engineering.

1.4.3.5 Revision Levels and Modifications

All hardware, firmware and software delivered as part of the communications network shall be field proven and at the most of current revision level. All modifications and changes necessary to meet this requirement shall be completed prior to the start of the factory tests or under special circumstances, on written approval by Employer, prior to the completion of SAT.

1.4.3.6 Equipment Capacities

Equipment supplied shall be sized and equipped with sufficient capacity to support BoQ and configuration requirements as identified in the appendices. Each subsystem supplied shall be sized (to be equipped as specified) to support full subsystem expansion. Data communications channelization required to support the NMS subsystems specified in Technical Specifications (TS) are not identified in the appendices. Therefore, the Contractor is required to size and equip the system to include all channelization and channel cards required to support the NMS function.

1.4.3.7 Redundancy Requirements and Protection Schemes

Equipment redundancy and Automatic Protection Schemes (APS) are specified in the Table 2-1. The failure of one element shall not prevent the use of any other that has not failed.

Table 2-1

Equipment Redundancy Requirements Summary

Fiber Optic transmission Equipment :	
SDH equipment	
Power Supply & Converters	1:1 APS or distributed power supply
Common Control*Cards	1:1 APS

*** = Common control cards which are essentially required for operation of the equipment.**

The offered equipment shall support at least SNCP as per standard ITU-T G.841. In case the equipment offered by the Bidder does not support the above mentioned minimum protection methods, the bidder shall have to provide all additional equipment needed to provide same level of flexibility, redundancy and functionality at no additional cost to Employer. The bidders shall provide details of protection schemes supported in the Bid document.

The offered equipment shall support automatic switchover function between the redundant modules and all required modules and hardware to support the automatic switch over shall be provided by the Contractor.

1.4.3.8 Lost Signal Recovery

At any digital signal level, reapplication of a lost signal shall result in automatic resynchronization and full restoration to normal operation without manual intervention. All alarms incident to the signal failure, shall be automatically cleared at the equipment, rack and monitoring levels and normal operation indications restored and reported if applicable.

1.4.3.9 Software Upgrades

The Contractor shall provide antivirus software along with all the computer hardware/software which shall be upgraded periodically till the maintenance services contract in the bid. Further, to meet all the specifications requirements during implementation and maintenance, if upgrade in the hardware/software of supplied item is required, the same shall be done by the contractor without any additional cost to the Employer.

1.4.3.10 General Site Considerations

All fiber optic links up to 250 Kms transmission line length shall be implemented by the Contractor without repeaters. In order to meet the link budget requirement, the Contractor shall provide all the necessary equipments only in the end stations. The contractor may provide the optical amplifier, wave length translator, optical cards or high capacity SDH equipment with suitable rack/ sub-rack to meet the maximum distance limit. All the provided equipments shall be monitored by centralized NMS.

1.4.3.11 Proposed Optical Fiber Characteristics

The link budget calculations and equipment design shall be based on the specified Fiber parameters. The optical cables shall have Dual Window Single Mode (DWSM) Fibers conforming to ITU-T Recommendations G.652D and the major parameters of these optical Fiber(s) are defined in Table-2-2:

Table-2-2

Optical Fiber Characteristics

Table-2-2	
Optical Fiber Characteristics	
Fiber Description:	Dual-Window Single-Mode(DWSM)
Mode Field Diameter:	8.6 to 9.5 μm ($\pm 0.6 \mu\text{m}$)
Cladding Diameter:	125.0 μm $\pm 1\mu\text{m}$
Mode field Concentricity	$\leq 0.6\mu\text{m}$
Core-Clad concentricity	$\leq 1.0\mu\text{m}$
Cladding non-circularity	$\leq 1\%$
Cable Cut off Wave length:	$\leq 1260 \text{ nm}$
1550 loss performance	As per G.652D
Proof Test Level	$\geq 0.69\text{Gpa}$
Attenuation coefficient	@1310nm $\leq 0.35 \text{ dB/Km}$ @1550nm $\leq 0.21 \text{ dB/Km}$
Attenuation Variation with wave length 1285 nm-1330 nm 1525 nm– 1575 nm	Attenuation coefficient @1310 $\pm 0.05 \text{ dB}$ Attenuation coefficient @1550 $\pm 0.05 \text{ dB}$
Point discontinuities	$< 0.1\text{dB}$
Chromatic Dispersion; Max.: Zero Dispersion Wave length: Zero Dispersion Slope:	18.0 ps/(nm x km) @ 1550 nm 3.5 ps/(nm x km) @ 1288-1339nm 5.3 ps/(nm x km) @ 1271-1360nm 1300 to 1324nm 0.092 ps/(nm ² xkm) maximum
Polarization mode dispersion coefficient	$\leq 0.2\text{ps/km}^{1/2}$
Temperature Dependence:	Induced attenuation $\leq 0.05 \text{ dB}$ (-60degC-+85degC)

Bend performance:	@1310nm (75±2 mm dia Mandrel), 100turns; Attenuation rise ≤0.05dB @1550nm(30±1 mm dia Mandrel), 100turns; Attenuation rise ≤0.10dB @1550nm (32±0.5 mm dia Mandrel),1turn;Attenuation rise ≤0.50dB
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1.5 Fiber Optic Link Lengths

The fiber optic route lengths are as specified in appendices. The lengths specified in appendices are the transmission line route lengths; however the actual fiber cable length shall exceed the route lengths on account of extra cable requirement due to sag, jointing & splicing, approach cabling etc. For bidding purposes the Contractor may assume an additional cable length of 5% of given route length + 1Km towards approach cable for calculating the link length. The exact cable lengths shall be determined by the Contractor during the survey. The same shall be used by the Contractor for final link design during the detailed engineering of the project.

1.6 Fiber Optic Transmission System

The Fiber Optic Transmission System (FOTS) is defined herein to include ETSI digital optical line termination equipment. The FOTS shall be based on SDH technology. Minimum aggregate bit rate shall be STM-4/STM-16 and equipped with 2 nos. of minimum 16 port E1 interface(G.703) card, one no. of minimum 4 port Ethernet interface (IEEE 802.3/IEEE 802.3u) card supporting layer 2 switching as tributaries. The Ethernet interfaces shall support VLAN (IEEE 802.1P/Q), spanning tree (IEEE 802.1D) quality of service. Protection scheme for Ethernet traffic should be ERPS based (Ethernet ring protection scheme) as per ITU-T G.8032.

The Contractor shall provide (supply and install) connectorised jumpers (patch cords) for FODP-to-equipment and equipment-to-equipment connection. Two numbers spare jumpers shall be provided for each equipment connection. Fiber jumpers shall be of sufficient lengths as to provide at least 0.5m of service loop when connected for their intended purpose.

1.6.1 SDH Equipment

1.6.1.1 Functional Requirement

There is a requirement for different types of equipment under this project which are described in this section. The BOQ is provided in the appendices. For the purpose of BOQ, the SDH Equipment is considered to be divided in three parts i.e. Optical interface/SFP, Tributary Cards (Electrical tributaries such as E1 & Ethernet 10/100 Mbps) and Base Equipment (Consisting of Common Cards, Control Cards, Optical base card, Power supply cards, sub-rack, cabinet, other hardware and accessories required for installation of equipment i.e. everything besides optical interface/SFP and tributary cards).

If bidder is offering equipment with multifunction cards such as cross-connect or control card with optical interface/SFP or tributary interface, such type of multifunction card shall be considered as Common control card and shall be the part of base equipment. In case optical interface/SFP is embedded with control card, the adequate number of optical interface/SFPs shall be offered to meet the redundancy requirements of the specifications.

Further, control card shall not be equipped with more than one optical interface/SFP and optical base card shall not be equipped with more than two optical interface/SFPs. The equipment shall be configurable either as Terminal Multiplexer (TM) as well as ADM with software settings only.

1.6.1.2 SDH ADM

The aggregate interfaces shall be (at least) STM-4/STM-16 towards at least two protected directions (Protected as specified in this specifications). At present the equipment shall be equipped with a 2 nos., min.16 E-1 port electrical tributary cards & one no., min.4 port Ethernet interface card as tributaries. The equipment shall provide access to full STM-4 payload. The offered STM-4 SDH equipment shall be upgradeable to STM-16 by changing optical line cards only. Cross connection (VC4) capability of offered SDH equipment shall be provided according to STM-16 equipment. The contractor shall demonstrate the STM-16 upgradeability during FAT.

1.6.1.3 Redundancy and Protection

Two Fiber rings shall be implemented wherever the network permits. On linear sections of the network, protected links using 4 Fibers shall be implemented.

1.6.1.4 Service Channel

Service channels shall be provided as a function of the SDH equipment and shall be equipped with Service Channel Modems that shall provide at a minimum: One voice channel (order wire) with analog interface (0.3 to 3.4 kHz) and one data channel. Both omnibus and selective calling facilities shall be provided. There shall be a

facility to extend the line system order-wire to any other system or exchange lines on 2W/4W basis.

1.6.1.5 Supervision and Alarms

ISM (In Service Monitoring) circuitry shall be provided as a function of the SDH equipment. Local visual alarm indicators shall be provided on the equipment, as a rack summary alarm panel. Alarms shall be as per ITU-T Standards G.774, G.783 and G.784. Additionally, F2/Q2 interfaces for a local craftsman terminal interface and remote equipment monitoring is required. The Equipment shall support collection of at least four (4) external alarms for monitoring and control of station associated devices by the NMS.

1.6.1.6 Synchronisation

The equipment shall provide synchronisation as per Table 2-2. One 2MHz synchronisation output from each equipment shall be provided.

1.6.1.7 Electrical and Optical I/O Characteristics and General Parameters

Table 2-3 provides the electrical and optical characteristics as well as other general parameters for SDH equipment.

Table 2-3

Electrical and Optical I/O Characteristics and General Parameters

Optical Wavelength ^{NOTE(1)}	1310/1550nm
Optical Source ^{NOTE(2)}	Laser
Optical Source Lifespan	Betterthan5X10 ⁵ hours
Optical Fiber Type	G.652D
Optical Connectors	Type FC-PC
Transmission Quality	PerITU-TG.821,G.823,G.826
Source Primary Power	-48Vdc
Equipment Specifications	PerITU-TG.783
Tributary, Electrical Interface	PerITU-TG.703,75Ω
Ethernet Interface	10/100Mbps
SDH Bit Rates	PerITU-TG.703
Optical Interfaces	PerITU-TG.957,G.958
Frame and Multiplexing Structure for SDH	PerITU-TG.707
Synchronization	PerITU-TG.813

Management Functions	PerITU-TG.774,G.784
Protection Architectures	PerITU-TG.841
Built In Testing and Alarms	PerITU-TG.774,G.783,G.784

NOTE (1) Optical wavelength shall be selected considering the characteristics of the optical Fiber and the link budget.

NOTE (2) Eye Safety for Laser Equipment: To avoid eye damage, when a receiver detects a line interruption, it is required that the optical power of the laser shall be reduced to safe limits on the transmitter in the opposite direction as per ITU-T G.958.

NOTE (3) In case other than FC-PC connector is provided in the equipment, suitable patch cord with matching connector are to be provided to connect with FODP.

1.7 Optical Link Performance Requirements

The optical Fiber link performance requirements are specified as follows:

1.7.1 Link Budget Calculations

The Fiber optic link budget calculations shall be calculated based upon the following criteria:

1. Fiber attenuation: The Fiber attenuation shall be taken to be the guaranteed maximum Fiber attenuation i.e. 0.21 dB/Km @1550nm and 0.35 dB/km @1310nm.
2. Splice loss: Minimum 0.05 dB per splice. One splice shall be considered for every 3 kms.
3. Connector losses: Losses due to connectors shall be considered to be minimum 1.0 dB per link.
4. Equipment Parameters: The equipment parameters to be considered for link budget calculations shall be the guaranteed "End of Life (EOL)" parameters. In case, the End of Life parameters are not specified for the SDH equipment, an End of Life Margin of at least 2 dB shall be considered and a similar margin shall be considered for optical amplifiers.
5. Optical path Penalty: An optical path penalty of at least 1 dB shall be considered to account for total degradations due to reflections, inter symbol interference, mode partition noise and laser chirp.
6. Maintenance Margin: A maintenance margin of at least 2.5 dB/100Km shall be kept towards cabling, repair splicing, cable ageing and temperature variations etc.

7. Other losses: Other losses, if any required specifically for system to be supplied shall also be suitably considered.
8. Dispersion: The Fiber dispersion shall be taken to be the guaranteed maximum dispersion i.e. 18 ps/nm.Km @1550 nm & 3.5 ps/nm.km @ 1310 nm for DWSM Fibers.
9. Bit Error Rate: The link budget calculations shall be done for a BER of 10^{-10} .

The bidders shall determine the total link loss based on the above parameters and shall submit the system design (including link budget calculations) for each category of Fiber optic link during detailed engineering.

For finalising the FOTS system design & BOQ, above methodology shall be adopted taking into account Fiber attenuation, dispersion and splice loss determined during the detailed engineering. Accordingly, additions and deletions from the contract shall be carried out based on unit rates indicated in the contract.

1.7.2 Link Performance

The Link performance for ES, SES and BER for the Fiber optic links shall correspond to National Network as defined in ITU-T G.826.

1.7.3 FODP to SDH Equipment

The Contractor shall be responsible for connectivity between the FODP and the SDH equipment. The Contractor shall provide FC PC coupled patch cords. The patch-cord length between the FODP & equipment rack shall be suitably protected from rodents, abrasion, crush or mechanical damage.

1.8 DDF and Cabling

For the purposes of the specification, the contractor shall provide cabling, wiring, DDF patching facilities to the wideband telecommunications system. Equipment and material components for DDF and cabling are also part of this procurement. It shall be the Contractor's responsibility to provide all cable support required for full supplied equipment interconnection and shall be in accordance with communications industry standard practices and the requirements mentioned in the technical specifications.

1.9 Digital Distribution Frame Functional Requirements

The Contractor shall provide DDF for Digital Signal Cross connect (DSX) Broadband-quality (better than 20 MHz) patching facilities configured "normally-thru" with Equipment, Line and Monitor Patch Jacks. DDFs shall provide the following basic functions:

- (i) "Normally thru" circuit routing

- (ii) Circuit rerouting via patch cord assemblies
- (iii) Circuit disconnect and termination

All DDFs shall be sized and equipped to support the offered configuration of the provided equipment. Independent Transmit and Receive patch jack assemblies (line and equipment) shall provide for separate transmit and receive single-plug patching. Transmit and receive patch jack assemblies shall be located side-by-side such that dual-plug patch cord assemblies may be used to route both transmit and receive for the same circuit.

1.10 Patch Cords

The Contractor has to supply FC PC coupled Patch cords as described in BOQ. The Patch cord return loss shall be equal to or better than 40 dB and insertion loss equal to or less than 0.5 dB.

1.11 Telecommunication Management Network / Network Management System

The Contractor shall provide Craft Terminal based Telecommunications Management Network System (NMS) for operational support to the FOTS subsystems. This NMS shall provide the capability to monitor, reconfigure, and control elements of the telecommunications network with the help of a portable personal computer to be known as craft terminal. The Contractor shall submit for Employer's approval the NMS architecture describing in detail the following subsystems/features:

- (a) Database used in NMS
- (b) Peripherals and hardware
- (c) Software and operating system
- (d) Craft Terminals

1.12 Management Functions

The NMS shall support following Management functions:

1.12.1 Configuration Management

Configuration management is concerned with management, display, and control of the network configuration. Minimum specific requirements that shall be satisfied include the following:

- a. Provide tools to establish and maintain the backbone topology and configuration information and provide graphical maps depicting the configurations.

- b. Gather descriptive information about the current configuration of the equipment, provide operator displays, and prepare reports.
- c. Provide tools for planning, establishing, and changing the static equipment configuration. Provide for changes to the equipment configuration in response to equipment failures, planned upgrades, and operator requests to take equipment offline for testing.
- d. Provide verification testing to support new equipment installation.

1.12.2 Fault Management

Fault management is concerned with detecting, diagnosing, bypassing, directing service restoration, and reporting on all the backbone network equipment, systems, and links. Minimum specific requirements that shall be satisfied include the following:

- a. Display equipment status in a consistent fashion regardless of the source of the data on a graphical topological, map-type display. Status shall be displayed through the use of colours on links and nodes as well as through text.
- b. Obtain status and detect faults through periodic polling, processing of unsolicited alarms and error events, and periodic testing for connectivity.
- c. Maintain an alarm summary of unacknowledged alarm events on the management station display and maintain a log of all received alarms. The operator shall be able to acknowledge and clear alarms individually and as a group. The use of alarm correlation techniques is encouraged to minimize the proliferation of alarms caused by a single, common event. All alarms shall be configurable as critical alarms, major alarms and minor alarms with different colours.
- d. Provide the capability to diagnose and isolate failures through analysis of error and event reports and through the use of both on-line and off-line diagnostic tests and display of monitored data.
- e. The criteria for fail over shall be configurable as automatic fail over to redundant equipment wherever possible and through operator-initiated actions where automatic fail over is not possible. The status of fail over shall be reported to the NMS.
- f. Track network equipment failure history.

1.12.3 Performance Management

Performance management is concerned with evaluation of the use of network equipments and their capability to meet performance objectives. Minimum specific requirements that shall be satisfied include the following:

- a. Provide support for an operator to initiate, collect, and terminate performance metrics under both normal and degraded conditions. For example, BER of each link, together with other data measured at each node, shall be available on operator request.
- b. Monitor point to point & end to end signal quality and history. Provide operator controls to monitor performance of specified events, measures, and resources. Specifically provide displays to permit the operator to:
 1. Select/deselect network equipments, events, and threshold parameters to Monitor
 2. Set monitoring start time and duration or end time
 3. Set monitoring sampling frequency
 4. Set/change threshold values on selected performance parameters
 5. Generate alarm events when thresholds are exceeded.
 6. Set multiple thresholds on certain performance parameters. Alarm categories include as a minimum a warning and a failure.
 7. Calculate selected statistical data to measure performance on selected equipment based on both current and historical performance data maintained in performance logs. Performance data provided is limited to what is available from the equipment Contractors.
 8. Provide graphical displays of point to point and end to end current performance parameter values. Provide tabular displays of current, peak, and average values for performance parameters.
 9. Generate reports on a daily, weekly, monthly, and yearly basis containing system statistics.

1.12.4 Security Management

The NMS shall be provided with security features to limit access to monitoring and control capabilities to only authorized personnel. One access level of System Administrator and at least two levels of operator access shall be provided - read (view) only and write (configure). The system administrator shall be able to create, define and modify operators with different access levels, network domains and perform all kind of maintenance and up gradation of the NMS system. With "read only" access level, network parameters should only be viewed. Access to database maintenance, command control and test functions shall be available with "write" access level. Means shall be provided to ensure only one authorized user has write capability for a selected domain of the network. It shall be possible to define multiple domains for purposes of monitoring and control.

Human error and conflict detection are also required. Such errors and access violations shall be reported to the offending user as error messages and warnings.

1.13 Communication Channel Requirement and Integration

Communication requirements for NMS system have not been considered in Appendices and the Contractor shall provide these as a part of NMS system. The Contractor shall provide all required interface cards / devices etc. The NMS data transport shall utilize the wideband communications transmission system service channel in the overhead whenever possible.

1.14 Craft Terminal

Each equipment on the Fiber optic communication network shall include provision for connecting a portable personal computer (PC) to be known as craft terminal to support local commissioning and maintenance activities. Through the use of this PC and local displays/controls, the operator shall be able to:

- a. Change the configuration of the station & the connected NEs.
- b. Perform tests
- c. Get detailed fault information

The craft terminal shall be connected to the interface available in the communication equipment. Portable (laptop) computers (Craft terminals), each complete with necessary system and application software to support the functions listed above, shall be supplied to the employer as per BOQ given in the appendices.

1.15 Hardware Requirements

1.15.1 Craft Terminal

The craft terminal shall have suitable processor(s) which shall be sufficient to meet all the functional requirement and expansion capabilities stipulated in this specification. Only reputed make like Dell, IBM, HP, Compaq make shall be supplied. The Craft Terminal shall be a laptop. The craft terminal shall have minimum configuration of 2.4 GHz, 2 GB RAM, 256 MB Video Graphics Memory, DVD RW drive, 160 GB Hard Disk Drive, keyboard, mouse/trackball etc., parallel, serial/USB (2.0) ports to accommodate printers,

and Internal/external Data/Fax modem and a battery back-up of at least 60 minutes. VDUs shall be 15" TFT active matrix color LCD with a minimum resolution of 1024 X 768.

1.15.2 Power Supplies

The NMS system shall use 220 volts 50 Hz A.C or -48 volt D.C as available at site for its operation as available at site.

1.16 General Software/Firmware Requirements

Due to various alternative design approaches, it is neither intended nor possible to specify all software and firmware characteristics. It is the intent herein to provide design boundaries and guidelines that help to ensure a demonstrated, integrated program package that is maintainable and meets both hardware systems requirements and the customer's operational requirements.

1.16.1 Operating System Software

Operating system software shall be provided to control the execution of system programs, application programs, management devices, to allocate system resources, and manage communications among the system processors. The contractor shall make no modifications to the OEM's operating system, except as provided as USER installation parameters.

1.16.2 Applications Software

All applications software shall be written in a high-level programming language unless developed using industry proven application programs and development tools provided with the system. The contractor shall make no modifications to the applications program except as provided as USER development tools.

1.16.3 Software Utilities

A utility shall be provided to convert all reports into standard PC application formats such as excel.

1.16.4 Revisions, Upgrades, Maintainability

All firmware and software delivered under this specification shall be the latest field proven version available at the time of contract approval. Installed demonstration for acceptance shall be required. All firmware provided shall support its fully equipped intended functional requirements without additional rewrite or programming.

All software shall be easily user expandable to accommodate the anticipated system growth, as defined in this specification. Reassembly recompilation or revision upgrades of the software or components of the software shall not be necessary to accommodate full system expansion. Software provided shall be compliant with national and international industry standards.

1.16.5 Database(s)

The contractor shall develop all the databases for final wideband network following the global acronyms for all stations. Database(s) to be provided shall contain all structure definitions and data for the integrated functional requirements of NMS system. NMS operator Groups shall share the same virtual database. This means

that they shall share the same database and database manager, whether or not physically separate databases are maintained.

1.16.6 Help

All applications shall be supported by USER accessible HELP commands that shall assist the user in the performance of its tasks. HELP commands for an application shall be available to the user from within the active application and shall not interfere with the activities of the application.

Section – 2

Environment, EMI , Power Supply, Cabling and Earthing

The purpose of this section is to describe the minimum general equipment characteristics and specifications for environmental conditions, source power conditioning and backup, equipment construction, and installation. The section also highlights the stringent Electro Magnetic Compatibility (EMC) guidelines for equipment that will be operated under the severest Electro Magnetic Interference (EMI) and Electro Static Discharge (ESD) conditions expected in an Extra High Voltage (EHV) power system environment.

2.1 Environmental Requirements

Equipment and their components provided under this specification shall operate reliably under the following environmental conditions.

2.1.1 Temperature and Humidity

Most of the equipment will not be installed in environmentally controlled shelters. Therefore, equipment shall operate in accordance with the limits shown in Table 4-1.

Table 4-1 Environmental Operating Limits

Temperature Range: Specification Operation without damage Shipping/storage	(Un Controlled Environment) 0 to 45°C -10 to 55°C -40 to 60°C
Relative Humidity, non-condensing	Up to 90%
Elevation: Operating Non- operating	to 3,000 m to 10,000 m

For each location, the Contractor is required to assess the environmental conditions for the equipment to be installed under this specification. The Contractor is responsible for all necessary enclosure, rack or equipment upgrades to ensure the proper operation of the installed equipment.

2.1.2 EMI and Electrostatic Interference

At each location, the Contractor shall assess the need for shielding against radiated emissions and shall provide recommended solutions for any EMI problem found at each location. Specifications provide the type of immunity tests for which the equipment shall be required to pass without failure. For the individual tests to be carried out at the different interfaces, references are made to the relevant IEC and ITU-T recommendations.

2.1.3 Vibration and Shock Resistance

As per testing requirements indicated in this specification.

2.1.4 Tropicalization

Communications equipment will often be stored and operated in uncontrolled environment areas and will be subject to mould, growth of fungus, corrosion and oxidation. The equipment and components shall be suitably tropicalized during manufacture through commissioning, as necessary.

2.1.5 Contaminants

Communications equipment may be located in areas of poor air quality with the main contaminant being dust. Cabinets shall be tight fitting utilizing filtered ventilation openings only.

2.2 Primary Source AC/DC Power Requirements

Facilities will be required to support both AC and DC power load requirements of telecommunications equipment as specified below:

2.2.1 Primary Source AC Power

It will be the Employer's responsibility to provide required Primary AC source Power for communications equipment installed under this specification. The Primary AC Power supplied will be 240 VAC \pm 10%, 50Hz with a frequency variance between 46 and 55 Hz. Harmonic distortion will not exceed five (5) percent. All equipment and components provided under this specification requiring Primary AC Power, shall be designed for normal operation under the above stated tolerances for 240 VAC supply.

The Contractor shall provide in their Bid as well as in the survey report to the Employer the projected 240 VAC Primary Power load requirement per equipment and totals, by location, for equipment provided under this specification. The Contractor shall provide suitable UPS for communication equipment/module etc. requiring AC power supply at locations other than control centre.

2.2.2 -48V DC Power

Power supplies/converters for communications equipment (except computer system supplied as part of NMS which shall use 240 VAC) provided under this specification, shall use -48Vdc uninterrupted primary source power. The power supply may vary normally within the voltage range -42 to -58 Vdc and the supplied equipment shall operate satisfactorily within this range.

2.2.3 Power Distribution and Protection

The Employer will furnish only one source primary 240 VAC and/or -48 VDC power. It shall be the Contractor's responsibility for the connection and distribution of all Primary AC and -48V dc source power, in full compliance with all local and national electrical codes. The Employer shall indicate during the survey by Contractor, on the primary source, the feeders/points that can be used by the Contractor. The Contractor shall supply & install Primary AC and -48Vdc feeder cables to Contractor-furnished distribution panels. The Contractor shall provide required distribution panels, circuit breakers and appropriate Panel Disconnects. Distribution Panel feeders, Panel Disconnects, distribution panels and circuit breakers shall be sized and equipped to support at least 100% expanded load requirements.

The Contractor shall provide and install all required primary power distribution sourced from the distribution panels. The Contractor shall also be responsible for Load Balancing.

The Contractor is responsible for all inter-rack (enclosure) and intra-rack (enclosure) power distribution required to support equipment supplied under this specification. The Contractor shall provide all cabling, fusing, switching and circuit breaker and surge protection required. Partially equipped subsystems shall be installed with provision for expansion. Equipment power supplies provided under this specification shall be sized to support fully equipped subsystems. Primary power distribution protection shall be sized to support and protect maximum operating load potential whether or not the actual projected load shall meet that maximum load potential. The Contractor shall provide equipment and rack safety earthing in compliance with this specification.

2.3 Equipment Construction, Assembly and Installation

All equipment supplied under this specification shall be constructed, assembled and installed in accordance with the following requirements:

2.3.1 Identification

All cabling, racks/enclosures, equipment, modules and materials shall be uniquely identifiable as per the following:

2.3.1.1 Equipment

Each equipment component to the level of printed circuit card, shall be clearly marked with the manufacturer's part number, serial number, month/year of manufacture and revision level. Changes to components shall be identified by an unambiguous change to the marked revision level. The Contractor shall be responsible for maintaining the master revision level list until the Contractor has complied with all requirements of this specification.

Where custom components and parts are provided, each component/part shall be marked to specifically identify that component/part. Printed circuit card cages are defined as an equipment component and as such, shall be clearly identified as stated within this specification.

Equipment chassis and printed circuit card cages having wired backplanes, shall be clearly marked with the manufacturer's part number, serial number, month/year of manufacture, revision level and an additional identifier corresponding directly to the applicable backplane wiring diagram/list.

2.3.1.2 Power Distribution

Power distribution panels shall be clearly marked with their unique identifier, source feed information, and remote source feed emergency disconnect location and identity. Power distribution panel "Main Disconnect" and circuit breakers shall be clearly marked with a unique identifier. Circuit breaker feed lists shall be clear, accurate and the feed list information shall be posted inside each distribution panel door.

Inter-rack and intra-rack (enclosure) power distribution shall be clearly identified with source feed, voltage and power rating information. All power feed cabling shall be clearly identified near the point of termination.

All power distribution identification shall utilize heat-resistant permanent marking techniques such as stamped non-metallic tags, embossed labels, etc. Marking techniques are subject to approval by the Employer. Power distribution identifiers and information shall agree with the Contractor's power cable plant drawings.

2.3.1.3 Signal Cabling

Connectorised signal cabling/wiring requires marking with a unique identifier at each connectorised end. The signal cable/wire identifier shall include a cable identifier and the location of both terminations.

Signal cable/wiring installed on terminal blocks requires marking with the cable identifier and distant end location. The cable tag shall be clearly visible at the cable fan out point.

All signal cable, wiring and terminations shall be clearly labeled/tagged with identifiers consistent with Contractor supplied cable plant records. Marking techniques are subject to approval by the Employer.

2.3.1.4 Equipment Racks and Enclosures

All equipment racks, enclosures and equipment, including distribution frames, shall be clearly labeled with unique identifiers consistent with Contractor supplied floor plans and rack elevations.

2.3.2 Installation Hardware

Equipment racks, enclosures, cable raceways and installation hardware shall, at a minimum, comply with the following requirements:

32.3.2.1 Equipment Sub-Racks and Cabinets (Enclosures)

All equipment provided under this specification, shall be physically mounted in sub-racks and cabinets (enclosures). The Contractor shall determine and propose for the Employer approval, the type, size, weight and manner of installation for each location. Selection of equipment sub-racks and cabinets (enclosures) shall meet the following requirements:

(A) Equipment Sub Rack Construction

Equipment Sub Racks provided for installation in environmentally controlled facilities, shall meet the following minimum requirements:

- (1) Equipment Sub Racks shall be steel/aluminum fabricated and finished on all surfaces. All metal and welds shall be thoroughly cleaned and sanded to obtain a smooth finish. All surfaces shall be treated for rust and primed to form a bond between metal and the finish coats of paint.
- (2) Equipment covers shall be provided for exposed components mounted in equipment sub Racks.
- (3) Dust and moisture protection shall meet or exceed IP20 standards.

(B) Equipment Cabinet (Enclosure) Construction

- (1) Equipment cabinets (enclosures) shall be steel/ steel & Aluminum extrusion fabricated and finished on all surfaces. All metal and welds shall be thoroughly cleaned and sanded to obtain a smooth finish. All surfaces shall be treated for rust and primed to form a bond between metal and the finish coats of paint.

(2) Equipment cabinets (enclosures) shall be designed free-standing but shall be mounted to the floor. Cabinets (enclosures) shall have secured fitting, lockable, full-length front doors for access to hardware and wiring. Equipment covers for exposed components mounted inside cabinets are not required unless specifically recommended.

(3) All doors and removable panels shall be fitted with long life rubber beading. All panels shall be fabricated from minimum 2.0mm thickness steel sheet. However, for racks with load bearing Aluminum extrusion frame, door panels and side panels may be fabricated from minimum 1.6mm thickness steel sheet and the top & bottom panels shall be fabricated from minimum 2.0mm thickness steel sheet.

(4) Equipment cabinets (enclosures) shall be dust and moisture-proof as per IP41 specification, or better.

2.3.2.2Cable Raceways

The Contractor is required to provide and install all additional necessary indoor and outdoor cable raceways. The cable raceways shall be in conformance with the following:

(1) Signal cabling and power cabling shall require separate cable raceways. Signal and power cabling shall not share the same raceways and shall be installed as far apart as is practical. Adequate shielding shall be provided as required.

(2) All cable raceways shall be sized to support full loading requirements plus at least a 200% safety loading factor.

(3) Outdoor cable raceways shall be of corrugated construction and shall be fitted with solid covers overlapping all sides of the cable raceways.

(4) Outdoor cable raceways shall be fabricated from construction grade aluminum, galvanized iron or anodized sheet metal or any other suitable material approved by the Employer. Suitable anti-corrosion measures shall be taken. Steel fabricated raceways shall be finished inside and out, treated to resist rust and to form a metal-to-paint bond.

(5) Indoor cable raceways fabricated of aluminum or galvanized iron, shall not normally need special finishing or painting, unless otherwise stipulated by the Employer. Steel fabricated raceways shall require a red oxide primer coat at a minimum.

2.3.3Signaling Distribution

The Contractor shall be responsible for all signal wiring associated with furnished equipment in accordance with the following:

(1) All signal wiring connections to the communications equipment shall be via Krone type or equivalent terminal blocks.

(2) The Contractor shall provide subscriber level wiring and patching wherever required.

2.3.4 Lightning and Transient Voltage Protection

The Contractor shall be required to provide protection from lightning and transient voltages for all wideband communications equipment, in accordance with the following:

(1) At the outside cable plant point-of-entry of all cabling penetrations for all cabling installed by the Contractor, the Contractor shall provide lightning and transient voltage isolation for the inside plants cabling, wiring, and all terminations and equipment.

(2) All equipment installed under this specification that requires 240VAC primary power, shall be surge protected.

2.3.5 Station Safety Earthing and Signal Grounding

For each facility, the Contractor is responsible for meeting the following station and equipment earthing requirements:

(1) All safety earthing and signal grounding shall be in full compliance with EMI/EMC requirements as per relevant international standards

(2) Each cabinet (enclosure) or cabinet (enclosure) group shall include suitable signal ground and safety earth networks. The signal ground network shall terminate at a separate signal ground stud connection isolated from safety earth.

(3) Each earth/ground network shall utilize copper bus bars, copper braids and/or 16 Sq.mm or bigger earth cable. All equipment earth/ground connections shall be made directly to the equipment chassis utilizing grounding lugs and secured metal-to-metal with star washers. Use of the enclosure frame, skin or chassis mounting hardware as part of the earthing/grounding networks, is not acceptable.

(4) The safety earth network shall be connected to "earth ground" at the safety earth stud. The earth stud connection shall be sized for an external earthing cable equipped with a 2/0 solid copper lug secured metal-to-metal with star washers. Primary AC feeds and distribution within enclosures requires earthing wire connection to the safety earth stud.

(5) The safety earth and signal ground networks shall be inter-connected only at the safety earth stud and signal ground stud.

The Contractor shall extend the existing station earth to the equipment room using suitable G.I. earthing strip (50 x 6 mm), wherever required. .

The Contractor is responsible for providing all required earthing/grounding cable and installation. Cabinet (Enclosure) and equipment safety earthing and signal grounding shall be subject to the Employer's approval.

The Contractor shall be responsible for determining the suitability of existing station earth for the equipment to be supplied under this contract. In case existing earthing arrangement at the site is not adequate, the Contractor shall either make improvement in the existing earthing arrangement or make new earthing as per requirement.

2.3.6 Interconnections

All power and signal cabling between component units of the communications systems shall be supplied and installed by the Contractor and shall be shown on contractor-supplied as-built drawings. The Contractor shall supply and install all primary power cords, power strips, receptacles, circuit breakers, fuse panels, switches, earth fault detectors, surge protectors, distribution cabling, and power connectors required to support all equipment enclosures and system components furnished and installed under this specification, except as specifically excluded.

Plug-type power connectors with captive fastening (such as "Twist-Lock") shall be used for interconnection of source power to the equipment enclosures or racks. Plug-type connectors, with captive fasteners (ie. DB-25, etc) shall be used for the interconnection of all inter and intra-enclosure signaling cable.

2.3.7 Finish Colors

Unless otherwise specified, finish colors for enclosures shall be gloss white enamel on the inside, and semi-gloss medium grey enamel on the outside. Only brushed aluminum trim shall be used. Employer reserves the right to approve the proposed color scheme.

2.4 Location of Equipment, Cable Routes and Associated Civil Works

During the Site Surveys, the Contractor shall determine and propose locations for all equipment to be supplied under this contract. Further, the Contractor shall locate and identify proposed routing for all cabling between all equipment locations including existing and planned equipment not provided under this contract, but required to be connected under the scope of this contract. This subsection defines the requirements and clarifies the responsibilities of the Employer and the Contractor regarding equipment siting, intra and inter facility interconnectivity and necessary associated civil works.

2.4.1 Locations for Supplied Equipment

All transmission equipment and associated DDFs, shall generally be co-located in the same communications room located in the Control Building whenever possible.

2.4.2 Associated Civil Works

The Contractor shall provide all required minor civil works necessary for full connectivity as required in the Contractor's scope of work as follows:

- (1) All wall and floor penetrations necessary for the installation of all cabling to be performed in accordance with the requirements of this specification.
- (2) Installation of racks, cabinets, cable raceways, and cabling supplied as part of this contract.

2.4.3 Cable Trenches

A network of cable trenches and/or ducts may exist at some sites but shall require expansion and/or new construction at some stations. It shall be a responsibility of the contractor to cooperate fully with the Employer and all other on-going project contractors in the planning and efficient use of existing and new cable trenches. The existing cable trenches/ cable raceways proposed to be used shall be identified in the survey report. The contractor shall make its best effort to route the cable through the existing available cable trenches. Where suitable existing cable trenches are not available, suitable alternatives shall be proposed for Employer approval. The Employer shall provide any additional cable trenches required for such approved alternatives.

It may be noted that in order to utilize the existing trenches, the Contractor supplied cables may be required to be co-located with LV cables. Accordingly, the contractor shall ensure that selection and installation of cables is suitable for the purpose. The contractor shall be responsible for new building penetrations required for supplied cabling. Caution shall be taken to ensure existing equipment and site personnel are protected from dust and debris incident to the cable penetration work. Penetration shall be neatly formed and sealed for protection from moisture, dust wind and vermin intrusion.

All required fitting, supports, accessories, ducts, inner ducts, conduits, riser and any item not specially mentioned but required for lay and installation of cables in trenches shall be supplied and installed by the Contractor.



REWA ULTRA MEGA SOLAR LIMITED BHOPAL

VOLUME –II

PART-8

**Technical Book Serial No.
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**TECHNICAL SPECIFICATION FOR SUPPLY
OF EHV EQUIPMENTS AND MATERIAL FOR
SUB-STATIONS AND FEEDER BAYS**

**OFFICE OF CHAIRPERSON, RUMS LIMITED,
URJA BHAWAN, SHIVAJI NAGAR,
LINK ROAD NO. 2, BHOPAL 462016**

PART-8

TECHNICAL **SPECIFICATION FOR** **400/220/132/33KV** **EQUIPMENTS**

(BOOK III OF III)

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SECTION-II(A)
2.3.1 TECHNICAL SPECIFICATION FOR 33/0.4 KV,
500 KVA STATION TRANSFORMERS

1.0 SCOPE:

The scope of this specification covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Specification means "Original Equipment Manufacturer (OEM)". The purchaser means the MPPTCL."

In case bidder is not OEM, sole responsibility of offering equipments/material of manufacturer as per this specification requirement shall rest on the bidder.

1.1 SYSTEM CONDITIONS:

Applicable climatic conditions shall be as per Section-I Volume-II.

1.2 STANDARDS:

Applicable Standards for the offered equipments/items shall be as per Section-I Volume-II.

1.3 DISCREPANCY IN TECHNICAL PARTICULARS:

Regarding discrepancy in technical particulars as stipulated in Section-I Volume-II shall be applicable

1.4 STANDARD RATING

Standard ratings shall be 33/0.400 KV, 500KVA Station Transformer with off circuit taps on HV winding for variation of HV Voltage.

1.5 CONTINUOUS MAXIMUM RATING AND TEMPERATURE RISE

Station transformers shall have a continuous maximum rating at the specific normal pressures, ratio, frequency and temperature rise.

A) All transformers shall be capable of operation continuously in accordance with IS loading guide at their C.M.R. at any ratio.

B) Transformer having tapping range extending not more than 5% below the normal voltage shall operate on the principal tapping without exceeding the limits laid down in IS 2026 for oil temperature rise and

winding temperature rise as measured by resistance. On other tapings, transformer shall operate continuously without injurious heating.

C) Transformers with tapping ranges extending more than 5% below normal voltage shall meet the temperature rise limits specified in IS 2026 on all tapings on which the rated current is not more than 95% of the maximum rated current on the lowest voltage tapping. On other tapings transformer shall operate continuously without injurious heating. The loading of the transformers is to be in accordance with IS 6600- guide for loading of oil immersed transformers natural cooled units.

D) Station transformers shall be capable of operation without danger on any particular tapping at the rated voltage in KV provided that the voltage does not vary by more than + 10% of the voltage corresponding to the tapping.

Maximum temperature rise in each transformer when tested at its continuous maximum KVA rating shall not exceed the following limits at the reference ambient air temperature of 50 deg.C.

- i. Temp. of oil by thermo-meter above 50 deg.C. ambient 45 deg. C.
- ii. Temp. of winding by test resistance above ambient 50 deg. C.

1.6 NORMAL NO LOAD VOLTAGE RATIO

Normal voltage ratio corresponding to the principal tapping shall be 33,000/400 volts for 500KVA transformers.

1.7a. Important technical particulars for 500 KVA transformer have been brought out in Annexure-I, which may please be noted carefully.

High voltage windings of the station transformers shall be designed to withstand voltage as under:

Highest System voltage	Lightening Impulse withstand voltage	Power frequency withstand voltage
36KV	170KV peak	70KV rms

Bidder shall state the impulse strength of winding guaranteed by them in Schedule-III "Technical Questionnaire". Reports and oscillographic records of tests carried out by them shall be enclosed with the bid. If called for, the Bidder shall agree to test or make arrangement for testing one prototype limb of 33/0.433KV windings at their cost or otherwise, they will have to furnish impulse test certificate for transformer of similar design at their cost and information as desired in Schedule-III.

- b. Transformers shall be capable of withstanding the power frequency test voltage as specified above as per IS: 2026 (latest issue).

1.8 OIL

Insulating oil used should be conforming to IS 335 (Latest issue). Station transformer will be transported with the initial filling of insulating oil. Important characteristics of insulating oil are shown in Annexure-II.

1.9 TAPS

1.9.1 Each transformer shall be provided with an off- circuit tap changing switch for varying its effective ratio of transformation whilst the transformer is de-energized and without providing phase displacement. Off circuit taps of transformer shall have tap range of (+) 5% to (-) 5% in steps of 2.5% each on HV winding for HV variation to give normal voltage on LV side at each tap.

1.9.2 Tap changing switch shall be located in a convenient position so that it can be operated easily. Switch handle will be provided with a locking arrangement along with tap position indicator and direction for operation, thus enabling the switch to be operated and locked in position. Operation shall result in simultaneous position change on all three phases, with spring loaded snap action and ensure positive pressure contact.

1.10 WINDING CONNECTIONS AND VECTORS

1.10.1 Primary winding shall be connected in delta and secondary winding in star as per vector symbol DY 11 in accordance with IS:2026, so as to produce a positive displacement of 30 deg. from the primary to the secondary vectors of the same phase (vector rotation assumed counter-clock-wise).

1.10.2 Neutral point on the secondary (LV) winding shall be extended for connection with solidly earthed system and should be brought out to a separate insulated terminal enabling external insertion of current transformer in the earth lead to be connected wherever required.

Insulation and magnetic induction shall be suitable for operating transformer continuously at a voltage 10% more than those specified in Annexure-I. Windings of the transformers should be fully insulated.

1.11 IMPEDANCE VALUE

Percentage impedance at 75 deg. C shall be 4.5% for 500 KVA Station Transformers. The impedance values relate to the principal tapping and are subject to a tolerance of + 10%. Impedance value measured on any other tapping shall not exceed the reference value measured on the principal tapping by more than + 10%.

1.12 TRANSFORMER LOSSES

Transformers covered in the specification are required to be offered with no load and load losses figures. Bids with lower losses will be given preference. Bidders must indicate no load loss in Kilowatts at rated voltage and rated frequency. Also load losses at 75 deg. C should be offered in Kilowatts. **It may be noted that the offered values of no load and load losses must be on FIRM basis and no positive tolerance in the transformer losses will be allowed. In case after actual manufacture, if the no load and load losses are found lower than the offered values, no financial benefit will be passed on to the Bidder.**

Station transformers with lowest loss figures would be given preference, while the Bidders may offer their own design it may be noted that the Transformer losses at 75 deg.C. should not exceed the following limits.

- i) **No load losses** - **700 Watts**
- ii) **Load losses in Watts.** - **5000 Watts**

It is to be noted that bidders will have to offer transformer as per above ceiling limit of losses. Station Transformer having transformer losses more than the above ceiling limit shall not be accepted.

1.14 DESIGN & STANDARDISATION

A. Station transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. All apparatus shall also be designed to ensure satisfactory operation under such sudden variation of load and voltage as may be met with under working conditions on the system including those due to short circuit.

B. Design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operating and maintenance of the Transformer keeping in view the requirements of Indian Electricity Rules.

C. All material including bought out item like bushings, oil, radiators and terminal connectors etc. shall be of the best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperatures and atmospheric conditions arising under working conditions without undue distortion or deterioration or the setting up of undue stresses in any part, and also without affecting the strength and suitability of the various parts of the work which they have to perform.

D. Corresponding parts liable to replacement shall be inter-changeable.

E. Cast Iron shall not be used for chambers of oil filled apparatus or for any part of the equipment which is in tension or subject to impact stresses or where erosion due to acidity or sludging is likely to occur. This clause is not intended

to prohibit the use of suitable grades of cast iron for parts where service experience has shown it to be satisfactory, e.g. large valve bodies.

F. All out door apparatus including bushing, insulators with their mountings etc. shall be designed so as to avoid external pocket in which water can collect and internally where air trap could occur.

G. All mechanism shall, where necessary, be constructed of stainless steel, brass or gun metal to prevent sticking due to rust or corrosion.

H. All taper pins used in any mechanism shall be of the split type complying with IS 2393 for these items.

I. All connections and contacts shall be made of adequate section and contact surface for carrying continuously the specified currents without undue heating and fixed connection shall be secured by bolts or set of screws of ample size adequately locked, with locking nuts used on stud connections carrying current.

J. All apparatus shall be designed to minimize the risk or accidental short circuit caused by animals, birds or vermin.

1.15 GALVANISING

A. Galvanizing, where specified, shall be applied by the dipped process or by electro-galvanizing process and for all parts other than steel wires, shall consist of thickness of zinc coating equivalent to not less than 6610 gm of zinc per sq. meter of surface. Zinc coating shall be smooth, clean and of uniform thickness and free from defects. Preparation of galvanizing itself shall not adversely affect the mechanical properties of the coated material. Quality will be established by tests as per IS 2633.

B. All drilling, punching, cutting, bending and welding of parts shall be completed and all burrs shall be removed before the galvanizing process is applied.

C. Galvanizing of wires shall be applied by the hot-dipped process and shall meet the requirements of the relevant Indian Standard.

D. Surface, which is in contact with oil, shall not be galvanized or chromium plated.

1.16 CLEANING, PAINTING & FINISHING

A. Before painting or filling with oil or compound, all ungalvanized parts shall be completely clean and free from rust, scale and grease, and all external surface cavities on casting shall be filled by metal deposition.

B. Interior of transformer tanks, and other oil filled chambers and internal structural steel work shall be cleaned of all scale and rust by shot-

blasting or other approved method. These surfaces shall be painted with oil resisting varnish or paint.

C. Except for nuts, bolts and washers, which may have to be removed for maintenance purposes, all external surface shall be given a minimum of three coats of paint whereas all nuts, bolts and washers shall be given minimum of one coat paint after erection.

D. Primary coat shall be applied immediately after cleaning. Second coat shall be of an oil and weather resisting nature and preferably of a shade of color easily distinguishable from the primary and final coats and shall be applied after the primary coat has been touched up where necessary. Final coat shall be of a glossy oil and weather resisting nonfade paint of shade no. 631 (light grey) of IS:5. Primer paint shall be ready made zinc chrome as per IS: 104, intermediate and final coats of paint shall be as per IS 2932.

E. All interior surface, except those which have received anticorrosion treatment, shall receive three coats of paint applied to the thoroughly cleaned metal surface. The final coat shall be of a light colored ant condensation mixture.

F. Spacing of the bolts centers on the tank and its cover should be so designed that the gaskets when pressed after bolting leave no room for either ingress of moisture or leakage of oil during transport, normal service under full load and guaranteed temperature rise conditions.

G. One coat of additional paint shall be given at site by the purchaser and for this purpose; supplier shall supply the requisite quantity of paint to the purchaser.

1.16 CORE

Cores shall be constructed from high grade, cold rolled, non-ageing, grain oriented silicon steel laminations, HI-B grade or better grade modern core material with lower core losses.

MAGNETIC CIRCUIT

A. Design of the magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earthed clamping structure and the production of flux components at right angle to the plane of the laminations which may cause local heating.

B. Every care shall be exercised in the selection, treatment and handling of core steel to ensure that as far as practicable the laminations are flat and the finally assembled core is free from distortion, burrs or sharp edge.

C. Although the oxide/silicate coating given on the core steel is adequate, however, laminations can be insulated by the manufacturers if considered necessary.

D. Oil ducts shall be provided where necessary to ensure adequate cooling and efficient heat transfer. The winding structure and major insulation shall not obstruct the free flow of oil through such ducts. Where magnetic circuit is divided into pockets by cooling ducts parallel to the panels of the laminations or by insulating material above 0.25 mm thick tinned copper bridging strip pieces shall be inserted to maintain electrical continuity between pockets.

E. Frame works and clamping arrangements shall be earthed in accordance with clause-1.22.II.

F. Insulation structure for the core to bolts and core to clamp plates shall be such as to withstand a voltage of 2000 V AC for one minute.

1.18 MECHANICAL CONSTRUCTION OF CORE

A. All parts of the cores shall be of robust design capable of withstanding any shocks to which they may be subjected during lifting, transport, installation and service.

B. All steel sections used for supporting the core shall be thoroughly sand blasted or shot blasted after cutting, drilling and welding. Any non-magnetic or high resistance alloy shall be of established quality.

C. Adequate lifting lugs shall be provided to enable the core and windings to be lifted.

D. Adequate provision shall be made to prevent movement of the core and winding relative to the tank during transport and installation or while in service.

E. Supporting frame work of the core shall be so designed as to avoid the presence of pockets which would prevent complete emptying of the tank through the drain valve, or cause trapping of air during filling.

1.19 TERMINAL ARRANGEMENTS

1.19.1 Station transformers shall be fitted with shedded porcelain bushings or outdoor type suitable for aluminum solder less connectors both on HV as well as LV side. Aluminum bushings stems and aluminum metal parts will not be accepted.

1.19.2 HV bushings shall be 52 KV class porcelain standard transformer bushings whereas LV bushing shall be 1.1 KV class non-oil communicating type.

The HV bushings shall have following parameters

- i) Minimum creepage distance - 840mm
- ii) Basic impulse level - 250KVP
- iii) Voltage class - 52KV
- iv) Type of bushings - Non-oil communicating porcelain

transformer bushings.

Electrical characteristic of bushing insulators shall be in accordance with IS: 2099/ IS: 3347 as amended from time to time. All type routine tests shall be carried out in accordance with IS: 2099/ IS: 3347.

1.19.3 Dimensions of the LV side transformer bushing including the neutral side shall conform to relevant IS and those of the 52 KV bushings for 33 KV side shall conform to IS 3347.

1.20 VIBRATION AND NOISE

A. Every care shall be taken to ensure that the design and manufacture of all transformers and accessories shall be such as to reduce noise and vibration to the level obtained as per the modern practice.

B. Manufacturers will ensure that the noise level shall be according to the NEMA standard publication TR-I.

1.21 FLUX DENSITY AND OVERFLUXING

A. Maximum flux density in any part of the core and yokes at normal voltage and frequency of each transformer shall be such that the flux density under over voltage condition as per clause-1.5 D shall not exceed 1.75 Tesla.

B. Over fluxing of the core shall be limited to 12.5%.

1.22 INTERNAL EARTHING ARRANGEMENTS

I. GENERAL

All metal parts of the transformer with the exception of the individual core bolts and associated individual clamping plates shall be maintained at some fixed potential.

II. EARTHING OF CORE CLAMPING STRUCTURE

Top main core clamping structure shall be connected to the tank body by a copper strip. The bottom clamping structure shall be earthed by one or more of the following methods.

A. By connection through vertical tie rods to the top structure

B. By direct metal-to-metal contact with the tank base maintained by the weight of the core and windings.

C. By a connection to the top structure on the same side of the core as the main earth connection to the tank.

III EARTHING OF MAGNETIC CIRCUIT

A. Magnetic circuit shall be earthed to the clamping structure at one point only through a disconnectable link placed on an accessible position beneath an inspection opening in the tank over. Connection to the link shall be on the same side of the core as the main earth connection.

B. Magnetic circuits having an insulated sectional construction shall be provided with a separate link for each individual section. When oil ducts or insulating barriers parallel to the plane of the laminations divide one magnetic circuit into two or more electrically separate parts the ducts or barriers shall be bridged in accordance with Clause-1.17.

C. Magnetic circuit shall not be regarded as being of sectional construction.

IV SIZE OF EARTHING CONNECTIONS

All earthing connections with the exception of those from the individual coil clamping rings shall have a cross sectional area of not less than 0.8 sq.cm. connections inserted between laminations of different section of core as per Clause-1.22-III (B) shall have a copper sectional area of not less than 0.2 sq.mm.

V LEADS FROM WINDING TO BUSHING AND INTERCAKE CONNECTIONS

Leads from winding to bushing and intercake connections should be rigid enough to withstand normal vibration and transportation shocks and short circuit stresses. They should be spaced in such a way that necessary clearances are maintained not only in air, but with oil medium at the lowest permissible electrical strength as per relevant ISS over the period of normal services.

1.23 TRANSFORMER TANK

1.23.1 Main tank of the transformer shall be made of good quality sheet steel of adequate thickness to provide sturdy and robust construction to withstand extreme pressure conditions. Interior of the transformer tank shall be thoroughly cleaned by sand or shot-blasting so as to produce a smooth and clean surface free of scale, grease and rust. Interior of transformer tank shall be painted with insulating oil resistance paint. Thickness of the Top and Bottom plate of tank shall be minimum 6mm, while that of side wall should be minimum 4mm.

1.23.2 OIL LEAKAGE TEST

All tanks and oil filled compartments shall be tested for oil tightness by being completely filled with air/oil of viscosity not greater than that of insulating oil of IS 335 at ambient temperature and subject to a pressure equal to the normal pressure plus 35 KN/sq.meter measured at the base of the tank. This pressure shall be maintained for a period of not less than 12 hours for oil and one hour for air during which time no leakage shall occur.

1.24 BOLTS & NUTS

- A. Steel bolts and nuts exposed to atmosphere with suitable cadmium plated or zinc plated passivity shall be used for diameters above 6mm.
- B. All nuts, bolts and pins shall be locked in position with the exception of these external to the transformer.
- C. On outdoor equipment, all bolts, nuts and washers in contact with non-ferrous parts which carry current shall be of phosphor bronze, where the transformer of current is through the bolts.
- D. If bolts and nuts are placed so that these are inaccessible by means of ordinary spanners, suitable special spanners shall be provided by the supplier.

1.25 TERMINAL CONNECTORS

Universal bi-metallic terminal connector for HV bushings shall have horizontal take off arrangement and shall be suitable to receive single 'ZEBRA' ACSR conductor and vertical takeoff arrangement shall be suitable for 0.1 sq.mm. ACSR conductor. Minimum thickness of clamp shall be 12mm at any part of the body. Thickness of bi-metallic liner shall be minimum 2mm. Terminal connectors shall be made out of pressure / gravity die-casting process only. Stud conductor hold length shall be 100 mm (min.). Suitable terminal connectors (4 nos.) for each transformer for LV shall also be included in the scope of supply.

1.26 PARALLEL OPERATION

Transformers of the same service voltage shall be suitable for parallel operation, the load being shared in proportion to the capacities and percentage impedance volts which will be within the limits specified in the relevant IS.

1.27 OVERLOAD CAPACITY

- A. Each transformer shall be capable of carrying sustained over loads as stated in IS: 6600.
- B. Type of Load: Station transformers will supply a mixed power and lightning load, with varying power factors from 0.6 lag to 0.8 lead due to capacitors.

1.28 GUARANTEE

Manufacturer shall guarantee the following:

- i. Quality and strength of material used, both electrical and mechanical.
- ii. Performance Guarantee period for satisfactory operation of Station Transformers shall be strictly as per clause no 26.0 of section I of the specification. This period will be reckoned from the day on which last of

all accessories are received, enabling assembly testing commissioning and commercial operation of transformers.

- iii. Performance details are to be supplied by Bidder in the schedule of 'Guaranteed Technical Particulars'

1.29 TOLERANCES

Tolerances of guaranteed performance figures shall be as specified in the latest version of IS 2026.

1.0 ROLLERS

Station Transformers shall be provided with bi-directional float rollers.

1.31 FITTINGS & ACCESSORIES

Unless otherwise specified in the order, the following standard fittings shall be provided. The fittings shall be in accordance with the details to the extent these are specified in IS: 2026.

- a. Rating & diagram plate with purchaser's order number and date, tap position and relative HV/LV voltage.
- b. 4 Nos pulling lugs.
- c. Two earthing terminals with lugs.
- d. 4 Nos. Lifting lugs.
- e. 4 nos. bi-directional float rollers
- f. Conservator with top filler cap and bottom drain valve and oil level gauge.
- g. Aluminum die cast Silica gel dehydrating breather having minimum 1.0kg. silica gel
- h. HV-3 nos. 52 KV bushings, LV – 4 nos. 1.1 KV bushings, Arcing horn for HV bushings
- i. Off circuit tap switch with indicator handle, lock and 2 keys.
- j. Thermometer pocket
- k. Air release device with cap on tank top.
- l. Explosion vent diaphragm.
- m. 2 filter valves (top valve, lower valve to be used also as drain valve).
- n. Bimetallic terminal connectors for each HV, LV&LV neutral bushings.

1.32 FINISHING

Exterior of the transformer and other ferrous fittings shall be thoroughly cleaned, scraped and given primary coat and the two finishing coats of durable oil and weather resistant paint of enamel. Color of the finishing coats shall be DARKGREEN conforming to IS: 5 of 1961 (colors for ready mixed paints) with conservator painted with white color OR any equivalent acceptable International Standards.

1.33 TESTS & TEST CERTIFICATES FOR TRANSFORMER

1.33.1 TYPE TESTS

1.33.1.1 All the equipments offered shall be fully type tested as per relevant ISS or any equivalent acceptable International Standard & technical specification. The following type tests shall be carried out on the transformers in accordance with ISS: 2026/1977 as amended from time to time or any equivalent acceptable International Standard:

- (i) Short Circuit test
- (ii) Lightning Impulse Voltage withstand test.
- (iii) Heat run test
- (iv) Loss measurement

1.33.1.2 In case the transformers offered are as per purchasers' technical specifications and are already type tested in an independent test laboratory, the Bidders shall furnish four sets of tests reports along with the offer. These tests must not have been conducted earlier than five years from the date of opening of Bids. Purchaser reserves the right to demand repetition of some or all the type tests in the presence of owners' representative. For this purpose, the Bidders may quote unit rates for carrying out each type test. These prices shall be taken in to consideration for bid evaluation.

1.0 In case there is any deviation in the type tested design, from the purchasers' technical specification, the type tests have to be conducted afresh by the manufacturer at their cost in accordance with the purchaser's specification. Tests shall be carried out immediately and detailed type test reports submitted within ONE MONTH from the date of issue of Letter of Intent. Please note that no separate time shall be permitted for this purpose.

1.33.1.4 Type tests on randomly selected unit

Suppliers may **carefully note our following specific requirements of Short Circuit, Impulse Voltage Withstand, and Heat Run & Loss Measurement Tests**

It may be noted that the MPPTCL reserve the right to conduct all or any of the test mentioned under clause- 1.33.1.1. in accordance with the ISS or any equivalent acceptable International Standard afresh on each ordered rating at MPPTCL's cost, even if the transformers of the same rating and similar design are already type tested. This test shall be carried out on a transformer to be selected by the MPPTCL either at supplier works when they are offered in a lot

for supply or random sample from the supplies already made to MPPTCL's Transmission Stores. **The findings and conclusions of these tests shall be binding on the supplier.**

In case the transformer does not pass either of the tests and if the active part details are not found to be in line with the design tested and approved, the following punitive measures shall be taken: -

- i. 5% payment of the bill for the supplies already made will be recovered.
- ii. For transformers already supplied, the **guarantee period shall stand twice** the normal guarantee period incorporated in the order and the period of performance Security Deposit shall be suitably extended to cover the extended guarantee period.

Further, the supply of balance quantity of transformers will not be accepted by the MPPTCL, till another transformer from the manufactured batch is satisfactorily tested (Or transformers are modified according to the tested design) for any or all the tests as per clause-1.33.1.1 above **at supplier's cost** and consequent to this, if there is any delay in executing the order, the same shall be to the suppliers' account. MPPTCL reserves the right to take action as per terms and conditions of the order.

- i. The test charges shall be borne by the firm.

1.33.2 ROUTINE TESTS

Before dispatch each of completely assembled transformer shall be subjected to the following routine tests at the manufacturer's works in accordance with the details specified in IS: 1180/2026 Or any equivalent acceptable International Standards and as detailed below: -.

- a. Measurement of winding resistance.
- b. Ratio, polarity and phase relationships.
- c. Impedance voltage.
- d. No load loss and No load current.
- e. Load loss
- f. Insulation resistance.
- g. Separate Source voltage withstand.
- h. Induced over voltage withstand.

1.33.3 ACCEPTANCE TESTS TO BE CARRIED OUT BEFORE DESPATCH

Following tests shall be witnessed by the Purchaser's representative at the works of the supplier.

1.33.4 All the routine tests as mentioned in 1.33.2 above shall be performed on **minimum 10% quantity** of offered lot.

Besides above, following tests are to be performed on **one unit of each lot** offered for inspection.

- a. Verification of active parts along with weighing of unit.
- b. Spill Current measurement test
- c. Test for Magnetic Balance shall be conducted by connecting the LV phase by phase to rated phase voltage and measurement of an, bn, cn voltage will be carried out.
- d. Test for Over fluxing of core.
- e. Pressure test performed on one tank.
- f. Breakdown voltage test of transformer Oil.
- g. Heat run test - **One unit** of the **ordered quantity**.

Heat run test shall have to be conducted at suppliers' cost on one transformer from first offered lot, during the course of supplies. This test shall be conducted **on lowest tap** by feeding corresponding losses at 75⁰ C. The measured losses at lowest tap at ambient temperature shall be specifically indicated in the inspection report.

To facilitate conduction of heat run test on any unit of any lot at any point of time during the supplies, the manufacturer will provide a thermometer pocket which gets immersed in oil on the side of the transformer in all the transformers. This pocket shall also be used for connecting thermal sensing device to monitor the variations in temperature, whenever required and to operate the protective devices. The Sensor pocket shall be of 12 mm diameter with blanking screwed cap, removable at site. The depth of the projecting stem of this pocket inside the transformer will be below oil level. It shall not fringe with electrical clearance nor obstruct the un-tanking of the active part.

1.34 TESTING FACILITIES

Bidders should have adequate testing facilities for all routine and acceptance tests as described above and also arrangement for measurement of losses, resistance etc.

1.35 INSPECTION

To ensure about the quality of transformers, the inspection shall be carried out by the MPPTCL's representative at following two stages.

1.35.1 When the raw-material is received, and the assembly is in process in the shop floor.

After the main raw-materials i.e. core and coil materials and tanks are arranged and transformers are taken for production on shop floor and a few assembly have been completed, the firm shall intimate the **O/oChief Engineer (Procurement), MPPTCL, Jabalpur** in this regard, so that an Officer for carrying out such inspection could be deputed, as far as possible within seven days from the date of intimation. During the stage inspection,

1.35.1.1 A few assembled core shall be dismantled to ensure that the CRGO laminations used are of good quality.

1.35.1.2 Dimensional details of construction of transformers as per the guaranteed technical particulars offered by the manufacturer and approved by the Purchaser shall be verified.

1.35.1.3 Pressure and vacuum test: Tank shall be fixed with a dummy cover with all fittings including bushings in position and shall be subjected to following pressure/vacuum created inside the tank: -

- i. 0.8 Kg. /cm sq. above atmospheric pressure for 30 minutes.
- ii. A vacuum corresponding to (-) 0.7 Kg. /cm sq. for 30 minutes.

Permanent deflection of tank plate, after pressure has been released, shall not exceed the values given below: -

Length of plate	Deflection
Up to 750 mm	5mm
751 to 1250 mm	6mm
251 to 1750 mm	8mm

In case of any defect/defective workmanship observed at any stage during stage inspection by the MPPTCL's Inspecting Officer, the same shall be pointed out to the firm in writing for taking remedial measures. Further, processing should only be done after clearance from the **O/oChiefEngineer (Procurement), MPPTCL, Jabalpur**.

1.35.1.4 Supplier shall provide to the purchaser, complete invoice of procurement of raw-materials i.e. core, winding material, insulation material, bushings, transformer oil, tanks etc., at the time of stage inspection.

If at any stage it is found that transformer is not manufactured out of the raw-material for which invoices have been furnished, the transformer shall be liable for rejection by purchaser and the transformer shall be replaced by the manufacturer at no extra cost to the purchaser.

1.35.2 At finished stage i.e. transformers are fully assembled and are ready for dispatch.

As and when the transformers are ready for dispatch, an offer intimating about the readiness of transformers, for final inspection for carrying out acceptance tests as per relevant ISS Or any equivalent acceptable International Standards and as in **clause 1.33.3** above, shall be sent by the firm **along with Routine Test Certificates**. The inspection shall normally be arranged by the MPPTCL at the earliest after receipt of offer for pre-delivery inspection.

All tests and inspection shall be carried out at the place of manufacturer unless otherwise specifically agreed upon by the manufacturer and purchaser at the time of placing of purchase order. The manufacturer shall offer the Inspector representing the Purchaser, all reasonable facilities, without charges, to satisfy him that the material is being supplied in accordance with this specification. This will include stage inspection during manufacturing stage as well as active part inspection during acceptance tests.

Random sample checking and testing of the transformer selected at random from the lot offered for pre-dispatch inspection shall be done for verification of technical details, design and losses as per approved G.T.P., drawings and technical specification of the order. In case of variations, the lot shall be rejected.

Purchaser has all the rights to conduct the test including type tests, at its own cost by an independent agency whenever there is a dispute regarding the quality of supply or interpretation of test results. In the event of failure of transformer(s) in such tests, the expenses incurred in testing shall be to the Supplier's account as already mentioned above in case of random testing.

1.36 TEST CERTIFICATES OF BOUGHT OUT ITEMS

To ascertain the quality of the transformer oil, the original manufacturer's test report should be submitted at the time of inspection. Also, arrangements should be made for testing of transformer oil, after taking out the sample from the manufactured transformers and tested in the presence of purchaser's representative.

1.37 TEST REPORTS ON THE ANALYSIS OF RAW MATERIALS

Bidders shall furnish details of source(s) of raw-materials, test certificates and report on the analysis of electrolytic copper used for the winding and the steel used for core, insulation material and also other bought out items from sub-suppliers.

1.38 QUALITY ASSURANCE PLAN:

The Quality Assurance Plan of this specification shall be as per Section-I Volume-II.

1.39 DRAWINGS

General Arrangement, Core-Coil Assembly and Name Plate detail drawing of each rating of transformer offered along with guaranteed technical particulars, should be submitted with the offer.

After award of contract four sets of drawing, Guaranteed Technical Particulars and type test certificate of transformer with duly stamped drawing from independent testing laboratory shall be submitted for approval.

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ANNEXURE-A
PRINCIPAL PARAMETERS OF 33/.433 KV,
500 KVA STATION TRANSFORMERS

The transformers shall conform to the following specific parameters described here under: -

S. No.	Particulars	Station Transformer
1	Voltage rating	33/0.433 KV
2	Rated KVA	500
3	Type of cooling	ONAN
4	Vector group HV/LV	DY11
5	Maximum flux density in iron at normal voltage & freq. and/at 10% over voltage.	1.7 to 1.75 Tesla
6	Max. current density in winding HV/LV	300 to 330A/cm ²
7	Max. no load losses at normal ratio, without positive tol.	700W
8	Max. load losses at 75 deg.C. and at normal ratio without positive tol.	5000W
9	%impedance at 75 deg.C. & normal ratio	4.5%
10	Details of bushing rating & type	
	HV	52 KV class porcelain standard X-mer bushing
	LV	1.1 KV class bushing (non-oil communicating type)
11	BIL level of HV winding	170 KV peak
12	BIL level of HV bushing	250 KV peak
13	One minute P.F. withstand voltage (HV bushing/winding)	70 KV rms.
14	Electrical clearance 33KVO.433KV i/ Phase to phase 350mm 75mm ii/ Phase to Earth 320mm 55mm	
15	Max.temp.rise over max. ambient temp. a. OIL above 50 deg.Camb b. Winding above 50 degC.amb.	45 deg C. 50 deg.C.
16	Continuous over voltage rating	10% above at each tapping on continuous
17	Terminal connector	
	a. HV	Horizontal/vertical take off suitable to receive Single ZEBRA conductor
	b. LV	Suitable for power cable connection

ANNEXURE-B

GUARANTEED TECHNICAL PARTICULARS OF EHV GRADE OIL

The important characteristic of new oil shall be as under:

S.No.	Characteristics	Requirements
1	Flash point Pensky Marten (closed) min.	140 deg.C.
2	Neutralization value	
	a/ Total acidity max. b/ Inorganic acidity alkalinity	0.03 mg. KOH/g NIL
3	Corrosive sulphur	Non- corrosive
4	Electrical strength (Break down voltage) min. a/ New unfiltered oil b/ New oil after filtration	30 KV (rms) 60 KV (rms)
5	Di-electric dissipation factor (Tan Delta) at 90 deg.C. max	0.002
6	Specific resistance (resistivity) a/ At 90 deg.C. Min. b/ At 27 deg.C. Min.	35×10^{12} Ohm-cm 1500×10^{12} Ohm-cm
7	Oxidation stability a/ Neutralization value after oxidation(max) b/ Total sludge after oxidation max. c/ S.K. Value	0.40 mg. KOH/g 0.10% by weight 4 to 8%
8	Ageing characteristics after accelerated ageing (open breaker method with copper catalyst) a/ Specific resistance (resistivity) i/ at 27 deg.C. min. ii/ at 90 deg.C. min. b/ Di-electric dissipation factor c/ Total acidity Max. d/ Total sludge value max.	2.5×10^{12} Ohm-cm 0.2×10^{12} Ohm-cm 0.2 0.05 mg. KOH/g 0.05% by weight.
9	Characteristics of oil in the transformer The important characteristics of the transformer oil after it is filled in the transformer (within three months of filling) shall be as follows:-	
a	Electrical strength(breakdown voltage)	40KV / Min.
b	Di-electric dissipation factor (Tan Delta) at 90 deg. centigrade	0.01 max.
c	Specific resistance (resistivity) at 27 deg. centigrade.	10×10^{12} Ohm-cm
d	Flash point Pensky Marten (closed)	140 deg. centigrade (Min.)
e	Interfacial tension at 27 deg. centigrade.	0.03 N/m. (Min.)
f	Neutralization value (total acidity)	0.05 mg KOH/g. (Max.)
g	Water content	35 PPM (Max.)

ANNEXURE-C
LIST OF FITTINGS AND ACCESSORIES

The transformers to be supplied shall be provided with following fittings & accessories

1	Rating & terminal marking plate.	
i	Purchase order No. & date to be indicated on rating plate.	
ii	Serial number of transformer to be indicated on rating plate.	
iii	Please confirm copper windings	
iv	Rating & diagram plate with tap position & relative HV/LV voltage	
2	Three nos. 52 KV class porcelain standard transformer HV bushings.	
3	4 nos. 1.1 KV Grade oil filled non communicating type LV bushings.	
4	Earthing terminals	
5	Tank lifting lugs	
6	Jacking pads	
7	Silica gel dehydrating breather having minimum 1.0 kg. silica gel.	
8	Conservator with oil filling cap, drain valve with plug and oil level gauge.	
9	Pressure relief device (explosion vent)	
10	Filter valves (Lower valve to be used as drain valve which should be capable to drain oil completely)	
11	Air release device with cap on tank top.	
12	4 nos. Bi-directional float rollers	
13	13. Thermometer pocket.	
14	Off-circuit tap changing switch with indicator locking arrangement.	
15	Terminals connector for HV & LV bushings	

SECTION-II(B)
2.3.1 TECHNICAL SPECIFICATION FOR 33/0.4 KV,
200 KVA STATION TRANSFORMERS

1.0 SCOPE:

1.1 The scope of this bid covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Bid means “Original Equipment Manufacturer (OEM)”. The purchaser means the ‘MPPTCL’.

In case bidder is not OEM, sole responsibility of offering equipments/material of manufacturer as per this bid requirement shall rest on the bidder.

1.2 SYSTEM REQUIREMENTS WHICH ARE TO BE CONSIDERED FOR DESIGN OF STATION TRANSFORMERS

1.2.1 CLIMATIC CONDITIONS

Applicable climatic conditions shall be as per Section-I Vol.II of this bid.

1.2.2 STANDARDS

Applicable Standards for the offered equipments/items shall be as per Section-I Volume-II.

1.3 DISCREPANCY IN TECHNICAL PARTICULARS

Regarding discrepancy in technical particulars stipulation under Section-I Volume-II shall be applicable.

1.4 STANDARD RATING

Standard ratings shall be 33/0.4 KV, 200KVA Station Transformer with off circuit taps on HV winding for variation of HV Voltage.

1.5 CONTINUOUS MAXIMUM RATING AND TEMPERATURE RISE

Station transformers shall have a continuous maximum rating at the specific normal pressures, ratio, frequency and temperature rise.

- A) All transformers shall be capable of operation continuously in accordance with IS loading guide at their C.M.R. at any ratio.
- B) Transformer having tapping range extending not more than 5% below the normal voltage shall operate on the principal tapping without exceeding the limits laid down in IS 2026 for oil temperature rise and winding temperature rise as measured by resistance. On other tappings, transformer shall operate continuously without injurious heating.

- C) Transformers with tapping ranges extending more than 5% below normal voltage, shall meet the temperature rise limits specified in IS 2026 on all tapplings on which the rated current is not more than 95% of the maximum rated current on the lowest voltage tapping. On other tapplings transformer shall operate continuously without injurious heating. The loading of the transformers is to be in accordance with IS 6600- guide for loading of oil immersed transformers natural cooled units.
- D) Station transformers shall be capable of operation without danger on any particular tapping at the rated voltage in KV provided that the voltage does not vary by more than + 10% of the voltage corresponding to the tapping.

Maximum temperature rise in each transformer when tested at its continuous maximum KVA rating shall not exceed the following limits at the reference ambient air temperature of 50 deg.C.

i.	Temp. of oil by thermo-meter above 50 deg.C. ambient	45 deg. C.
ii.	Temp. of winding by test resistance above ambient	50 deg. C.

1.6 NORMAL NO LOAD VOLTAGE RATIO

Normal voltage ratio corresponding to the principal tapping shall be 33,000/400 volts for 200KVA transformers.

- 1.7 a. Important technical particulars for 200KVA transformer, have been brought out in Annexure-I, which may please be noted carefully.

High voltage windings of the station transformers shall be designed to withstand voltage as under:

Highest System voltage	Lightening Impulse withstand voltage	Power frequency withstand voltage
36KV	170KV peak	70KV rms

Bidder shall state the impulse strength of winding guaranteed by them in Schedule-III "Technical Questionnaire". Reports and oscillographic records of tests carried out by them shall be enclosed with the bid. If called for, the Bidder shall agree to test or make arrangement for testing one prototype limb of 33/0.433KV windings at their cost or otherwise, they will have to furnish impulse test certificate for transformer of similar design at their cost and information as desired in Schedule-III.

- c. Transformers shall be capable of withstanding the power frequency test voltage as specified above as per IS:2026(latest issue).

1.8 OIL

Insulating oil used should be conforming to IS 335 (Latest issue). Station transformer will be transported with the initial filling of insulating oil. Important characteristics of insulating oil are shown in Annexure-II.

1.9 TAPS

1.9.1 Each transformer shall be provided with an off-circuit tap changing switch for varying its effective ratio of transformation whilst the transformer is de-energised and without providing phase displacement. **Off circuit taps of transformer shall have tap range of (+) 5% to (-)5% in steps of 2.5% each on HV winding for HV variation to give normal voltage on LV side at each tap.**

1.9.2 Tap changing switch shall be located in a convenient position so that it can be operated easily. Switch handle will be provided with a locking arrangement along with tap position indicator and direction for operation, thus enabling the switch to be operated and locked in position. Operation shall result in simultaneous position change on all three phases, with spring loaded snap action and ensure positive pressure contact.

1.10 WINDING CONNECTIONS AND VECTORS

1.10.1 Primary winding shall be connected in delta and secondary winding in star as per vector symbol DY 11 in accordance with IS:2026, so as to produce a positive displacement of 30 deg. from the primary to the secondary vectors of the same phase (vector rotation assumed counter-clock-wise).

1.10.2 Neutral point on the secondary (LV) winding shall be extended for connection with solidly earthed system and should be brought out to a separate insulated terminal enabling external insertion of current transformer in the earth lead to be connected wherever required.

Insulation and magnetic induction shall be suitable for operating transformer continuously at a voltage 10% more than those specified in Annexure-I. Windings of the transformers should be fully insulated.

1.12 IMPEDANCE VALUE

Percentage impedance at 75 deg. C shall be 4.5% for 200 KVA Station Transformers. The impedance values relate to the principal tapping and are subject to a tolerance of + 10%. Impedance value measured on any other tapping shall not exceed the reference value measured on the principal tapping by more than + 10%.

1.12 TRANSFORMER LOSSES

Transformers covered in the specification are required to be offered with no load and load losses figures. Bids with lower losses will be given preference. Bidders must indicate no load loss in Kilowatts at rated voltage and rated frequency. Also load losses at 75 deg. C should be offered in Kilowatts. **It may be noted that the offered values of no load and load losses must be on FIRM basis and no positive tolerance in the transformer losses will be allowed. In case after actual manufacture, if the no load and load losses are found lower than the offered values, no financial benefit will be passed on to the Bidder.**

Station transformers with lowest loss figures would be given preference, while the Bidders may offer their own design it may be noted that the Transformer losses at 75 deg.C. should not exceed the following limits.

- i) **No load losses** - **400 Watts**
- ii) **Load losses in Watts.** - **2100 Watts**

It is to be noted that bidders will have to offer transformer as per above ceiling limit of losses. transformer losses more than the above ceiling limit shall not be accepted.

1.13 DESIGN & STANDARDISATION

- A. Station transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. All apparatus shall also be designed to ensure satisfactory operation under such sudden variation of load and voltage as may be met with under working conditions on the system including those due to short circuit.
- B. Design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operating and maintenance of the Transformer keeping in view the requirements of Indian Electricity Rules.
- C. All material including bought out item like bushings, oil, radiators and terminal connectors etc. shall be of the best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperatures and atmospheric conditions arising under working conditions without undue distortion or deterioration or the setting up of undue stresses in any part, and also without affecting the strength and suitability of the various parts of the work which they have to perform.
- D. Corresponding parts liable to replacement shall be inter-changeable.
- E. Cast Iron shall not be used for chambers of oil filled apparatus or for any part of the equipment which is in tension or subject to impact stresses or where erosion due to acidity or sludging is likely to occur. This clause is not intended to prohibit the use of suitable grades of cast iron for parts where service experience has shown it to be satisfactory, e.g. large valve bodies.
- F. All out door apparatus including bushing, insulators with their mountings etc. shall be designed so as to avoid external pocket in which water can collect and internally where air trap could occur.
- G. All mechanism shall, where necessary, be constructed of stainless steel, brass or gun metal to prevent sticking due to rust or corrosion.
- H. All taper pins used in any mechanism shall be of the split type complying with IS 2393 for these items.
- I. All connections and contacts shall be made of adequate section and contact surface for carrying continuously the specified currents without undue heating and fixed connection shall be secured by bolts or set of screws of ample size adequately locked, with locking nuts used on stud connections carrying current.
- J. All apparatus shall be designed to minimise the risk or accidental short circuit caused by animals, birds or vermin.

1.14 GALVANISING

- A. Galvanising, where specified, shall be applied by the dipped process or by electro-galvanising process and for all parts other than steel wires, shall consist of

thickness of zinc coating equivalent to not less than 6610 gm of zinc per sq. meter of surface. Zinc coating shall be smooth, clean and of uniform thickness and free from defects. Preparation of galvanising itself shall not adversely affect the mechanical properties of the coated material. Quality will be established by tests as per IS 2633.

- B. All drilling, punching, cutting, bending and welding of parts shall be completed and all burrs shall be removed before the galvanising process is applied.
- C. Galvanising of wires shall be applied by the hot-dipped process and shall meet the requirements of the relevant Indian Standard.
- D. Surface, which is in contact with oil, shall not be galvanised or chromium plated.

1.15 CLEANING, PAINTING & FINISHING

- A. Before painting or filling with oil or compound, all ungalvanised parts shall be completely clean and free from rust, scale and grease, and all external surface cavities on casting shall be filled by metal deposition.
- B. Interior of transformer tanks, and other oil filled chambers and internal structural steel work shall be cleaned of all scale and rust by shot-blasting or other approved method. These surfaces shall be painted with oil resisting varnish or paint.
- C. Except for nuts, bolts and washers, which may have to be removed for maintenance purposes, all external surface shall be given a minimum of three coats of paint whereas all nuts, bolts and washers shall be given minimum of one coat paint after erection.
- D. Primary coat shall be applied immediately after cleaning. Second coat shall be of an oil and weather resisting nature and preferably of a shade of colour easily distinguishable from the primary and final coats and shall be applied after the primary coat has been touched up where necessary. Final coat shall be of a glossy oil and weather resisting nonfade paint of shade no. 631 (light grey) of IS:5. Primer paint shall be ready made zinc chrome as per IS:104, intermediate and final coats of paint shall be as per IS 2932.
- E. All interior surface, except those which have received anticorrosion treatment, shall receive three coats of paint applied to the thoroughly cleaned metal surface. The final coat shall be of a light coloured anticondensation mixture.
- F. Spacings of the bolts centres on the tank and its cover should be so designed that the gaskets when pressed after bolting leave no room for either ingress of moisture or leakage of oil during transport, normal service under full load and guaranteed temperature rise conditions.
- G. One coat of additional paint shall be given at site by the purchaser and for this purpose, supplier shall supply the requisite quantity of paint to the purchaser.

1.17 CORE

Cores shall be constructed from high grade, cold rolled, non ageing, grain oriented silicon steel laminations, HI-B grade or better grade modern core material with lower core losses.

1.16.1 MAGNETIC CIRCUIT

- A. Design of the magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earthed clamping structure and the production of flux components at right angle to the plane of the laminations which may cause local heating.
- B. Every care shall be exercised in the selection, treatment and handling of core steel to ensure that as far as practicable the laminations are flat and the finally assembled core is free from distortion, burrs or sharp edge.
- C. Although the oxide/silicate coating given on the core steel is adequate, however, laminations can be insulated by the manufacturers if considered necessary.
- D. Oil ducts shall be provided where necessary to ensure adequate cooling and efficient heat transfer. The winding structure and major insulation shall not obstruct the free flow of oil through such ducts. Where magnetic circuit is divided into pockets by cooling ducts parallel to the panels of the laminations or by insulating material above 0.25 mm thick tinned copper bridging strip pieces shall be inserted to maintain electrical continuity between pockets.
- E. Frame works and clamping arrangements shall be earthed in accordance with clause-1.22.II.
- F. Insulation structure for the core to bolts and core to clamp plates shall be such as to withstand a voltage of 2000 V AC for one minute.

1.17 MECHANICAL CONSTRUCTION OF CORE

- A. All parts of the cores shall be of robust design capable of withstanding any shocks to which they may be subjected during lifting, transport, installation and service.
- B. All steel sections used for supporting the core shall be thoroughly sand blasted or shot blasted after cutting, drilling and welding. Any non-magnetic or high resistance alloy shall be of established quality.
- C. Adequate lifting lugs shall be provided to enable the core and windings to be lifted.
- D. Adequate provision shall be made to prevent movement of the core and winding relative to the tank during transport and installation or while in service.
- E. Supporting frame work of the core shall be so designed as to avoid the presence of pockets which would prevent complete emptying of the tank through the drain valve, or cause trapping of air during filling.

1.18 TERMINAL ARRANGEMENTS

1.18.1 Station transformers shall be fitted with shedded porcelain bushings or outdoor type suitable for aluminium solderless connectors both on HV as well as LV side. Aluminium bushings stems and aluminium metal parts will not be accepted.

1.18.2 HV bushings shall be 52 KV class porcelain standard transformer bushings whereas LV bushing shall be 1.1 KV class non-oil communicating type.

The HV bushings shall have following parameters

i)	Minimum creepage distance	840mm
ii)	Basic impulse level	250KVP
iii)	Voltage class	52KV
iv)	Type of bushings	Non-oil communicating porcelain transformer bushings

Electrical characteristic of bushing insulators shall be in accordance with IS:2099/ IS:3347 as amended from time to time. All type routine tests shall be carried out in accordance with IS: 2099/ IS:3347.

1.18.3 Dimensions of the LV side transformer bushing including the neutral side shall conform to relevant IS and those of the 52 KV bushings for 33 KV side shall conform to IS 3347.

1.19 VIBRATION AND NOISE

- A. Every care shall be taken to ensure that the design and manufacture of all transformers and accessories shall be such as to reduce noise and vibration to the level obtained as per the modern practice.
- B. Manufacturers will ensure that the noise level shall be according to the NEMA standard publication TR-I.

1.20 FLUX DENSITY AND OVERFLUXING

- A. Maximum flux density in any part of the core and yokes at normal voltage and frequency of each transformer shall be such that the flux density under over voltage condition as per clause-1.5 D shall not exceed 1.75 Tesla.
- B. Over fluxing of the core shall be limited to 12.5%.

1.21 INTERNAL EARTHING ARRANGEMENTS

I. GENERAL

All metal parts of the transformer with the exception of the individual core bolts and associated individual clamping plates shall be maintained at some fixed potential.

II. EARTHING OF CORE CLAMPING STRUCTURE

Top main core clamping structure shall be connected to the tank body by a copper strip. The bottom clamping structure shall be earthed by

one or more of the following methods.

- A. By connection through vertical tie rods to the top structure
- B. By direct metal-to-metal contact with the tank base maintained by the weight of the core and windings.
- C. By a connection to the top structure on the same side of the core as the main earth connection to the tank.

III EARTHING OF MAGNETIC CIRCUIT

- A. Magnetic circuit shall be earthed to the clamping structure at one point only through a disconnectable link placed on an accessible position beneath an inspection opening in the tank over. Connection to the link shall be on the same side of the core as the main earth connection.
- B. Magnetic circuits having an insulated sectional construction shall be provided with a separate link for each individual section. When oil ducts or insulating barriers parallel to the plane of the laminations divide one magnetic circuit into two or more electrically separate parts the ducts or barriers shall be bridged in accordance with Clause-1.17.
- C. Magnetic circuit shall not be regarded as being of sectional construction.

IV SIZE OF EARTHING CONNECTIONS

All earthing connections with the exception of those from the individual coil clamping rings shall have a cross sectional area of not less than 0.8 sq.cm. connections inserted between laminations of different section of core as per Clause-1.22-III(B) shall have a copper sectional area of not less than 0.2 sq.mm.

V LEADS FROM WINDING TO BUSHING AND INTERCAKE CONNECTIONS

Leads from winding to bushing and intercake connections should be rigid enough to withstand normal vibration and transportation shocks and short circuit stresses. They should be spaced in such a way that necessary clearances are maintained not only in air, but with oil medium at the lowest permissible electrical strength as per relevant ISS over the period of normal services.

1.23 TRANSFORMER TANK

1.23.1 Main tank of the transformer shall be made of good quality sheet steel of adequate thickness to provide sturdy and robust construction to withstand extreme pressure conditions. Interior of the transformer tank shall be thoroughly cleaned by sand or shot-blasting so as to produce a smooth and clean surface free of scale, grease and rust. Interior of transformer tank shall be painted with insulating oil resistance paint. Thickness of the Top and Bottom plate of tank shall be minimum 6mm, while that of side wall should be minimum 4mm.

1.23.2 OIL LEAKAGE TEST

All tanks and oil filled compartments shall be tested for oil tightness by being completely filled with air/oil of viscosity not greater than that of insulating oil of IS 335 at ambient temperature and subject to a pressure equal to the normal pressure plus 35 KN/sq.meter measured at the base of the tank. This pressure shall be maintained for a period of not less than 12 hours for oil and one hour for air during which time no leakage shall occur.

1.24 BOLTS & NUTS

- A. Steel bolts and nuts exposed to atmosphere with suitable cadmium plated or zinc plated passivity shall be used for diameters above 6mm.
- B. All nuts, bolts and pins shall be locked in position with the exception of these external to the transformer.
- C. On outdoor equipment, all bolts, nuts and washers in contact with non-ferrous parts which carry current shall be of phosphor bronze, where the transformer of current is through the bolts.
- D. If bolts and nuts are placed so that these are inaccessible by means of ordinary spanners, suitable special spanners shall be provided by the supplier.

1.26 TERMINAL CONNECTORS

Universal bi-metallic terminal connector for HV bushings shall have horizontal take off arrangement and shall be suitable to receive single 'ZEBRA' ACSR conductor and vertical take off arrangement shall be suitable for 0.1 sq.mm. ACSR conductor. Minimum thickness of clamp shall be 12mm at any part of the body. Thickness of bi-metallic liner shall be minimum 2mm. **Terminal connectors shall be made out of pressure / gravity die-casting process only.** Stud conductor hold length shall be 100 mm (min.). Suitable terminal connectors (4 nos.) for each transformer for LV shall also be included in the scope of supply.

1.26 PARALLEL OPERATION

Transformers of the same service voltage shall be suitable for parallel operation, the load being shared in proportion to the capacities and percentage impedance volts which will be within the limits specified in the relevant IS.

1.27 OVERLOAD CAPACITY

- A. Each transformer shall be capable of carrying sustained over loads as stated in IS:6600.
- B. Type of Load: Station transformers will supply a mixed power and lightning load, with varying power factors from 0.6 lag to 0.8 lead due to capacitors.

1.30 GUARANTEE

Manufacturer shall guarantee the following:

- i. Quality and strength of material used, both electrical and mechanical.
- ii. Performance Guarantee period for satisfactory operation of Station Transformers shall be strictly as per clause no 26.0 of section I of the specification. This period will be reckoned from the day on which last of all accessories are received, enabling assembly testing commissioning and commercial operation of transformers.
- iv. Performance details are to be supplied by Bidder in the schedule of 'Guaranteed Technical Particulars'

1.31 TOLERANCES

Tolerances of guaranteed performance figures shall be as specified in the latest version of IS 2026.

1.30 ROLLERS

Station Transformers shall be provided with bi-directional float rollers.

1.31 FITTINGS & ACCESSORIES

Unless otherwise specified in the order, the following standard fittings shall be provided. The fittings shall be in accordance with the details to the extent these are specified in IS:2026.

- a. Rating & diagram plate with purchaser's order number and date, tap position and relative HV/LV voltage.
- b. 4 Nos pulling lugs of 8mm thickness.
- c. Two earthing terminals with lugs.
- d. 4 Nos. Lifting lugs of 8 mm thickness.
- e. 4 nos. bi-directional float rollers (150mm dia and 50mm wide).
- f. Conservator with top filler cap and bottom drain valve and oil level guage.
- g. Aluminium die cast Silicagel dehydrating breather having minimum 0.5kg. silicagel
- h. HV-3 nos. 52 KV bushings, LV – 4 nos. 1.1 KV bushings, Arcing horn for HV bushings
- i. Off circuit tap switch with indicator handle, lock and 2 keys.
- j. Thermometer pocket
- k. Air release device with cap on tank top.
- l. Explosion vent diaphragm.
- m. 2 filter valves (top valve, lower valve to be used also as drain valve).
- n. Bimetallic terminal connectors for each HV, LV & LV neutral bushings.

1.32 FINISHING

Exterior of the transformer and other ferrous fittings shall be thoroughly cleaned, scraped and given primary coat and the two finishing coats of durable oil and weather

resistant paint of enamel. Colour of the finishing coats shall be **DARK GREEN** conforming to IS: 5 of 1961 (colours for ready mixed paints) with conservator painted with **white colour** OR any equivalent acceptable International Standards.

1.33 TESTS & TEST CERTIFICATES FOR TRANSFORMER

1.33.1 TYPE TESTS

1.33.1.1 All the equipments offered shall be fully type tested as per relevant ISS or any equivalent acceptable International Standard & technical specification. The following type tests shall be carried out on the transformers in accordance with ISS: 2026/1977 as amended from time to time or any equivalent acceptable International Standard:

- (i) Short Circuit test
- (ii) Lightening Impulse Voltage withstand test.
- (iii) Heat run test
- (iv) Loss measurement

1.33.1.2 In case the transformers offered are as per purchasers' technical specifications and are already type tested in an **independent test laboratory**, the Bidders shall furnish **four** sets of tests reports along with the offer. These tests must not have been conducted **earlier than five years** from the date of opening of Bids. Purchaser reserves the right to demand repetition of some or all the type tests in the presence of owners' representative. For this purpose, the Bidders may quote unit rates for carrying out each type test. These prices shall be taken in to consideration for bid evaluation.

1.33.1.3 In case there is any deviation in the type tested design, from the purchasers' technical specification, the type tests have to be conducted afresh by the manufacturer at their cost in accordance with the purchaser's specification. Tests shall be carried out immediately and detailed type test reports submitted within **ONE MONTH** from the date of issue of Letter of Intent. Please note that no separate time shall be permitted for this purpose.

1.33.1.4 Type tests on randomly selected unit

Suppliers may **carefully note our following specific requirements of Short Circuit, Impulse Voltage Withstand, Heat Run & Loss Measurement Tests**

It may be noted that the MPPTCL reserve the right to conduct all or any of the test mentioned under clause- 1.33.1.1. in accordance with the ISS or any equivalent acceptable International Standard afresh on each ordered rating at MPPTCL's cost, even if the transformers of the same rating and similar design are already type tested. This test shall be carried out on a transformer to be selected by the MPPTCL either at supplier works when they are offered in a lot for supply or random sample from the supplies already made to MPPTCL's Transmission Stores. **The findings and conclusions of these tests shall be binding on the supplier.**

In case the transformer does not pass either of the tests and if the active part details are not found to be in line with the design tested and approved, the following punitive measures shall be taken: -

- (i) 5% payment of the bill for the supplies already made will be recovered.
- (ii) For transformers already supplied, the **guarantee period shall stand twice** the normal guarantee period incorporated in the order and the period of performance Security Deposit shall be suitably extended to cover the extended guarantee period.

Further, the supply of balance quantity of transformers will not be accepted by the MPPTCL, till another transformer from the manufactured batch is satisfactorily tested (Or transformers are modified according to the tested design) for any or all the tests as per clause-1.33.1.1 above **at supplier's cost** and consequent to this, if there is any delay in executing the order, the same shall be to the suppliers' account. MPPTCL reserves the right to take action as per terms and conditions of the order.

- (iii) The test charges shall be borne by the firm.

1.33.2 ROUTINE TESTS

Before despatch each of completely assembled transformer shall be subjected to the following routine tests at the manufacturer's works in accordance with the details specified in IS:1180/2026 Or any equivalent acceptable International Standards and as detailed below: -

- i. Measurement of winding resistance.
- j. Ratio, polarity and phase relationships.
- k. Impedance voltage.
- l. No load loss and No load current.
- m. Load loss
- n. Insulation resistance.
- o. Separate Source voltage withstand.
- p. Induced over voltage withstand.

1.33.3. ACCEPTANCE TESTS TO BE CARRIED OUT BEFORE DESPATCH

Following tests shall be witnessed by the Purchaser's representative at the works of the supplier.

1.33.4 All the routine tests as mentioned in 1.33.2 above shall be performed on **minimum 10% quantity** of offered lot.

Besides above, following tests are to be performed on **one unit of each lot** offered for inspection.

- h. Verification of active parts alongwith weighment of unit.
- i. Spill Current measurement test
- j. Test for Magnetic Balance shall be conducted by connecting the LV phase by phase to rated phase voltage and measurement of an, bn, cn voltage will be carried out.

- k. Test for Over fluxing of core.
- l. Pressure test performed on one tank.
- m. Breakdown voltage test of transformer Oil.
- n. Heat run test - **One unit** of the **ordered quantity**.

Heat run test shall have to be conducted at suppliers' cost on one transformer from first offered lot, during the course of supplies. This test shall be conducted **on lowest tap** by feeding corresponding losses at 75⁰ C. The measured losses at lowest tap at ambient temperature shall be specifically indicated in the inspection report.

To facilitate conduction of heat run test on any unit of any lot at any point of time during the supplies, the manufacturer will provide a thermometer pocket which gets immersed in oil on the side of the transformer in all the transformers. This pocket shall also be used for connecting thermal sensing device to monitor the variations in temperature, whenever required and to operate the protective devices. The Sensor pocket shall be of 12 mm diameter with blanking screwed cap, removable at site. The depth of the projecting stem of this pocket inside the transformer will be below oil level. It shall not fringe with electrical clearance nor obstruct the un-tanking of the active part.

1.34 TESTING FACILITIES

Bidders should have adequate testing facilities for all routine and acceptance tests as described above and also arrangement for measurement of losses, resistance etc.

1.35 INSPECTION

To ensure about the quality of transformers, the inspection shall be carried out by the MPPTCL's representative at following two stages.

1.35.1 When the raw-material is received, and the assembly is in process in the shop floor.

After the main raw-materials i.e. core and coil materials and tanks are arranged and transformers are taken for production on shop floor and a few assembly have been completed, the firm shall intimate the **O/o Executive Director (T&P), MPPTCL, Jabalpur** in this regard, so that an Officer for carrying out such inspection could be deputed, as far as possible within seven days from the date of intimation. During the stage inspection,

1.35.1.1 A few assembled core shall be dismantled to ensure that the CRGO laminations used are of good quality.

1.35.1.2 Dimensional details of construction of transformers as per the guaranteed technical particulars offered by the manufacturer and approved by the Purchaser shall be verified.

1.35.1.3 Pressure and vacuum test: Tank shall be fixed with a dummy cover with all fittings including bushings in position and shall be subjected to following pressure/vacuum created inside the tank: -

- i) 0.8 Kg./cm sq. above atmospheric pressure for 30 minutes.
- ii) A vacuum corresponding to (-) 0.7 Kg./cm sq. for 30 minutes.

Permanent deflection of tank plate, after pressure has been released, shall not exceed the values given below: -

Length of plate	Deflection
Up to 750 mm	5mm
751 to 1250 mm	6mm
251 to 1750 mm	8mm

In case of any defect/defective workmanship observed at any stage during stage inspection by the MPPTCL's Inspecting Officer, the same shall be pointed out to the firm in writing for taking remedial measures. Further, processing should only be done after clearance from the **O/o Executive Director (T&P), MPPTCL, Jabalpur.**

1.35.1.4 Supplier shall provide to the purchaser, complete invoice of procurement of raw-materials i.e. core, winding material, insulation material, bushings, transformer oil, tanks etc., at the time of stage inspection.

If at any stage it is found that transformer is not manufactured out of the raw-material for which invoices have been furnished, the transformer shall be liable for rejection by purchaser and the transformer shall be replaced by the manufacturer at no extra cost to the purchaser.

1.35.2 At finished stage i.e. transformers are fully assembled and are ready for despatch.

As and when the transformers are ready for despatch, an offer intimating about the readiness of transformers, for final inspection for carrying out acceptance tests as per relevant ISS Or any equivalent acceptable International Standards and as in **clause 1.33.3** above, shall be sent by the firm **alongwith Routine Test Certificates**. The inspection shall normally be arranged by the MPPTCL at the earliest after receipt of offer for pre-delivery inspection.

All tests and inspection shall be carried out at the place of manufacturer unless otherwise specifically agreed upon by the manufacturer and purchaser at the time of placing of purchase order. The manufacturer shall offer the Inspector representing the Purchaser, all reasonable facilities, without charges, to satisfy him that the material is being supplied in accordance with this specification. This will include stage inspection during manufacturing stage as well as active part inspection during acceptance tests.

Random sample checking and testing of the transformer selected at random from the lot offered for pre-despatch inspection shall be done for verification of technical details, design and losses as per approved G.T.P., drawings and technical specification of the order. In case of variations, the lot shall be rejected.

Purchaser has all the rights to conduct the test including type tests, at its own cost by an independent agency whenever there is a dispute regarding the quality of supply or interpretation of test results. In the event of failure of transformer(s) in such tests, the expenses incurred in testing shall be to the Supplier's account as already mentioned above in case of random testing.

1.36 TEST CERTIFICATES OF BOUGHT OUT ITEMS

To ascertain the quality of the transformer oil, the original manufacturer's test report should be submitted at the time of inspection. Also, arrangements should be made for testing of transformer oil, after taking out the sample from the manufactured transformers and tested in the presence of purchaser's representative.

1.37 TEST REPORTS ON THE ANALYSIS OF RAW MATERIALS

Bidders shall furnish details of source(s) of raw-materials, test certificates and report on the analysis of electrolytic copper used for the winding and the steel used for core, insulation material and also other bought out items from sub-suppliers.

1.38 QUALITY ASSURANCE PLAN:

1.38.1 Bidders must establish that they are following a proper quality assurance programme for manufacture of Materials. Bidders shall invariably furnish following information along with their offer.

- (i) Statement giving list of important raw materials, names of sub-suppliers for the raw material, list of standards according to which the raw material is purchased and copies of test certificates thereof.
- (ii) Information and copies of test certificates as in (i) above in respect of bought out items.
- (iii) List of manufacturing facilities available.
- (iv) Levels 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 & inspections.
- (vi) List of testing equipment available with the Bidders for final testing of material specified and test plant limitation, if any, vis-à-vis type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

1.38.2 Successful Bidder 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 Bid.
- (ii) Type test certificates of the raw material and bought out accessories.
- (iii) Quality Assurance Plan (QAP) with hold-up points for purchaser's inspection. The quality assurance plans and hold-up points shall be discussed between the Purchaser and supplier before the QAP is finalized.

1.39 DRAWINGS

General Arrangement, Core-Coil Assembly and Name Plate detail drawing of each rating of transformer offered along with guaranteed technical particulars, should be submitted with the offer.

After award of contract four sets of drawing, Guaranteed Technical Particulars and type test certificate of transformer with duly stamped drawing from independent testing laboratory shall be submitted for approval.

1.40 Please ensure that bid document containing number of pages have been properly numbered and signed by the Bidder. Bid document including all schedules and Annexures should be indexed properly and Index of the document should be enclosed/placed at the beginning of the bid document.

APPENDIX-A1

PRINCIPAL PARAMETERS OF 33/4 KV, 200KVA STATION TRANSFORMERS

The transformers shall conform to the following specific parameters described here under:-

S. No.	Particulars	Station Transformer	
1	Voltage rating	33/0.4 KV	
2	Rated KVA	200	
3	Type of cooling	ONAN	
4	Vector group HV/LV	DY11	
5	Maximum flux density in iron at normal voltage & freq. and/at 10% over voltage	1.7 to 1.75 Tesla	
6	Max. current density in winding HV/LV	300 to 330A/cm ²	
7	Max. no load losses at normal ratio without positive tol.	400W	
8	Max. load losses at 75 deg.C. and at normal ratio without positive tol.	2100W	
9	%impedance at 75 deg.C. & normal ratio	4.5%	
10	Details of bushing rating & type		
	HV	52 KV class porcelain standard X-mer bushing	
	LV	1.1 KV class bushing (non oil communicating type)	
11	BIL level of HV winding	170 KV peak	
12	BIL level of HV bushing	250 KV peak	
13	One minute P.F. withstand voltage (HV bushing/winding)	70 KV rms.	
14	Electrical clearance	33KV	0.400KV
	i/ Phase to phase	350mm	75mm
	ii/ Phase to Earth	320mm	55mm
15	Max. temp. rise over max. ambient temp.		
	a. OIL above 50 deg.C amb.	45 deg C.	
	b. Winding above 50 deg.C.amb.	50 deg.C	
16	Continuous over voltage rating	10% above at each tapping on continuous basis	
17	Terminal connector		
	HV	Horizontal/vertical take off suitable to receive single ACSR Zebra conductor	
	LV	Suitable for power cable connection	

APPENDIX - AII

GUARANTEED TECHNICAL PARTICULARS OF EHV GRADE OIL

The important characteristic of new oil shall be as under:

S.No.	Characteristics	Requirements
1	Flash point Pensky Marten (closed) min.	140 deg.C.
2	Neutralisation value	
	a/ Total acidity max.	0.03 mg. KOH/g
	b/ Inorganic acidity alkalinity	NIL
3	Corrosive sulphur	Non- corrosive
4	Electrical strength (Break down voltage) min.	
	a/ New unfiltered oil	30 KV (rms)
	b/ New oil after filtration	60 KV (rms)
5	Di-electric dissipation factor (Tan Delta) at 90 deg.C. max	0.002
6	Specific resistance (resistivity)	
	a/ At 90 deg.C. Min.	35×10^{12} Ohm-cm
	b/ At 27 deg.C. Min.	1500×10^{12} Ohm-cm
7	Oxidation stability	
	a/ Neutralization value after oxidation(max)	0.40 mg. KOH/g
	b/ Total sludge after oxidation max.	0.10% by weight
	c/ S.K. Value	4 to 8%
8	Ageing characteristics after accelerated ageing (open breaker method with copper catalyst)	
	a/ Specific resistance (resistivity)	
	i/ at 27 deg.C. min.	2.5×10^{12} Ohm-cm
	ii/ at 90 deg.C. min.	0.2×10^{12} Ohm-cm
	b/ Di-electric dissipation factor (Tan Delta) at 90 deg.C. Max.	0.2
	c/ Total acidity Max.	0.05 mg. KOH/g
	d/ Total sludge value max.	0.05% by weight.
9	Characteristics of oil in the transformer The important characteristics of the transformer oil after it is filled in the transformer (within three months of filling) shall be as follows:-	
	(a) Electrical strength (breakdown voltage)	40KV / Min.
	(b) Di-electric dissipation factor (Tan Delta) at 90 deg. centigrade	0.01 max.
	(c) Specific resistance (resistivity) at 27 deg. centigrade.	10×10^{12} Ohm-cm
	(d) Flash point Pensky Marten (closed)	140 deg. centigrade (Min.)
	(e) Interfacial tension at 27 deg. centigrade	0.03 N/m. (Min.)
	(f) Neutralisation value (total acidity)	0.05 mg KOH/g. (Max.)

(g)	Water content	35 PPM (Max.)
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APPENDIX-AIII

LIST OF FITTINGS AND ACCESSORIES

The transformers to be supplied shall be provided with following fittings & accessories

1. Rating & terminal marking plate.
 - i/ Purchase order No. & date to be indicated on rating plate.
 - ii/ Serial number of transformer to be indicated on rating plate.
 - iii/ Please confirm copper windings
 - iv/ Rating & diagram plate with tap position & relative HV/LV voltage
2. Three nos. 52 KV class porcelain standard transformer HV bushings.
3. 4 nos. 1.1 KV Grade oil filled non communicating type LV bushings.
4. Earthing terminals - 2 nos.
5. Tank lifting lugs - 4 nos.
6. Jacking pads - 4 nos.
7. Silicagel dehydrating breather having minimum 0.5 kg. silicagel.
8. Conservator with oil filling cap, drain valve with plug and oil level gauge.
9. Pressure relief device (explosion vent)
10. Filter valves (Lower valve to be used as drain valve which should be capable to drain oil completely)
11. Air release device with cap on tank top.
12. 4 nos. Bi-directional float rollers (150 mm dia and 50 mm wide).
13. Thermometer pocket.
14. Off-circuit tap changing switch with indicator locking arrangement.
15. Terminals connector for HV & LV bushings

SCHEDULE-I (A)
DESCRIPTION OF EQUIPMENT FOR
SCHEDULE FOR RATES AND PRICES TO BE FURNISHED
IN VOLUME-VI

S.No.	Particulars of equipment/ Item	Qty.
1.	Supply of 33/0.4 K.V., 200KVA, 3-Phase, Copper Wound, Naturally Air Cooled (ONAN type) Station Transformers fitted with all accessories & fittings as described in the specification complete with first filling of Oil etc. conforming to all technical requirements.	As per Price Schedule
2.	Supply of 33/0.4 K.V., 500KVA, 3-Phase, Copper Wound, Naturally Air Cooled (ONAN type) Station Transformers fitted with all accessories & fittings as described in the specification complete with first filling of Oil etc. conforming to all technical requirements.	

NOTE:1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.

2. The quantity of above equipments has been mentioned in Volume VI.

SECTION-II(B)

TECHNICAL SPECIFICATION FOR LT DISTRIBUTION BOX SUITABLE FOR 33/0.4KV 200KVA/500 KVA STATION TRANSFORMER

1.0 SCOPE:

The scope of this specification covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Specification means "Original Equipment Manufacturer (OEM)". The purchaser means the MPPTCL."

In case bidder is not OEM, sole responsibility of offering equipments/material of manufacturer as per this specification requirement shall rest on the bidder.

1.1 It is not the intent to specify all details of design and construction of the LT Distribution Box Suitable for 33/0.433KV 200KVA Station Transformer here. However, LT Distribution Box shall conform in all respects to the high standard of engineering design and workmanship. LT Distribution Box offered shall be complete with all components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of supply of the tender irrespective of whether these are specifically brought out in this specifications or not.

1.2 LT Distribution Box Suitable for 33/0.433KV 200KVA/500 KVA Station Transformer included in the tender are required for installation in various, 400KV, 220KV and 132 KV EHV substations of Madhya Pradesh Power Transmission Company located within the state of Madhya Pradesh.

2.0 STANDARDS:

Applicable Standards for the offered equipments/items shall be as per Section-I Volume-II of this bid.

3.0 CLIMATIC CONDITION:

Applicable climatic conditions shall be as per Section-I Volume-II of this bid.

4.0 GENERAL DESCRIPTION AND SPECIFICATIONS OF EQUIPMENT AND QUANTITY REQUIRED:

4.1. In the following paragraphs, General description and technical requirement of LT Distribution Boxes have been described;

S. No.	Particulars	Rating 200 KVA
1	Scope	Manufacture & Testing of L.T. distribution Boxes
2	System	AC 3 Phase, 4Wire 50 C/S

S. No.	Particulars	Rating 200 KVA
3	Material should be suitable in the weather conditions as below:	
a.	Temperature Range	0 ^o to 50 ^o C
b.	Relative Humidity	20% to Max.100%
c.	Altitude	0 to 1000 Meters
4	System Details	
a.	K.V.A.	Suitable for use with 200 KVA/500 KVA Station Transformer
b.	Voltage	400 VAC
c.	Frequency	50 C/s
d.	Approximate full load current	300 A/750 A
e.	No of outgoing circuit per phase.	2 Nos. (with a provision of 3 rd circuit on the back side)
5	Applicable Standards Amended Upto Date	
a.	Switch Dis-connector	IS:13947(Pt-III)/ 1993 or to any equivalent International Standards
b.	LT MCCBs	IS:13947(Pt-II)/ 1993 or to any equivalent International Standards
c.	Enclosure Box	IS:2147/1962 or to any equivalent International Standards
d.	General Regulator	IS:4237/1992 or to any equivalent International Standards
e.	LT Switch-gear used in Box	IS:8623(Pt-I)/ 1993 or to any equivalent International Standards
6	Manufacturing/ Contruconal Details	One Triple Pole Switch Dis-connector of 400A /1000A rating on in coming side with 6 Nos. Single pole MCCBs for two circuits on the outgoing side, as follows:- (i) Circuit-I:- 3 Nos. single pole MCCBs, nominal current rating-200 Amps/500Amps Amps O/L current setting-160Amps/ 400 Amps. (ii) Circuit-II:- 3 Nos single pole MCCBs, nominal current rating 200 Amps /500 Amps O/L current setting-160 Amps /400 Amps The interconnection and links shall be as per the enclosed drawings Adequate space shall be provided for incorporating an additional circuit in the dist. box.
7	Details Of Incoming Circuit With Triple Pole Switch Disconnecter (Handle Should Be Detachable)	

S. No.	Particulars	Rating 200 KVA
a.	Rated Insulation VAC voltage	Should be more than 660 volts
b.	Utilization category	AC 23 A
c.	Rated Impulse withstand voltage	12 KV
d.	Rated Thermal current	400 Amps/1000 Amps
e.	Rated Operational current at 240 V	400 Amps /1000 Amps
f.	Short withstand current for one second	10 KA
g.	Rated making capacity at 415 VAC at 0.45 PF	As per relevant clause of IS No.13947 (Pt-III) or to any equivalent International Standards i.e. 10 times of the rated operational current of S.D.
h.	Rated breaking capacity 415 VAC at = 0.45PF	As per relevant clause of IS No.13947 (Pt-III) or to any equivalent International Standards i.e. 8 times of rated operational current of S.D.
i.	Mechanical Endurance (Operating Cycles) (nos)	As per relevant Clause of IS No.13947(Pt-III) or to any equivalent International Standards
j.	(j) Electrical Endurance (Operating Cycles)	As per relevant Clause of IS No.13947(Pt-III)or to any equivalent International Standards
k.	Cross section of terminal strips of switch dis-connector in coming side & outgoing side	50 x 6 Sq.mm. (As per drawing no.63.722 E)
l.	Length of terminal on incoming side	80 mm
m.	Length of terminal on out-going side	60 mm
n.	Material of the terminal strips (in-coming & out-going)	Tinned Electrolytic Copper
o.	Length of Operating Handle and position of handle.	Switch Disconne-ctor should be front operated & length should be at-least 80mm
p.	Body material of Switch Disconnecter	Body of the Switch Disconnecter should be made of DMC compound

S. No.	Particulars	Rating 200 KVA
q.	Applicable ISS for type test	The Switch Disconnecter, to be used in the Distbn. Box should be type tested as per IS:13947-III)/1993 for Seq.I, II & III or to any equivalent International Standards. The type test should be conducted by CPRI/ EREDA or other recognized and reputable International Laboratory or Institutions.
8	Outgoing Circuit Details Single Pole MCCB Shall Be Provided As Per Details Given Below :-	
a.	No. of CKTS on Out-going side per phase.	2 nos./ phase
b.	Nominal current	200 Amps
c.	Current setting (Fixed over load)	160/160 Amps/ phase Two Ckt./ phase
d.	No. of pole	Single Pole
e.	Rated Short-circuit breaking capacity in KA as per IS:13947 (Part-III)/1993	10 KA at 0.4 PF (LAG)
f.	The sequence of operation for MCCB	As per Clause 8.3.4 of IS:13947 (Pt-II) or to any equivalent Inter-national Standards
g.	Utilization Category	(A)
h.	Power factor for short CKT Test	0.4 (LAG)
i.	Colour of MCCB	Black
j.	Arrangement of terminal strip of MCCB	As per drawing No. 63.606 A
k.	Projections of terminal strips of MCCB on :-	
(i)	Bus-bar	60 mm
(ii)	On outgoing(Cable side)	80 mm
l.	Size of terminal strips	30 x 5 Sq.mm.
m.	Material of the busbar strips	Continuous tinned copper strip from the point of contact.

S. No.	Particulars	Rating 200 KVA
n.	Details of Type tests for MCCB	MCCB to be used in the distbn. box must be type tested for Seq-I, Seq-II & Seq.III as per IS:13947 (Pt-II)/ 1993 / or to any equivalent International Standards / done by CPRI Bhopal, Banglore or EREDA and other recognized and reputable International Laboratory or Institutions.
o.	Type of MCCBs to be used	Fully magnetic
p.	LT MCCB SHALL HAVE TIME CURRENT CHARACTERISTICS AS INDICATED BELOW:	
	SETTING	TRIPPING TIME
	1.05	More than 2.5 Hrs
	1.2	More than 10 minutes & less than 2 hrs.
	1.3	Less than 30 minutes
	1.4	Less than 10 minutes
	2.5	Less than 1 minute
	4	Not less than 2 secs
	6	Not less than 5 secs
	12	Instantaneous (< 40 m.secs)
9	DETAILS OF BUS-BAR & LINKS:	
a.	Material	Electrolytic tinned copper (As per drawing)
b.	Size of main Bus-bar	50 x 6 Sq.mm.
c.	Size inter-link	30 x 5 Sq.mm. As per drawing no.63.606 D)
d.	Insulations over the Bus-bar & links	PVC Insulation of standard colour code i.e. Red, Yellow, Blue for R, Y & B Phase
e.	Minimum Clearance between Busbar Box and terminals of Switch Disconnecter & MCCBs	As per drawing no.021 dt.Feb' 2001 as per IS:4237 amended upto date or to any equivalent International Standards
10	Enclosures	
a.	Size	(1200 x 1100 x 470 mm) (1000 x 1000 x 400 mm) As per drawing 021 dt.Feb'2001 (Revised)
b.	Material	CR/MS Sheet
c.	Thickness	2 .0 mm

S. No.	Particulars	Rating 200 KVA
d.	Arrangement for Pad lock	Arrangement to be provided for pad- lock as per drawing no.021 dt.Feb'2001 (R)
e.	Weather Auto lock is to be provided on front of door	Auto lock is to be provided in such a manner that the cover of the box can not be left open and it gets latched automatically when closed manually. Latch should be provided with master key for opening of the door.
f.	Slopping of Roof	As per drawing no.21 Feb'2001 (Revised)
g.	Front door of the Box	A sticker written with "PROPERTY OF MPPTCL "
11	Size of Bottom plate perforated.	As per drawing 021 dt.Feb'2001 (Revised)
a.	Thickness of bottom plate	2 mm
b.	Material of the bottom plate	Perforated sheet
c.	Fixing arrangement of the bottom plate	Should be detachable
d.	Knock out holes in the bottom plate	3 Nos. with PVC glands suitable for the required size of cable and additional 2 mm thick sheet of suitable width to be provided to hold the cable glands.
e.	Additional Supports of the Bottom Plate	2 mm thick perforated sheet
f.	Bottom Cleats of Box	Bottom cleat of 80 x 110 x 3 mm thick sheet to be provided below the box on both side, so that box does not come in direct contact with ground when stored.
g.	Air Circulation & clearance in the Box.	Both side louvers with wire mesh, vermin proof ventilation.
h.	clearance between the terminals of bus bar switch dis-connector and MCCB	Creepage should be as per IS:4237 or to any equivalent International Standards
i.	Instructions to Lineman	Instruction printed in Hindi to be provided as per drawing No.03 (B) in side each box.

S. No.	Particulars	Rating 200 KVA
j.	Danger Board Identification Plate	To be provided as per drawing No.62.70 and each box must have identification plate on the front cover. a/ Name of the firm b/ Rating Box c/ Serial No. d/ Date of Manufacture e/ Order No. & date
k.	Hinges	As per drawing no. 6.606(c) out side.
l.	Other parts such as Nuts, and Bolts Washers etc.	All Nut, Bolts & Washers used in current carrying parts should be of good quality stain less steel (As per drawing no.63.606 & 63.722)
12	EARTHING BOLTS	
a.	Required No	Two (one on each side)
b.	Fixing	Earthing should be welded.
c.	Size	As per drawing
d.	Others	One spring washer and two plain washers should be provided on the earthing bolt.
13	PAINTING & FIXING ARRANGEMENT FOR BOX:	
a.	Process No.	3 Tank process
b.	Painting	With synthetic enamel paint of good quality.
c.	Colour outside &	Brown / White
d.	Fixing Arrangement for Box	Suitable arrangement on a double pole structure as per drawing
(i)	Size	50 x 6 Sq.mm or equivalent
(ii)	Fixing	As per drawing
(iii)	Lugs	Double hole bimetallic lugs adequate size as per drawing.
14	Neutral busbar	
a.	Size	50x6 sq.mm or equivalent
b.	Fixing	As per drawing
c.	Lux	Double hole bimetallic lux of adequate size as per drg.
15	LUGS ON INCOMING AND OUTGOING TERMINALS	
a.	Size of Incoming side cable & lugs.	95 Sq.mm. Single LT XPLE Cable with suitable single holes lug.
b.	Size of Outgoing cable & lugs	70 Sq.mm. XLPE Single core Cable suitable single hole size lugs

S. No.	Particulars	Rating 200 KVA
16	CABLE HOLDING CLAMP	Cable holding clamp be made of 2mm thick strip with 4mm base to be provided on in coming side and outgoing side as per drg. No.63.606 (R-2)
17	OTHER REQUIREMENTS	There should be free circulation of Air between Switch Dis-connector busbar & SP MCCB at back and front so that the inside temp. does not exceed beyond permissible limits.
18	APPLICABLE STANDARDS FOR BOX	IS:2147/1962 with latest amendments or to any equivalent International Standards. B. IP-20 IS:8623 (Pt-I)/1993 or to any equivalent International Standards
19.	Provision of cut-outs	If needed, MPPTCL will provide cutout in distribution boxes for which tender will provide space and plate as per enclosed drawing No.
20	TEST & TEST CERTIFICATE	
a.	Type Test Certificate	(A) Temperature rise test as per IS:8623/Pt-I/ 93 or to any equivalent International Standards (B) High Voltage Test should be done at 3.00 KV for one minute (C) Short time withstand current test on Distribution Box.
	For short time current test the box should be subjected to a current of 10 KA for 1 Sec. for all the Circuit. independently, after by passing the MCCBs.	
b.	Routine Test Certificate:-	Each Distbn. Box should be tested for the routine test as indicated. The routine test report indicating S. no. must be submitted with the offer at the time of inspection of the material. A. Over all dimension B. Insulation Resistance Test C.H.V. withstand test for 3.0 KV for one minute. D. Operation test on MCCB and S.D. Separately.
c.	Acceptance Test On Complete Box (These test should be carried out as acceptance test in addition to routine test on one Random sample in each rating out of the lot offered for inspection.)	TEMPERATURE RISE TEST For this test, the Box should be kept in an enclosure that the temp. is maintaining at 50°C and the full load current of MCCB setting i.e. 160 Amps. is passed in all circuit and maintained till the temp. is established and max temp. rise is recorded. (These tests should be carried on box and MCCB separately.

S. No.	Particulars	Rating 200 KVA
d.	Time Current Characteristic Test	With the established temperature rise as above the Distribution Box MCCB should be tested for time current characteristic at 1.05 and 1.2 times of over load release current setting and it should pass the requirement given as per Cl.-8(p) above.
e.	Instruction for submission of Type Test Certificates:	The type test of the distribution box (as per relevant ISS or to any equivalent International Standards) should be carried out by reputed national Laboratory / test houses such as CPRI Bangalore/ Bhopal/ and other recognized and reputable International Laboratory or Institutions.

5.0 INSPECTION:

5.1 The purchaser's representative shall at all times be entitled to have access to the works and all places of manufacture where equipment/ material shall be manufactured and the representative shall have full facilities for unrestricted inspection of the supplier's works, raw materials and process of manufacture for conducting necessary tests as detailed herein.

5.2 The supplier shall keep the purchaser informed in advance of the time of starting and of the progress of manufacture of equipment/material in its various stages so that arrangements can be made for inspection.

5.3 No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is waived off by the purchaser in writing. In the later case also, the equipment/material shall be dispatched only after satisfactory testing for all tests specified herein has been completed.

5.4 The acceptance of any quantity of material shall in no way relieve the supplier of any of his responsibilities for meeting all requirements of the specification, and shall not prevent subsequent rejection if such material is later found to be defective.

5.5 The number of sample selected to carryout the acceptance test shall be as per provision in the respective IS or any equivalent International Standards.

5.6 The purchaser has the right to have the tests carried out by an independent Agency subject to recovery of testing expenditure in case of failure, whenever there is dispute regarding the quality of supply.

6.0 QUALITY ASSURANCE PLAN:

6.1 The supplier shall invariably furnish following information along with his offer, failing which his offer shall be treated as non responsive. Information shall be separately given for individual type of equipment offered.

- (i) Statement giving list of important raw materials, names of sub supplies 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 supplier's representative copies of test certificates.

- (ii) Information and copies of test certificates as in above in respect of bought out accessories.
- (iii) List of manufacturing facilities available.
- (iv) Level of automation achieved and list of areas where manual process exists.
- (v) List of areas in manufacturing process, where state inspections are normally carried out for quality control and details of such tests and inspections.
- (vi) Special features provided in the equipments to make it maintenance free, if any.
- (vii) List of testing equipments available with the supplier for final testing of equipment specified and test plant limitation. If any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviation from specified test requirements.

6.2 The successful 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 item accessories and the names of sub-suppliers selected from those furnished along with offer.
- (ii) Type test certificate of raw material and bought out accessories, if any.
- (iii) Quality assurance plan (QAP) with hold points for purchaser's inspection. The quality assurance of plan and Purchaser's hold points shall be discussed between the Purchaser and supplier, before QAP is finalized.

7.0 DOCUMENTATION:

7.1 One set of type tests reports, duly approved by the Purchaser shall be submitted by the supplier for distribution, before commencement of supply. Adequate copies of acceptance and routine test certificates, duly approved by the purchaser shall accompany the dispatched consignments.

7.2 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 supplier's risk.

7.3 Approval of drawing/work by purchaser shall not relieve the supplier of his responsibility and liability for ensuring correctness and correct interpretation of the latest

revision of applicable standards, rules and codes of practices. The equipment shall conform in all respect to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering. Purchaser shall have the power to reject any ordered material which in his judgment is not in full accordance therewith.

8.0 PACKING AND FORWARDING:

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

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

- (a) Name of 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.

8.3 On each package / crates containing the material / equipment following information shall be distinctly stenciled on it in indelible Ink along with other essential data:-

- (i) Contact Award letter number
- (ii) Name and address of consignee
- (iii) Manufacturer's name and address
- (iv) Name of item
- (v) Quantity
- (vi) Gross weight
- (vii) Arrow Marking for stacking/opening.

8.4 The supplier shall ensure that the packing list and bill of material are approved by the owner before despatch.

9.0 QUANTITY AND DELIVERY REQUIREMENTS:

- (i) This is set out in this specification.
- (ii) The scope of supply shall include supply of 2.5% extra quantity of bolts, nuts, washers, split pins, cotter pins and such other small loose items free of cost.

10.0 COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS:

Bidders must furnish the following information along with technical Bid:

10.1 Complete details of all the accessories which will be supplied with the LT distribution box should be furnished.

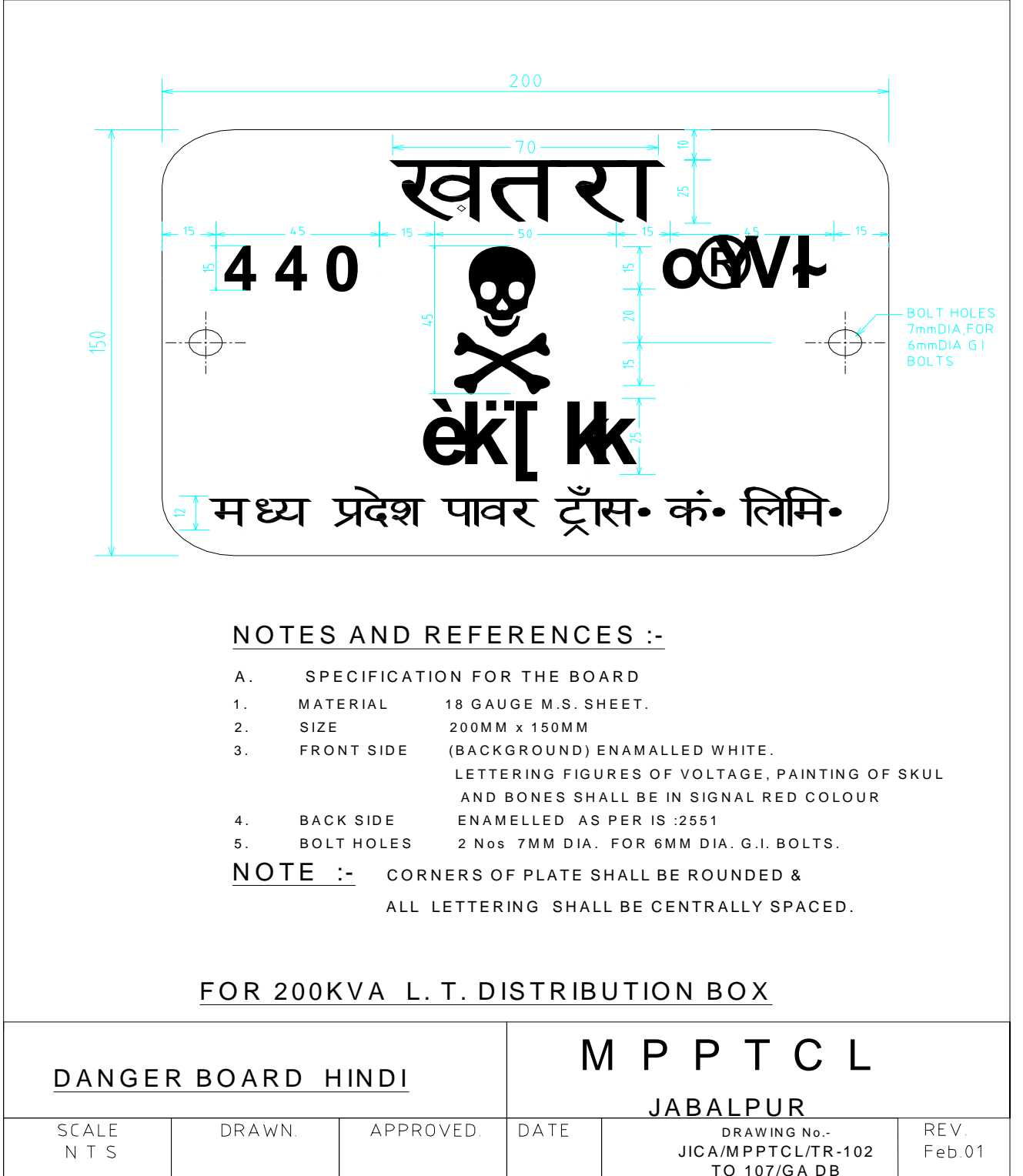
10.2 It is obligatory on the part of Bidder to ensure that supply of all accessories along with Main equipment are simultaneously delivered to avoid any holdup in erection and commissioning. The responsibility for obtaining timely supplies of bought out items will rest on Bidders and only on this basis, delivery period will be offered in the Bid.

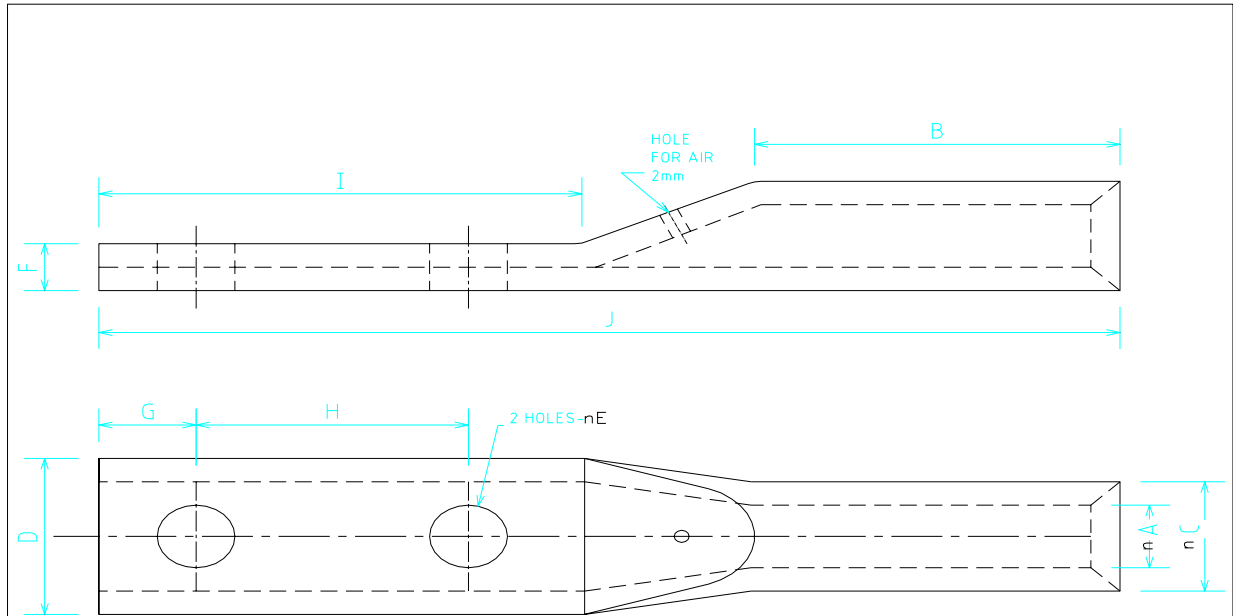
10.3 It may be noted that in case of damages/shortages due to improper packing or any other negligence, replenishment shall be arranged within one month time. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and also in case defective supply of any item is reported, will rest with the Bidder. In case for attending to defects in any accessory or inspection/ replacement of the accessory, which may be bought out item for the Bidder; if services of engineer of original manufacturer is required, the same will be organized on immediate basis by Bidder at his cost.

11.0 Please ensure that Bid document containing number of pages have been properly numbered and signed by the Bidder. Bid document including all schedules and Annexures should be indexed properly and Index of the document should be enclosed / placed at the beginning of the Bid document.

APPENDIX-B
DRAWINGS

S.No.	Drawing No.	Description
1	JICA/MPPTCL/TR-101 TO 107/ GA DB	General Arrangement Drawing for Danger Board
2	JICA/MPPTCL/TR-101 TO 107/ GA CABLE LUG	General Arrangement Drawing for Long Palm Double Stud Cable Lug
3	JICA/MPPTCL/TR-101 TO 107/ GA MCCB/DS	General Arrangement Drawing for MCCB/ Switch Disconnecter Terminal connection
4	JICA/MPPTCL/TR-101 TO 107/ GA C.C	General Arrangement Drawing for Cable Terminal Connection/ Cable Holding
5	JICA/MPPTCL/TR-101 TO 107/ GA LTDB	General Arrangement Drawing for L.T Distribution Box of 200 KVA Xmer



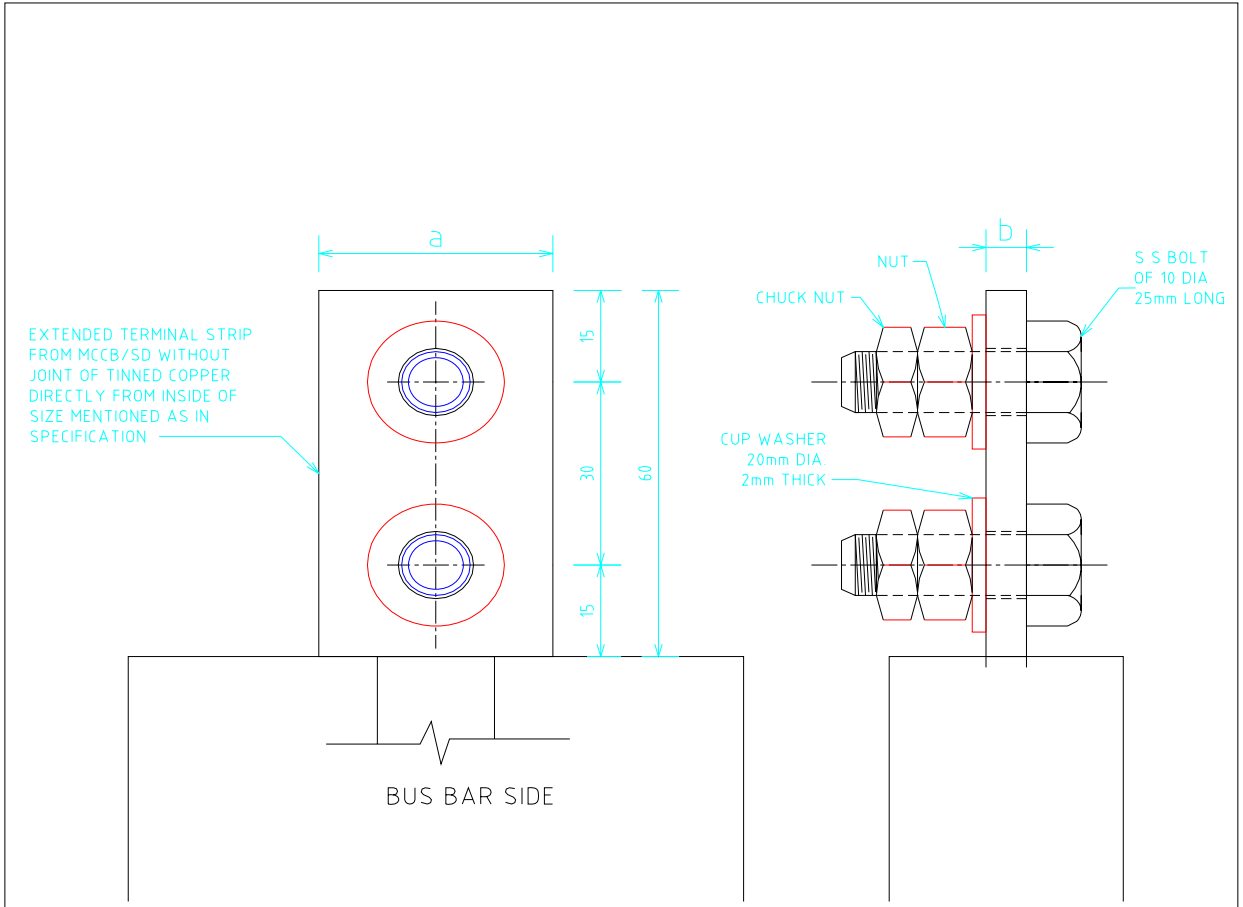


SIZE No.	Ø A	Ø C	D	F	Ø E	B	G	H	I	J
CABLE SIZE (50 Sq.mm)	9.6	13.6	22.0	3.5	10.3	30	13	40	65.0	115
CABLE SIZE (70 Sq.mm)	11.8	17.0	26.0	5.3	10.3	30	13	40	65.0	115
CABLE SIZE (95 Sq.mm)	13.0	17.0	30.0	3.5	10.3	30	13	40	65.0	115
CABLE SIZE (120 Sq.mm)	15.6	21.9	30.0	6.0	13.0	50	20	40	90.0	145
CABLE SIZE (150 Sq.mm)	16.5	22.0	30.0	5.3	13.0	50	20	40	90.0	156
CABLE SIZE (185 Sq.mm)	18.2	27.6	50.0	9.0	13.0	50	20	40	90.0	156
CABLE SIZE (225,240 Sq.mm)	21.0	30.0	50.0	7.5	13.0	50	20	40	90.0	156
CABLE SIZE (300 Sq.mm)	24.0	31.0	50.0	6.8	13.0	50	20	40	90.0	156

LONG PALM. DOUBLE STUD CABLE LUGS			M P P T C L JABALPUR		
SCALE N T S	(SIMETALLIC) DRAWN.	APPROVED.	DATE	DRAWING No.- JICA/MPPTCL/TR-102 TO 107/GA CABLE LUG	REV. Feb.01

SECTION II

200KV Δ LT DISTRIBUTION BOX

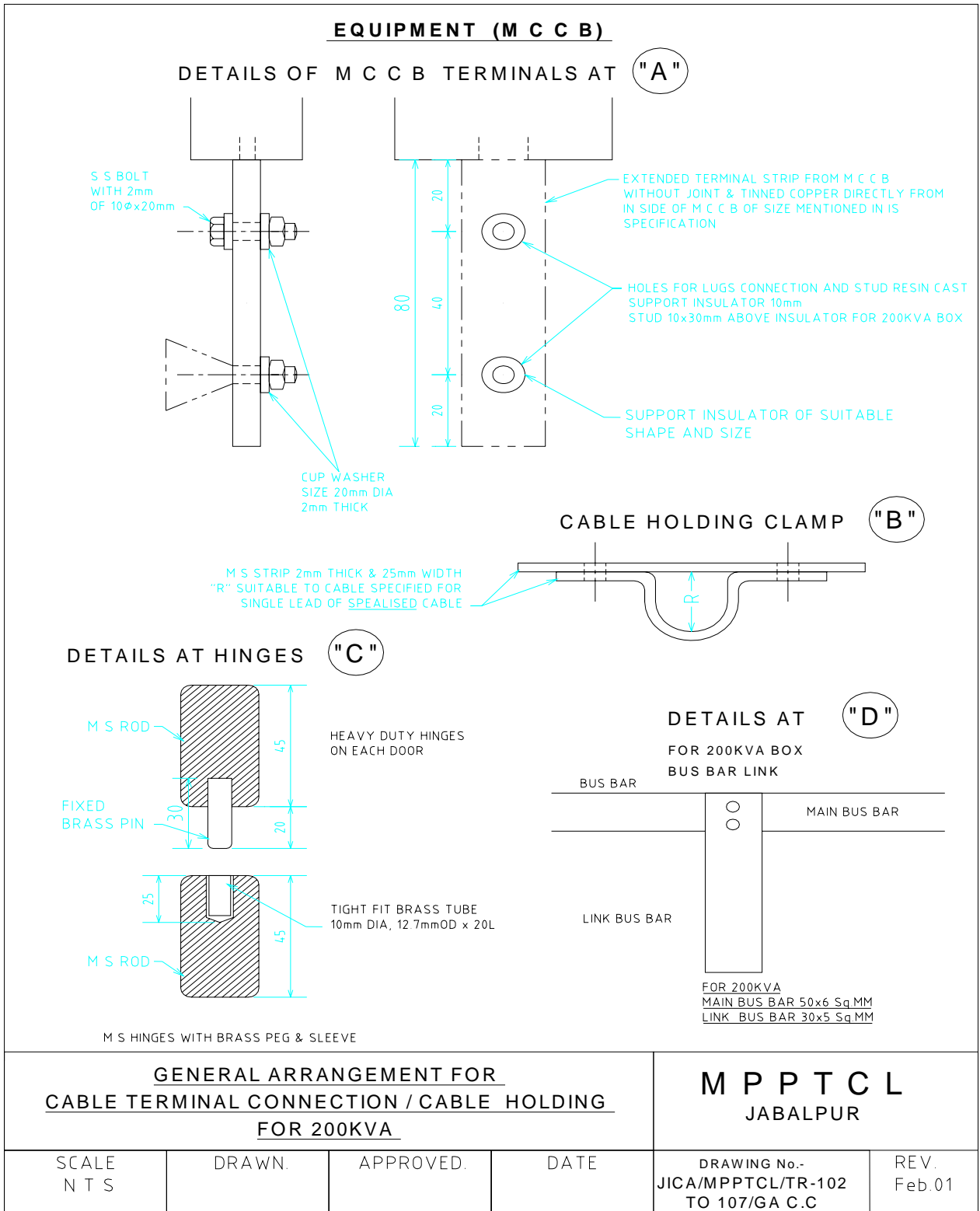


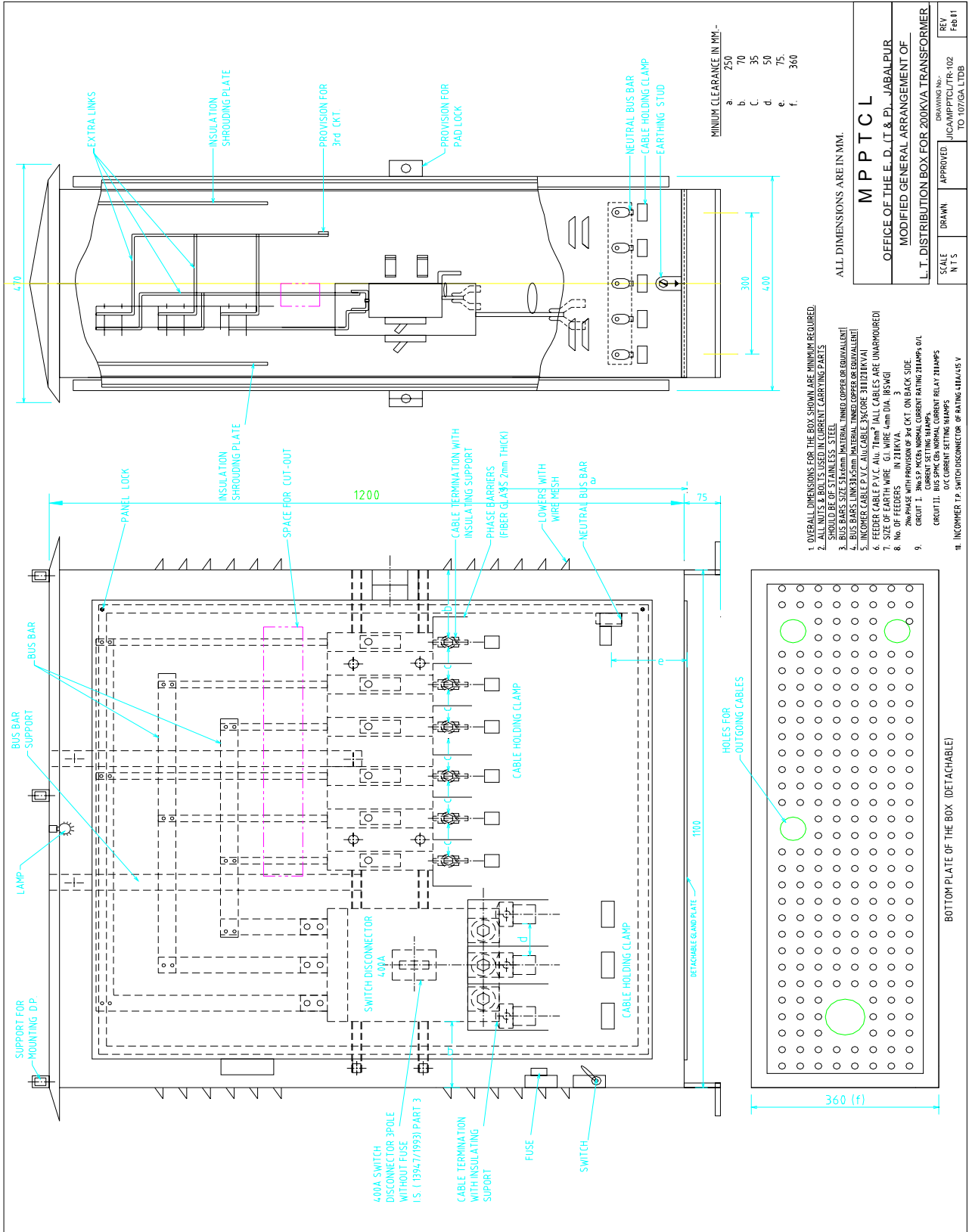
EQUIPMENT (M.C.C.B.)
SWITCH DISCONNECTOR

DETAILS OF TERMINALS AT- " E "

	a	b
M C C B	30mm	5mm
SWITCH DISCONNECTOR	50mm	6/10 mm

<u>GENERAL ARRANGEMENT FOR M.C.C.B. / SWITCH DISCONNECTOR TERMINALS CONNECTION FOR 200KVA L. T. DISTRIBUTION</u>				M P P T C L	
				JABALPUR	
SCALE N T S	DRAWN.	APPROVED.	DATE	DRAWING No.- JICA/MPPTCL/TR-102 TO 107/GA MCCB/DS	REV. Feb.01





SCHEDULE-I (A)
DESCRIPTION OF EQUIPMENT FOR
SCHEDULE FOR RATES AND PRICES TO BE FURNISHED
IN BIDDING FORM OF SECTION-IV, VOLUME-I

S.No.	Particulars of equipment/ Item	Qty.
1.	200 KVA LT Distribution Boxes suitable for 33/0.4KV 200KVA Station Transformers	As per Price Schedule
2	500 KVA LT Distribution Boxes suitable for 33/0.4KV 500KVA Station Transformers	

NOTE:1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.

2. The quantity of above equipments has been mentioned in Volume VI

SECTION-II (C)
TECHNICAL SPECIFICATION FOR 33KV DO FUSE UNITS

1.0 SCOPE:

The scope of this specification covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the MPPTCL.”

In case bidder is not OEM, sole responsibility of offering equipments/material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 SYSTEM CONDITIONS:

Applicable climatic conditions shall be as per Section-I Volume-II.

2.1 STANDARDS:

Applicable Standards for the offered equipments/items shall be as per Section-I Volume-II.

3.0 DISCREPANCY IN TECHNICAL PARTICULARS:

Regarding discrepancy in technical particulars as stipulated in Section-I Volume-II shall be applicable

4.0 STANDARD RATING

Standard ratings shall be 33/0.433 KV, 500KVA Station Transformer with off circuit taps on HV winding for variation of HV Voltage.

5.0 DROP OUT FUSES:

The drop-out fuses (D.O.fuses) shall be expulsion type. This shall be ‘D’ type and out-door lift off type suitable for manual operation by an operating rod from the ground level. The drop out operation will be angular in vertical plane.

5.1 The equipment offered by the Bidder shall be suitable for 33KV three phase 50 Hz solidly grounded earthed neutral systems. The DO set unit shall be designed designed for a normal current rating of 200 Amps. Whereas the rating of fuse unit shall be 15 Amp.

5.2 The drop out fuses are required with Post Insulators. These shall be suitable for mounting on the structure. The bracket /channel hardwares for DO Fuses shall be provided with adequate sizes of nuts, bolts and washer for mounting on the structures of the purchaser.

6.0 POST INSULATORS:

Each 33KV DO Fuse Units shall have two nos 33KV Post insulator. The insulators shall conform to IS:2544 of 1973 with latest amendment. The porcelain used for manufacture of DO Fuse shall be homogeneous, free from flaws or imperfections that might effect the mechanical or dielectric strength. They shall be thoroughly vitrified tough and impervious to moisture. The glazing of the porcelain shall be of uniform brown colour free from blisters, burns and other similar defects. Insulators of the same rating and type shall be interchangeable.

The porcelains and metal parts shall be assembled in such a manner that any thermal expansion differential between the metal and porcelain parts through range of temperature variation shall not loosen parts or create undue internal stresses which may affect the electrical or mechanical strength and rigidity. Each cap and base pin shall be made of high grade cast steel or malleable steel casting and they shall be machine faced and smoothly galvanized. The cap and base shall be properly cemented with insulators to give perfect grip. Excess use of cement shall be avoided.

6.1 Type Test Certificate:

The Bidder shall invariably enclose with the offer, the type test certificate of MPSEB Design DO Fuses alongwith certified copy of the drawing and other guaranteed technical particulars. Please note that offers without type test certificate will not be entertained and would be out rightly rejected.

The type test report of the supplier shall also be acceptable if the supplier's manufacturing unit, including the testing laboratory has ISO 9000 (or its equivalent) certification and type tests has been witnessed by the representative of any of the utilities.

The type test should not be older than 5 (five) years from the date of opening of Bid.

6.2 Each 33KV Post Insulators should have technical particulars as detailed below:-

S.No.	Description	33KV
i.	Nominal system voltage KV (rms)	33
ii.	Highest system voltage KV (rms)	36
iii.	Dry Power Frequency one minute withstand voltage KV(rms)	75
iv.	Wet one minute power frequency withstand voltage KV (rms)	75
v.	Power Frequency puncture with stand dry voltage. KV (rms)	1.3 times the actual flashover voltage.
vi.	Impulse withstand voltage KV (peak)	170
vii.	Visible discharge voltage KV (rms)	27
viii.	Creepage distance in mm (minimum)	580
ix.	Cantilever strength (KN)	10

7.0 As stated above unless otherwise modified in this specification the drop out shall conform to ISI:9385 (Part-I to III) and as amended from time to time or any equivalent International Standards.

7.1 Rated Voltage:

The rated voltage shall be 33KV for 33KV DO Fuse Units.

7.2 Rated Current:

The DO Fuse Unit components shall be suitable for 200 Amp. Current whereas the rating of fuse unit shall be 15 Amps.

7.3 Rated Lightning impulse withstand voltage values for the fuse base:

The rated lightning impulse withstand voltage both for positive and negative polarities shall be as given below:

S.No.	Description	33KV
a	To earth and between poles	170 KV Peak
b	Across the isolating distance of fuse	195 KV Peak base.

7.4 Rated one minute power frequency withstand voltage (dry and wet) values for the fuse base:

S.No.	Description	33KV
a	To earth and between poles	75 KV Peak
b	Across the isolating distance of fuse	80 KV Peak base.

7.5 Temperature Rise Limit in Air Above Ambient Temperature (°C):

S.No.	Description	33KV
a	Brass contacts silver faced	650C
b	Terminals	500C
c	Metal parts acting as spring	The temperature shall not reach such a value that elasticity of the metal is changed.

8.0 MAIN CONTACTS:

The main contacts of the D.O.Fuse shall be suitable for heavy duty, properly aligned, made from Brass material. These shall have good finish and smooth surface and shall be silver plated. All the sharp edges shall be rounded off. These contacts shall be so designed to withstand highest short circuit breaking current that may be encountered during service. In nut-shell the contact assembly shall ensure.

- i. Electro-dynamic withstand ability during short circuit without any risk of repulsion of contact.

- ii. Thermal withstand ability during short circuits.
- iii. Constant contact pressure even when the lower parts of the insulator stacks are subjected to tensile stresses due to linear expansion of connected busbar or flexible conductors either because of temperature variation or strong winds.
- iv. Proper alignment to ensure smooth operation of D.O.Fuse without adjustment.

9.0 CONNECTORS:

The connectors shall be made from Brass suitable to receive single Zebra conductor. The connectors should be bolted type having 4 bolts & groove to hold the conductor. All brass parts should be silver plated for corrosion resistance and efficient current flow. All ferrous parts should be hot dip galvanized as per the latest version of IS:2633. Nuts and bolts shall conform to IS: 1364 and should be hot dip galvanized. Spring washer should be electro galvanized.

10.0 FLY NUTS:

These shall be provided at both the ends of SRBP tube for tightening the fuse elements. The nut shall be provided with one flat washer of 25mm dia. The arrangement shall be made to ensure that the fuse wire runs centrally inside the SRBP tube after tightening.

11.0 SPRING STRIPS:

The spring strips shall be of phosphore bronze multiline brush type having a high pressure contacts and should retain its tension under minimum continuous service current of 200 Amps at 900C.

12.0 OPERATING HOOKS:

The brass operating hook shall be fixed over the SRBP tube in such a way that the barrel can be removed for replacing the fuse element by operating rod from the ground level.

The drop out fuse units shall operate efficiently. Speed of operation shall not depend on the inclination of the fuse. However, the inclination of the fuse barrel shall be adjusted in such a way that the barrel does not drop by gravitational force.

13.0 D.O.BARRELS:

The D.O. Fuse Barrels shall be made from SRBP and shall conform to BSS:1314. The supplier shall furnish the test certificate for the fuse barrels offered for use in the drop out fuses alongwith each lot offered for inspection to the inspecting officer. The test certificates of SRBP barrel should indicate the following test results:-

i.	Dimension: (a) External dia (b) Wall thickness (c) Internal dia	
----	--	--

ii.	Max. wrapping in 12" length of the tube.	
iii.	Axial electric strength (Proof test in oil at 900C at 25KV rms 50 C/s.)	The barrel should with stand this test satisfactorily for one minute
iv.	Radial electric strength (Proof test in oil at 900C at 19 KV rms 50 C/s.)	The barrel should with stand this test satisfactorily for one minute
v.	Surface electric strength (Proof test in air at room temp.(320C) at 14 KV rms at 50 C/s)	The barrel should withstand this test satisfactorily for one minute.
vi.	Water absorption in 14 hours	
vii.	Resistance to Hot Oil	
viii.	Cohesion between layers (Proof test)	
ix.	Machineability	

13.1 The Bidder should indicate the name of manufactures of SRBP tube from where they will purchase the Barrel to make available the above test certificate. The barrels should have the property to resist fire whenever the fuse is blown off. It should not catch fire easily during blowing off of fuse element inside the barrel which causes short time high temperature.

14.0 DESIGN, MATERIALS AND WORKMANSHIP:

The successful Bidders shall assume full responsibility for co-ordination and adequate design. All materials used in the construction of the equipment shall be of the appropriate class, well finished and of approved design and material. All similar parts should be accurately finished and interchangeable. The connecting of cap and pin with insulator should be perfect to avoid any 0 kind of loosening. After cementing the insulator should be cured adequately in water to attain good gripping.

15.0 GUARANTEED DATA & OTHER TECHNICAL PARTICULARS:

Guaranteed data and other technical particulars of the D.O. Fuse should be given in Schedule-II (C) enclosed herewith. Any other particulars considered necessary by the supplier may also be given in addition to those listed in the schedule.

16.0 TESTS:

Each D.O.Fuse shall strictly comply with requirement of all the type tests and shall be subjected to all routine tests stipulated in the relevant standard. All tests shall be made prior to despatch in the presence of the representative of the purchaser. No material should be despatched without prior approval of the tests certificate by the purchaser.

The Bidder should note that alongwith the Bid, the following type test certificate as per ISS:9385 Part-II-1980 (with latest amendment) or any equivalent International Standards must be furnished on MPPTCL design D.O. fuses. The type test should not be

older than 5 (five) years from the date of opening of Bid and should be performed in the Govt. recognized Lab.

- (i) Impulse voltage withstand test,
- (ii) H.V. Power Frequency dry / wet withstand test.
- (iii) Temperature rise test.
- (iv) Breaking Current test.

Alongwith the inspection report of D.O.Fuse Units, the supplier should invariably furnish Routine Test certificate of DO Fuse barrels & Post Insulator of their manufacturers.

17.0 IMPORTANT REQUIREMENTS TO BE NOTED BY THE BIDDER:

The suppliers should carefully note the following requirements and comply the same.

- i. All the accessories of D.O. Fuse Unit should be listed out clearly and despatch with DO Fuse Units.
- ii. Technical particulars of D.O. Fuse Units should be as given in the enclosed schedule.

18.0 Each D.O. Fuse shall be provided with name plate of size 4"x 2" on steel channel in case of 33KV DO Fuse and shall be either rivitted/bolted.

The following shall be indicated on the plate:

- Name of manufacturer
- Order No. & date
- Sl.No. of the equipment
- Rating.....Amps Volts
- Name of purchaser "MPPTCL".

Please note paper sticker should not be used for name plate. The material should be packed in appropriate Wooden cartoons, so as to sustain transport hazards.

19.0 DRAWING AND LITERATURE:

The following drawing of 33KV DO Fuses are enclosed herewith:-

(i) EB/P6/MPEB/6 (revised) dt.14.1.88 for 33KV DO Fuse Unit.

The Bidder shall ensure that the design of their equipment is as per the drawing enclosed and specification of the Bid. The main dimensions are given here as under:-

DIMENSION OF D.O.FUSE UNITS IN MM

S.No.	Particulars	33KV
1.	Drawing No.	EB/P6/MPEB/6/(revised) Dated 14.1.88
2.	M.S. Flat	600x50x6
3.	M.S. Channel	600x100x50x6
4.	Fuse Barrels	510x25x14

S.No.	Particulars	33KV
5.	Lower Contact Hinge of Barrel:-	
	(i) Connectors	60x60x6
	(ii) Hinge Contact Length	95
	(iii) Hinge Contact Width	85
	(iv) Thickness of Hinge (i)Outer (ii) Inner	5 4
6.	Barrel take out hook:-	
i	Width	25
ii	Thickness	4
iii	Length	30
iv	Inner dia meter	25
v	Thickness between inner outer dia	3 mm
7.	Operating Hook:-	
i	Width	18
ii	Thickness	4
iii	Inner Radius	20
iv	Outer Radius	25
8.	Female contact :-	
i	Main Contact Width	70
ii	Strip thickness	1.5
iii	Strip length	100
iv	Width	20
v	Female contact height	75
9.	Female Contact Holder:-	
i	Length	74
ii	Upper width	34
iii	Lower width	40
10.	Creepage of Insulator	580

Note: Normally Post Insulators of following standard makes should be used for manufacturing of D.O. Fuses. The successful bidder shall required to submit the type test certificate and obtain its approval before commencing production.

- (i) M/s Allied Ceramics Pvt. Ltd. Calcutta
- (ii) M/s Birla NGK Insulators, Rishra
- (iii) M/s India Potteries Ltd. Calcutta
- (iv) M/s Bharat Heavy Electricals, Bangalore.
- (v) M/s W.S. Industries, Chennai.

20.0 INSPECTION:

20.1 The purchaser's representative shall at all times be entitled to have access to the works and all places of manufacture where equipment/material shall be manufactured and the representative shall have full facilities for unrestricted inspection of the supplier's works raw materials and process of manufacture for conducting necessary tests as detailed herein.

20.2 The supplier shall keep the purchaser informed in advance of the time of starting and of the progress of manufacture of equipment/material in its various stages so that arrangements can be made for inspection.

20.3 No material shall be despatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is waived off by the purchaser in writing. In the later case also, the equipment/material shall be despatched only after satisfactory testing for all tests specified herein has been completed.

20.4 The acceptance of any quantity of material shall in no way relieve the supplier of any of his responsibilities for meeting all requirements of the specification, and shall not prevent subsequent rejection if such material is later found to be defective.

20.5 The number of sample selected to carryout the acceptance test shall be as per provision in the respective IS or any equivalent International Standards.

20.6 The purchaser has the right to have the tests carried out by an independent Agency subject to recovery of testing expenditure in case of failure, whenever there is dispute regarding the quality of supply.

21.0 DOCUMENTATION:

21.1 Six sets of 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 and dispatched consignments.

21.2 The manufacturing of the equipment shall be strictly in accordance with the approved drawings/specification 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 supplier's risk.

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

22.0 PACKING AND FORWARDING:

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

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

- (a) Name of 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.

22.3 Marking:

On each packages / crates containing the material / equipment following information shall be distinctly stenciled on it in indelible Ink alongwith other essential data:

- (i) Contract Award letter number
- (ii) Name and address of consignee
- (iii) Manufacturer's name and address
- (iv) Name of item
- (v) Quantity
- (vi) Gross weight
- (vii) Arrow Marking for stacking/opening.

22.4. The supplier shall ensure that the packing list and bill of material are approved by the owner before despatch.

SCHEDULE-I (A)
DESCRIPTION OF EQUIPMENT FOR
SCHEDULE FOR RATES AND PRICES TO BE FURNISHED
IN BIDDING FORM OF SECTION-IV, VOLUME-I

S.No.	Particulars of equipment/ Item	Qty.
1.	33 KV Drop Out Fuse Units of current carrying capacity of 200 Amps. With fuse of 15 Amp. Rating. (each unit having 2 nos. of 33 KV Post Insulators fitted on channel base with fuse barrel as per BSS-1314) as per technical requirement as described in Section-C in the Bid Document.	As per Price Schedule

- NOTE:1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.**
- 2. The quantity of above equipments has been mentioned in Volume VI**

SECTION-II (A)
2.3.2 TECHNICAL SPECIFICATION FOR 220 V 600 AH,110V
300AH & 48V 300AH STATION BATTERIES

1.0 SCOPE:

1.1 The scope of this specification covers design, manufacturing and supply of equipment as per Section-I, Volume-II. The bidder mentioned in the Section of the Technical Specification means "Original Equipment Manufacturer (OEM)". The Purchaser means the "MPPTCL".

In case bidder is not OEM, sole responsibility of offering equipment/material of manufacturer as per this specification requirement shall rest on the bidder.

1.2. SYSTEM REQUIREMENTS WHICH ARE TO BE CONSIDERED FOR DESIGN OF BATTERIES:

1.2.1 CLIMATIC CONDITIONS:

Applicable climatic conditions shall be as per Section-I Volume-II.

1.2.2 STANDARDS:

Applicable Standards for the offered equipments/items shall be as per Section-I Volume-II.

1.2.3 OPERATING CONDITIONS:

Batteries shall be designed to render highest efficiency for the duties specified and shall be capable of operating continuously without the need for any shutdown. Design shall be such as to ensure trouble free operation.

1.3. GENERAL AND CONSTRUCTIONAL REQUIREMENTS FOR STATION BATTERIES:

General description of Batteries of capacity 220 V 600 AH,110V, 300AH& 48V, 300AH shall be as under:

1.3.1 Cells shall be supplied in glass boxes or hard rubber boxes and ample space must be provided below the plate for accumulation of deposit. Spray arresters shall be provided to prevent loss of acid by spraying during charge. Improved design of tubular type Positive plates may be offered.

1.3.2 Lead acid battery, comprising of closed type cells shall be complete with tubular positive plate assemblies, glass boxes or hard rubber boxes, lids providing micro porous plastic separators, polystyrene dewels and buffers, inter cell connector and lead covered bolts and nuts. Battery, shall be offered complete with (i) inter row connectors, acid jars and packing case, (ii) stands (iii) stand insulator (iv) Cable sockets for two end cells and four tapping connections.

1.3.3 Bidders may please note that all 110 cells of 220 Volts, 55 Cells of 110 Volts and 24 Cells of 48 Volts Battery sets shall be arranged in single tier system, such that, all 110/55/24 Cells are placed on one wooden stand which shall be at a height of 1 ½ ft from ground level. The Stands shall be constructed of selected timber and painted with three coats of acid proof paint. This is mandatory requirement.

1.3.4 Necessary paint for this purpose shall also be supplied. No metal fastenings shall be used in wooden stand. Stands shall be supported on insulators to obtain necessary insulation from earth and there shall be insulators between each cell and stand.

1.3.5 Bidders may please note that there shall be two holes per inter cell connector and two strips (one short and one long) need necessarily be provided for connections. Arrangement of connection shall be such that if one inter cell connector/strip is removed for cleaning of terminal and application of petroleum jelly etc. then other strip must remain in circuit and battery should not get open circuited. Bidders may explore possibilities of providing this arrangement for inter cell connections and confirm.

1.3.6 One set of following accessories shall be supplied along with each battery set

- i. One battery logbook.
- ii. Two copies of printed instruction sheet.
- iii. One No. cell testing voltmeter (3-0-3 volts) complete with lead.
- iv. One no. rubber syringe.
- v. One no. rubber syringe type hydrometer suitable for specific gravity reading.
- vi. One no. thermometer (0 to 70 ° C min.) with specific gravity correction scale.
- vii. One set cell bridging connectors.
- viii. Anti sulphuric enamel paint -
 - (a) red colour in required quantity, and
 - (b) black colour - 2 liters.
- ix. Battery stand suitable for accommodating the cells coated with 3 coats of anti acid paint.
- x. Hard rubber cell insulators in required quantity with 12 Nos. extra (spare).
- xi. PVC sheet stand insulators in required quantity with 4 Nos. extra (spare).
- xii. One set of cell number plates with fixing pins.
- xiii. One pair of spanners.
- xiv. One no. acid resisting funnel.
- xv. One no. acid resisting jug of 2 liters capacity.
- xvi. Requisite quantity of electrolyte with 10% extra in non-returnable containers.
- xvii. One pair of rubber gloves.
- xviii. One pair of rubber boots.
- xix. One no. rubber apron.
- xx. One set of inter tier connector.
- xxi. Cable socket for two end cells and four tapping cells.

1.3.7 Please note that if any of the above mentioned items are not required for the batteries offered by you, the same shall be brought out clearly with proper justification with drawings. Any other accessories other than those mentioned above, which you feel necessary for the batteries offered by you, may also be mentioned and the prices of the same should be quoted separately.

1.3.8 Battery shall comprise of 110/55/24 cells with capacity not less than 600AH /300AH for 220 Volts 600AH and 300AHfor 110 Volts 48 Volts Batteries at 10 hour discharge rate.

1.3.9 For the purpose of confirmation to supply all the items mentioned above under Clause 1.3.2 to 1.3.6, the Bidders shall bring out all the details in a tabular form in the manner indicated in Schedule –VIII.

1.4 It shall be Bidder's responsibility to prove adequacy of its design by submitting all technical particulars and suitable graphs to show suitability of battery for supplying emergency load on continuous basis for few hours without getting discharged.

1.5 TYPE TEST:

1.5.1 Bidders may furnish type test reports from any Govt. test house, CPRI, NPL or other reputed agency approved by the Statutory institutions for the type of cell offered for each rating of the batteries. Type test report of each rating cell shall not be more than five years old. Type test report shall be as per the requirement of IS: 1651 - 1991 (with latest amendment, if any), and shall cover the following:

- (i) Verification of constructional requirement.
- (ii) Verification of marking.
- (iii) Verification of dimensions.
- (iv) Test for capacity for voltage during discharge.
- (v) Ampere -hour and watt-hour efficiency tests.
- (vi) Test for retention of charges
- (vii) Endurance test.

1.5.2 ROUTINE AND ACCEPTANCE TESTS:

Batteries shall be tested after manufacture as per the requirement of IS:1651 - 1991 (with latest amendment, if any) jointly in presence of our team of officers at the discretion of purchaser at Bidder's works. Two copies of test certificates indicating the test results obtained during the tests shall be submitted for approval. It will be obligatory on the part of supplier to despatch the material, only after obtaining acceptance of Test results, strictly as per our despatch clearances.

Above and other Special Tests if any required by the purchaser or his representative shall also be carried out, so that the purchaser and his representative is satisfied that the offered equipment shall meet our field requirements under adverse system conditions. All these Tests shall be carried out in presence of the representative of the purchaser prior to dispatch, if so desired by the purchaser and the test results in quadruplicate shall be submitted to the purchaser for approval. No material shall be dispatched by the supplier without prior approval of the test certificates by the purchaser.

1.6 DOCUMENTATION, DRAWINGS AND TEST REPORTS:

1.6.1 Bidders shall submit with their offers, all such drawings, instruction manual, descriptive literature etc. as may be necessary for the proper understanding of his BID. In the drawings Bidder shall indicate the name, make and rating of all components used including details of placement of battery on its stand and arrangement for cable socket for end cells and four tapping cells.

1.6.2 Bidders may carefully go through this specification and while submitting their BID, all requirements as described under specification shall be complied with and complete details should be furnished. In absence of non-furnishing of any of the confirmations or schedules or technical/commercial questionnaire, the BID shall be treated as incomplete and may be non responsive from technical angle.

1.6.3 Successful Bidder shall, within two weeks of placement of order, submit four sets of final version of all the above drawings for purchaser's approval. Purchaser shall communicate his comments/approval on the drawings to the supplier within two weeks. Supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for purchaser's approval within two weeks from the date of comments. After receipt of purchaser's approval, the supplier shall, within three weeks, submit 4 prints per battery set and two set of good qualities reproducible of the approved drawings for purchaser's use.

1.6.4 Successful Bidder shall also furnish two sets each of bound manuals covering erection, commissioning, operation and maintenance instructions and all relevant information and set of approved drawings alongwith each battery set. Marked erection drawings shall identify the component parts of the equipment as shipped to enable erection by purchaser's own personnel. Each manual shall also contain one set of all the approved drawings, type test reports as well as acceptance reports of the corresponding consignment dispatched.

Manufacture of Batteries shall be strictly in accordance with the approved drawings and no deviation shall be permitted without written approval of the purchaser.

1.6.5 Approval of drawings/work by the purchaser shall not relieve the Bidder of any of his responsibility and liability for ensuring correctness and correct interpretation of the drawings for meeting the requirements of the latest revision of the applicable standards, rules and codes of practices. Battery shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of supply and purchaser reserves the right to reject any work or materials which, in his judgment, is not in full accordance therewith.

1.7 COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS:

Bidder must furnish following information along with technical bid.

1.7.1 Complete details of all the accessories which will be supplied with each battery set should be furnished. While furnishing these details, items which will be manufactured by the Bidder and balance items, which will be procured from sub-suppliers should be clearly identified and indicated in the BID.

1.7.2 It is obligatory on the part of Bidder to ensure that supply of all accessories along with each battery set are simultaneously delivered to avoid any holdup in erection and commissioning . Responsibility for obtaining timely supplies of bought out items will rest on the Bidder and only on this basis, delivery period will be offered in the BID.

1.7.3 It may be noted that in case of damages/shortages due to improper packing or any other negligence, replenishment shall be arranged within one month time. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and also in case defective supply of any item is reported, will rest on the Bidder. In case for attending to defects in any accessory or inspection/ replacement of the accessory, which may be bought out item for the Bidder; if services of engineer of original manufacturer is required, the same will be organized on immediate basis by the Bidder at his cost.

1.8 INSPECTION:

- (i) Purchaser shall have access at all times to the works and all other places of manufacture, where the Battery Sets are being manufactured and the Bidder shall provide all facilities for unrestricted inspection of Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed in the bidding document.
- (ii) Successful Bidder shall keep the purchaser informed in advance of the time of starting and of the progress of manufacture of Battery Sets in its various stages, so that arrangement could be made for inspection.
- (iii) No material shall be dispatched from the point of manufacture unless the material has been satisfactorily inspected / tested and dispatch clearance issued.
- (iv) Acceptance of any quantity of the Battery Sets shall in no way relieve the successful Bidder of this responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipment are later found to be defective.

1.9 QUALITY ASSURANCE PLAN:

1.9.1 Bidder must establish that they are following a proper quality assurance programme for manufacture of Battery Sets. Bidders shall invariably furnish following information alongwith their BID. Information shall be separately given for each type of each battery set:

- (i) Statement giving list of important raw materials, names of sub-suppliers for the raw material, list of standards according to which the raw material is purchased and copies of test certificates thereof.
- (ii) Information and copies of test certificates as in (i) above in respect of bought out items.
- (iii) List of manufacturing facilities available.
- (iv) Levels 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 & inspections.
- (vi) List of testing equipment available with the Bidder for final testing of Battery Sets and test plant limitation, if any, vis-à-vis type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

1.9.2 Successful Bidder 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 bid.
- (ii) Type test certificates of the raw material and bought out accessories.
- (iii) Quality Assurance Plan (QAP) with hold-up points for purchaser's inspection. The quality assurance plans and hold-up points shall be discussed between the Purchaser and supplier before the QAP is finalized.

1.9.3 Successful Bidder shall submit routine test certificates of bought out items and raw material at the time of routine testing of each battery set.

1.10 PACKING AND FORWARDING:

1.10.1 Battery Sets 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. Bidder shall be responsible for any damage during transit, due to improper and inadequate packing and handling. Easily damageable material shall be carefully packed and marked with appropriate caution symbols. Wherever necessary, proper arrangement for lifting, such as lifting hooks etc. shall be provided. Bidder shall supply any material found short inside the packing cases without any extra cost.

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

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

1.10.3 On each package/crate containing the Battery Sets, following information shall be distinctly stenciled on it in indelible ink alongwith other essential data:

- i) Contract Award Number
- h) Name and address of consignee
- i) Manufacturer's name and address
- j) Name of item

- k) Quantity
- l) Gross weight
- ii) Arrow marking for stacking/opening.

Supplier shall ensure that the packing list and bill of material are approved by the purchaser before despatch.

1.11 SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS:

Bidder shall furnish guaranteed technical particulars for the battery sets in the format provided under enclosed Schedule-II.

1.12 DISCREPANCY IN TECHNICAL PARTICULARS:

Regarding discrepancy in technical particulars stipulation under Section-I Volume-II shall be applicable.

1.13 Please ensure that Bid document containing number of pages have been properly numbered and signed. Document including all Schedules shall be indexed properly and Index of the document shall be enclosed/placed at the beginning of the Bid document.

APPENDIX-A

**SCHEDULE OF ACCESSORIES TO BE PROVIDED
WITH EACH STATION BATTERY SET**

S. No.	Particulars	Qty.
1.	One battery logbook.	1 No.
2.	Printed instruction sheet.	2 Nos.
3.	Cell testing voltmeter (3-0-3 volts) complete with lead.	1 No.
4.	Rubber syringe.	1 No.
5.	Rubber syringe type hydrometer suitable for specific gravity reading.	1 No.
6.	Thermometer (0 to 70° C min.) with specific gravity correction scale.	1 No.
7.	Cell bridging connectors	1 set
8.	Battery stand suitable for accommodating the cells in single tier in case of 220 Volts, 110 Volts & 48 Volts battery sets coated with 3 coats of anti acid paint.	1 set
9.	Anti sulphuric enamel paint	
	a) Red colour	1 litre
	b) Black colour	1 litre
10.	Hard rubber cell insulators with 12 Nos. extra (spare).	As required
11.	PVC stand insulators in required quantity with 4 Nos. extra (spare).	As required
12.	Cell number plates with fixing pins.	1 set
13.	Spanners.	1 pair/set
14.	Acid resisting funnel.	1 No.
15.	Acid resisting jug of 2 liters capacity.	1 No
16.	Electrolyte with 10% extra in non-returnable containers.	Requisite quantity
17.	Rubber gloves.	One pair
18.	Rubber boots.	One pair
19.	Rubber apron.	1 No
20.	Inter tier/ row connector.	1 set
21.	Cable socket for two end cells and four tapping cells.	6 Nos
22.	Petroleum Jelly	
	a) 220V	200g
	a) 110V	100g
	b) 48V	50g
23.	Wall mounting holder for hydrometer and thermometer	1 No
24.	No. of cells 220/110/48V	110/55/24 Nos.

Note:- The accessories to be supplied with each battery sets will be finalized at the time of drawing approval.

SCHEDULE-I (A)
DESCRIPTION OF EQUIPMENT FOR
SCHEDULE FOR RATES AND PRICES TO BE FURNISHED
IN VOLUME-VI

S. No.	Particulars of equipment/ Item	Qty.
1	220 Volts, 600 AH Station batteries complete with accessories confirming to all technical requirement as per specification.	As per Price Schedule
2	110 Volts, 300 AH Station batteries complete with accessories confirming to all technical requirement as per specification.	
3	48 Volts, 300 AH Station batteries complete with accessories confirming to all technical requirement as per specification.	

- NOTE: 1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.**
- 2. The quantity of above equipments has been mentioned in Volume VI.**

SECTION-II (B)

TECHNICAL SPECIFICATION FOR 220 V ,110V & 48 V BATTERY CHARGERS

1.0 SCOPE:

1.1 The scope of this specification covers design, manufacturing and supply of equipment as per Section-I, Volume-II. The bidder mentioned in the Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The Purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment/material of manufacturer as per this specification requirement shall rest on the bidder.

1.2 SYSTEM REQUIREMENTS WHICH ARE TO BE CONSIDERED FOR DESIGN OF BATTERY CHARGERS:

1.2.1 CLIMATIC CONDITIONS:

Applicable climatic conditions shall be as per Section-I Volume-II.

1.2.2 STANDARDS:

Applicable Standards for the offered equipments/items shall be as per Section-I Volume-II.

1.2.3 FAULT LEVEL: Fault level of the auxiliary AC supply at the terminals of the charger shall be 10 KA. All accessories shall be selected and equipment shall be designed accordingly.

1.2.4 INPUT SUPPLY: Input supply where the chargers shall be installed shall be 400V + 10% or -15%. Accordingly suitable taps in the input transformer may be provided for supply voltage of 400V taking into account above voltage variation. Depending upon the supply voltage available, selection of taps shall be made by the purchaser.

There is a possibility that variation/unbalance to the extent of 10% may be involved in the phase voltage of different phases (R, Y & B) in the input voltage at some of the locations. The Bidders shall finalise a design, particularly the rating of diodes and components of control circuitry of charger such that it shall take into account such variation of +10% in the phase voltage so that performance of battery charger is not affected. **Details of precautions taken in this regard and modifications considered in design may be brought out separately by the Bidders in their offer.**

1.3 CONSTRUCTIONAL REQUIREMENTS FOR BATTERY CHARGERS:

1.3.1 DIMENSIONS: One single sheet steel cabinet shall accommodate both boost and float chargers. Dimensions of battery chargers shall be as under:-

i.	Height	1600 mm including base channel
ii.	Depth	800 mm

Width may be selected as per requirement to accommodate various components speciously keeping in view proper cooling of components

1.3.2 CONSTRUCTION:

1.3.2.1 Charger cabinets shall be sheet metal enclosed and shall be dust, weather and vermin proof. Sheet steel used shall be atleast **2.5 mm thick** and properly braced to prevent wobbling wherever necessary. Cubicle shall be of iron angle frame, i.e. a suitable sturdy frame shall be prepared with strong base channels, to bear the load of heavy accessories.

1.3.2.2 Charger cabinet shall be free standing, floor mounting type and shall be provided with a hinged door in the back with suitable pad locking arrangements.

1.3.2.3 All doors removable covers end plates shall be gasketed all around with neoprene gaskets. Louvers where provided shall have screens and filters. The screen shall be made of fine GI wire mesh.

1.3.2.4 Suitable entries for various incoming and outgoing cables shall be from bottom and fitted with cable glands etc. Cable glands shall be "screw on" type and made of brass.

1.3.2.5 It may be noted that all heavy components namely input transformers, chokes and **motorised variac** shall be mounted on the floor of the charger such that the load is taken by the sturdy angle frame work either in one tier or two tiers if necessary. Cantilever type mounting arrangement for these heavy items shall not be acceptable

1.3.2.6 Axis of the cable trench in the control room shall be parallel to the width of the charger. In view of this the two cable gland plates for input and output cable connections to the battery charger shall be provided across the cable trench at both ends (i.e. on 800 mm width side of the charger) to facilitate direct cable entries from the trench of around 550 mm, width. Grouting bolts for the charger cabinet at four corners shall be provided after keeping in view that the cable trench of 550 mm width shall be in the centre and parallel to the width of the charger.

1.3.2.7 In order to provide neat appearance and also to protect all indicating instruments and switches/knobs provided on the front of the panel, the upper portion of the front of the panel accommodating these accessories shall be constructed with suitable duct in the sheet so that the level of mounting of these accessories is lower than the front face of the panel.

1.4 WIRING: For the wiring purpose, standard 1100 volts stranded copper conductor of 2.5 sq. mm area with minimum seven strands should only be used. Terminations shall be crimped tag solder-less type with covering sleeves only. Colour coded wires should be used to facilitate easy tracing of wires as detailed out here under:-

- a. **AC circuit**
 - Red, yellow and blue for RYB phases
 - Green for earthing
 - Black for neutral
- b. **DC circuit**
 - Red for positive
 - Black for negative

c. **Control wiring**

- Grey for annunciation & other control circuits

1.4.1 All fuses shall be HRC type and of reputed make. All fuses shall be provided with protective covers. In case links are to be provided these shall also be with protective covers. Please note that open links or fuses are not acceptable and should not be offered.

Fuses shall be provided with visible operation indicators to show that they have operated. All accessible live connections shall be adequately shrouded and it should be possible to change fuses with the circuit alive, without danger of contact with live metal. Insulated fuse pulling handle shall be supplied with each cabinet.

1.4.2 Since a number of wires will run from one point to another, it is desired that the support arrangement should be adequate and neat. Conventional method of bunching of wires should not be adopted since the same creates problems in case any wire is to be removed. Wires should be accommodated in suitable plastic channels with sliding plastic cover, which may be mounted inside the panels suitably. Inspection/removal of wires should be possible by sliding the covers. Blank plastic channels should be provided by the sides of the panels to accommodate the incoming cables from switchyard through the cable glands with suitable holding arrangement so that the cables could be rigidly fixed and jerks etc may not be transferred to the terminals inside the cubicle.

1.4.3 All door mounted equipment as well as equipment mounted inside the cabinet shall be provided with individual labels with equipment designation engraved. Also the cabinets shall be provided on the front with a level engraved with designation of the cabinet as furnished by purchaser. Labels shall be made of non-rusting metal.

1.4.4 Battery charger cabinet shall be provided with two separate earthing terminals.

1.4.5 Input and output terminals should be neatly brought out on the back side of charger. The terminals to be provided are 4 Nos for AC input i.e. RYBN + 2 Nos. from load i.e. +ve & -ve, and two Nos. from battery connections i.e. +ve, -ve and all tap cell connections. Distance between the above three groups of terminals shall not be less than 15 cms. Distance between battery +ve, -ve and tap cell terminals shall not be less than 20 cms. For battery connections nut/bolts and washer arrangement shall be used. All terminals provided shall be 200 mm above the base level for ease of operation.

1.4.6 Indicating lamps shall be of low watt consumption. Lamps shall be provided with series resistors to prevent short-circuiting of control supply.

1.4.7 Engraved core identification ferrules, marked to correspond with the wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires, and shall not fall off when the wire is removed. Spare auxiliary contacts of all relays, connectors etc. shall be wired to terminal blocks. All wiring shall be terminated on suitable terminal blocks using solder less crimping type tinned copper lugs. Insulated sleeves shall be provided at all the wire terminations. All wiring shall be neatly bunched and cleated without affecting access to equipment mounted within the cabinet wiring troughs shall be provided for vertical cabinet wiring and for interconnecting wiring between front and rear sections of the cabinet. Terminal blocks shall be numbered for identification and grouped according to function.

1.4.8 Electrical indicating instruments shall be mounted flush on the front panel.

1.5 PRE-TREATMENT AND PAINTING PROCESS: Sheet steel fabricated members shall be subjected to pre-treatment process before painting and the process shall be carried out as under. Process can broadly be divided as “Metal Treatment” and “Painting”.

1.5.1 METAL TREATMENT:

- i. **Degreasing** : This can be achieved either by immersing in hot alkaline degreasing bath or in hot tri chloroethylene solution. In case degreasing is done by alkaline bath rinse with cold water thoroughly.
- ii. **Pickling** :- This is to remove rust and metal scales. Immersing in diluted sulphuric acid (approximately 20%) at nearly unit scale and rust are totally removed.
- iii. Rinse it in cold water in two tanks to remove traces of acids.
- iv. Treat with phosphoric acid base neutriliser for removal of chlorine from the above acid pickling and again wash with running water.
- v. **Phosphating**:- 'Immerse in grenadine' zinc phosphate solution for about 20 minutes at 80 degree to 90 degree centigrade. The uniform phosphate coating 4 to 6 gms per sq. meter shall be achieved.
- vi. Swill in cold water
- vii. Rinse in Deolyte bath at 70 degree to 80 degree Centigrade to neutralise any traces of salts.
- viii. Seal the above phosphate coating with hot dilute chromate solution.
- ix. Dry with compressed air.

1.5.2 PAINTING:

- i. **Primer**:- Spray one coat wet on wet specially developed 'High Luster' zinc chromate primer and stove at 150 degree Centigrade to 160 degree Centigrade for 25 to 30 minutes. Alternatively, Red-oxide primer with zinc chromate content may be used. However, former process is preferred.
- ii. **Rubbing and puttying**: Apply putty to fill up the scars, if any, to present smooth surface and stove 15 to 20 minutes. Apply putty several times to get the perfectly smooth finish.
- iii. **Surfacing**: - Sand down with mechanical abrasive and stove for 20 minutes.
- iv. Immediately spray second coat of primer as per (i) above or grey primer surfacer wet on wet and stove for 30 to 40 minutes at 125 degree centigrade.
- v. **Finish Paint**: Rub down dry and spray first coat of synthetic enamel finish paint wet on wet and stove for 30 minutes.
- vi. **Surfacing**: Sand down or rub dry to prepare for final finish and then spray two coats of synthetic enamel finish paint wet on wet and stove it at 150 degree for 30 minutes.

1.5.3 Following shall be ensured:-

- i. Necessary stiffeners may be welded between large cut outs to provide rigidity before painting process.
- ii. Painting process shall be done within 24 hours of completion of metal treatment
- iii. Small quantity of paint shall be supplied alongwith equipment for touching up at site.
- iv. Cold process or any other authoritative process which ensures equal or better quality than the process mentioned above shall also be acceptable.

1.5.4 Exterior surface colour finish shall be 'smoke grey' shade No. 692 as per IS-5 and the interior surface of the charger shall be painted with egg shell white.

1.5.5 While general constructional features have been described above, it is desired that Bidders may adopt modern construction practices to ensure that the charger cabinet is sturdy in construction with suitable ventilation arrangements duly meshed so that under all weather conditions the inside temperature does not exceed the prescribed limits.

1.5.6 On the top of the charger cabinet at the four corners, lifting hooks shall be provided.

1.5.7 At the time of dispatch the front side of the panel where indicating instruments and accessories are to be provided shall be covered with thermocol packing. Also the complete charger cabinet shall be packed using suitable crate so that the equipment is able to withstand transport hazards from manufacturer's works to Transmission Area Store and then from Area Stores to work site. Each consignment shall be accompanied by a detailed packing list containing the following information:

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

1.5.8 It is desired that complete schematic alongwith voltage levels marked at important points for identification and rectification of defective components of the charger is provided on a permanently laminated/engraved plate of suitable thickness which has to be bolted at the four corners on the inside face of rear door. Size of the plate shall be 400 mm x 300 mm. In addition, one more plate of similar type and dimension shall be provided on the outside of the rear door providing guidelines and instructions for operation of the charger. Guidelines to be provided on the plates shall be to our approval. Also schematic to be provided on the plate shall be to our approval for which separate drawing shall be furnished immediately after award of contract.

1.6. CAPACITY AND RATING FOR CHARGERS: Battery charger capacity shall be designed based on the requirements stated here under:

CHARGER UNIT TYPE	RATING	REQUIREMENTS		
		220V 600AH	110V 300AH	48V 300AH
Float charger unit	Load(Amps)	60	40	32
	Trickle(mA)	600	300	300
	Total design rating of trickle charger (Amps)	61	41	33
Boost charger unit	Load(Amps)	60	40	32
	Boost current (Amps)	60	30	30
	Total requirement (Amps)	120	70	62
	Design rating of boost charger to be taken	120	70	62

1.7 DETAILS OF DESIGN PARTICULARS FOR BATTERY CHARGERS:

1.7.1 BASIC DESIGN: Basic design of battery chargers for 220 ,110 & 48 Volt systems shall be identical except for minor variations described below. Basic requirement to be noted is that under all condition of failure of any component of trickle charger, boost charger, AC supply faults during the short circuit etc., over voltage condition, and under voltage condition etc., load and battery shall always remain paralleled. purchaser can not afford interruption of DC supply to load under any circumstances and therefore this requirement shall be kept in view carefully. The battery charger shall have two independent units one for boost charging and other for the float charger. At a time only one unit shall be in service through selector switch.

1.7.2 END CELL CUTTING: It is desired that the battery charger shall be designed on the basis of end cell cutting principle for the purpose of providing the required voltage to the load under the condition when boost charger is in circuit. Thus, four tap connections shall be taken from the battery in addition to the permanent tap connection from 44th and 19th cell as already referred to under Para 5.10.5. These four additional tap connections will be taken from the following cells

- i. 220 V battery : : 90th cell, 96th cell, 102nd cell and 110th cell
- ii. 110V battery : 45th cell, 48th cell, 51st cell and 55th cell.
- iii. 48V battery : 20th cell, 21st cell, 23rd cell and 24th cell.

1.7.3 SELECTOR SWITCHES: Suitable single pole, heavy duty, four way selector switch preferably of "Kaycee" make of required rating shall be provided so that the required tap connection could be selected for regulating the load voltage. Thus the design of boost charger unit should not take into account any dropper diode since regulation of voltage shall be made by way of cutting of battery end cell.

1.7.4 THYRISTOR CONTROL CIRCUIT: Thyristor control circuit to be provided for float charger unit should incorporate soft start feature. Voltage should not shoot up

when the supply of the charger is switched on. Suitable filter circuit and device must be incorporated to suppress all characteristics harmonics in DC output. Also, adequate surge suppressor shall be provided in the input AC supply circuit of the charger. Main rectifier shall be provided with suitable fuses with facility of indication of fuse failure. It should be possible to identify the faulty rectifier to facilitate quick replacement/rectification of faulty rectifier.

1.8 BASIC DESIGN PARAMETERS:

1.8.1 VOLTAGE REGULATION: Float charger output voltage shall be set within the following limits.

- i. **220 V Charger** - Output of the unit shall be $2.2 \times 110 = 242$ Volt which would be supplied to the battery for trickle charging and same voltage without any drop but with regulation of plus/minus 1% shall be provided for the load bus. Voltage above 121 volt at load bus shall not be acceptable..
- ii. **110V charger** - Output of the unit shall be $2.2 \times 55 = 121$ Volt which would be supplied to the battery for trickle charging and same voltage without any drop but with regulation of plus/minus 1% shall be provided for the load bus. Voltage above 121 volt at load bus shall not be acceptable. Thus unlike 48 volt charger, no dropper diodes or voltage regulatory circuit are to be provided.
- iii. **48 V charger** - 48 volt plus/minus 1% on load bus. Thus the design should be such that the bus voltage is sensed and output voltage is regulated within plus/minus 1% range. Thus in this case the trickle charger should simultaneously provide $2.2 \times 24 = 52.8$ Volt output for trickle charging of the battery as well as regulated voltage of 48 volt plus/minus 1% at the load bus. The arrangement provided for meeting these requirements should be explained.

1.8.2 FILTER CIRCUIT: Suitable filter circuit shall be provided in all the chargers to limit the ripple current (Peak to Peak) in the out put voltage to 2% irrespective of the D.C. load even when they are not connected to battery. Ripple content shall be controlled as under ;

- i **220 V charger** :- In this case both for trickle charger unit and boost charger unit, ripple control shall be within limit of 1% of the output voltage
- ii **110V charger** :- In this case both for trickle charger unit and boost charger unit, ripple control shall be within limit of 1% of the output voltage
- iii **48V charger** :- In this case, ripple content for both float and boost circuit should be within maximum limit of 2 millivolt psophometric with battery in circuit and a maximum of 4 millivolt psophometric without battery.

1.8.3 HEAT SINKS: Wherever necessary, standard heat sinks shall be utilized for heat conduction. In many components, the rating is specified with heat sinks only and therefore heat sinks should be procured from the component manufacturer only.

1.9 GENERAL REQUIREMENTS – FLOAT AND BOOST CHARGERS:

- 1.9.1 FLOAT CHARGERS:** Battery charger should have two independent units one for boost charging and another for trickle charging. Output of both the units shall be paralleled with the battery and load to suit the technical requirements specified, earlier.
- 1.9.2** Charger shall be capable of float charging the batteries at 2.15 to 2.2 volts per cell and simultaneously supplying the continuous D.C. load of the station, and boost charging them at a voltage of about 2.65 volts per cell and delivering current equal to 100% of the rated 10 hours discharge current of battery plus the continuous D.C load of the station.
- 1.9.3** During normal condition, the battery shall be floated across the float charger at 2.2 volts per cell +/- 1 % and the DC load demand during the normal state will be met by float charger. **Float charger shall be static type comprising of Silicon Controlled Rectifiers (SCR) connected in three phase banks along-with other necessary circuit to supply a stabilized DC out-put.** Provision shall be made to have stepless and smooth voltage setting in the auto mode and also for adjustment in manual mode in case the automatic constant voltage controller fails.
- 1.9.4** Float charger shall be able to give a DC output voltage of 2.0 to 2.25 V per cell, with maximum variation being +/- 1% of the set value. Constant Potential Controller Circuit shall be suitable to stabilize the output voltage within +/- 1% from no load to full load, even when the AC input voltage to the charger varies as already specified under 'Input supply'. The voltage should not shoot up when the supply of the charger is switched ON. Suitable filter circuits and devices must be incorporated to suppress all the characteristic harmonics in DC output also adequate suppressor shall be provided in the input AC supply to the charger.
- 1.9.5** Float charger shall have built in current limiting feature to drop the output voltage on currents more than 100% of the rated current and it should be ensured that the output voltage of the charger across battery terminals should be below 2Volt per cell if output current is 125% or more of the rated current.
- 1.9.6** One Moulded Case Circuit Breaker (**MCCB**) of 15 KA short time current rating shall be provided on the AC input side of the float charger with facility to indicate MCCB Trip condition through the annunciation scheme. The main transformer steps down the input voltage to the desired level and the output of the transformer shall be applied to the 3 phase, full wave thyristors bridge consisting of three thyristors & three Diodes of the specified ratings as per Annexure-I of this document. The Bidder shall also furnish detailed calculation for fixing VA capacity of the transformer.
- 1.9.7** One Moulded Case Circuit Breaker (**MCCB**) of at least 10 KA short time current rating with suitable overload setting shall be provided on the DC output side of the float charger so that any fault on the DC load will not be reflected on the equipment but will trip the MCCB and provide an annunciation. One ammeter of suitable range shall be provided to read the DC output current of the float charger clearly.

1.10 BOOST CHARGERS:

- 1.10.1** Boost charger shall have adequate rating to quick charge the battery fully within 14 hrs. after an emergency during which complete DC load is met by the battery.
- 1.10.2** Current rating of Boost charger shall be 20Amps for 200AH, 30 amps for 300AH and 60 Amps for 600AH battery sets as stated earlier.
- 1.10.3** In the constant current mode, it shall have a current stability of +/- 2% of the set value. Constant current setting shall have step-less range from 20% to 100% of full rate current. **Further, the boost charger shall have a provision of manual mode of operation.**
- 1.10.4** Boost charger and float chargers shall be so interlocked electrically that during Boost charging of the Battery, the float charger will supply the DC constant load and at the same time will be in parallel with the battery through reverse current blocking diode at a suitable tapping (89th cell in case of 220 V Battery 44th cell in case of 110 Volt battery and 19th cell in case of 48 Volt Battery). One DC contactor with normally closed (NC) power contact may be incorporated for the above. This contactor will be normally in de-energised condition and only during Boost charging, the same should get energized to isolate the battery from load. Rating of the DC contactor shall be suitable as per rating of the charger. One Ammeter of suitable range shall be provided in the boost charger circuit to read the boost charger output current.
- 1.10.5** One moulded case circuit breaker of at least 10 KA short time current rating with suitable overload setting shall be provided on the DC output side of the boost charger so that any fault on DC output side of boost charger shall not reflect on the equipment, but shall trip the MCCB and provide necessary annunciation. AC input to the boost charger shall be through a Moulded Case Circuit Breaker of at least 15 KA short time current rating with suitable overload setting and its trip conditions shall be annunciated.
- 1.10.6** For variation of voltage from boost charger unit suitable motorized automatic run down variac of specified rating shall be provided. **This motorized variac shall be complete with facility for manual operation and shall be mounted on the floor with control on the front panel.**
- 1.10.7** Output voltage of boost charger unit shall be designed on the basis of maximum voltage of 2.7 volt (quick charge finishing rate) per cell i.e. $2.7 \times 110 = 297.0$ for 220 Volt Charger , $2.7 \times 55 = 148.5$ volts for 110 volt charger and $2.7 \times 24 = 64.8$ volts for 48 volt charger.

1.11 FLOAT CHARGER EQUIPMENT DETAILS:

Trickle Charger shall have necessary equipment for satisfactory Operation which shall include atleast following instruments, Relays, Control switches and other accessories.

(A) ONE NUMBER MOULDED CASE CIRCUIT BREAKER (MCCB):

The Battery Charger shall have 415V or 433V Triple Pole AC of MCCB suitable capacity with Overload and Short Circuit releases and contacts for annunciation for ON / OFF operation of the unit. The Circuit Breakers shall be liberally rated.

The continuous Current Carrying Capacity and Breaking Capacity at 415 or 433 Volts AC shall be stated with back up calculations. High Rupturing capacity (HRC) fuses of suitable capacity for Back up Protection shall also be provided. The opening coil shall be rated for 240 Volts AC ON & OFF Push Buttons shall be provided for closing and opening of the Breakers Sufficient NC & NO contacts shall be available for interlock and indications.

(B) ONE SET OF THERMAL OVERLOAD RELAY:

A Thermal over load, relay incorporating a distinct single phasing protection (Using Different Movement of Bimetalic Strip) shall also be provided for the AC input. The relay shall trip the above MCCB.

(C) THREE NUMBERS HRC FUSES:

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

(D) PILOT LAMPS:

Three number Pilot Lamps each to indicate Float/Boost AC Supply On / Off shall also be provided.

(E) RECTIFIER TRANSFORMER:

Dry type Step Down Rectifier Transformer with copper winding shall be three phase double wound impregnated, naturally air cooled, having Class – F insulation corresponding to the rating of the Associated Rectifier Assembly. It shall be suitable for Operation at 415 or 433 \pm 15% Volts 50 \pm 3% cycles per second.

i) PRIMARY WINDING OF RECTIFIER TRANSFORMER:

This shall be the Alternating Current supply. The winding shall be connected in star connection.

ii) SECONDARY WINDING OF RECTIFIER TRANSFORMER:

The Secondary winding of the Transformer shall be 3 Phase, double wound. The Winding shall be delta connected. This winding of the Transformer shall be conductively connected to Rectifier Circuit elements and shall conduct the Direct Current of Transformer.

iii) RATING OF RECTIFIER TRANSFORMER:

The Rectifier Transformer shall be suitably rated VA, Voltage, Current frequency & number of phases at Terminals of alternating Current Winding based on turn ratio of the Transformer & RMS Current & No. of phases at the terminals of the Direct Current Winding as assigned to it by the Manufacturer, corresponding to the Rated Load of Rectifier unit shall be clearly stated. The calculations for the

rating of the Transformer shall be furnished. Ripple contents in the output voltage and Current shall also be clearly stated.

(F) CONTROLLER (AUTO / MANUAL):

To stabilize the DC Voltage within $\pm 1\%$ of the set value with an AC Voltage variation of $\pm 15\%$, Frequency variation $\pm 3\%$ and Load Variation between 0 to 110% shall be provided.

(G) AUTO / MANUAL SWITCHES:

For selecting the mode of Operation auto / Manual, Selector Switch shall be provided.

(H) AC INSTRUMENTS:

AC Voltmeter & Ammeter (with shunt) shall be provided with Selector Switch. The instruments shall be flush mounting Type, dust/ vermin proof and moisture resistant. The instrument shall have easy accessible means for zero adjustment. They shall be of 0.5 Accuracy Class as per IS:1248 – 1988. The range of instrument shall be as under:

S. No.	Particulars	220Volt	110Volt	48Volt
		600AH	300AH	300AH
1	AC Ammeter with Selector Switch	0-120	0-50	0-25
2	AC Voltmeter with Selector Switch	0-500	0-500	0-500

(I) RECTIFIER SELECTION: Rectifier Selection will consist of:

- i) One set of Thyristor stack of compact silicon diode shall be connected in three phases for 415 or 433V $\pm 15\%$ Volts, 50 $\pm 3\%$ C/S Full wave Bridge Current. Each Thyristor will be mounted on a Heat Sink made of aluminium and protected by high speed Semi conductor fuses and RC Network against Current and Over Voltage transients. Thyristor stack / Silicon Diode shall be liberally rated. Fuse failure relay across each high speed semi conductor fuse shall be provided so as to know and identify which fuse has blown off.
- ii) One set – AC Damping network to protect the thyristor stack against Voltage Surges due to Transformer switching.
- iii) One set – Automatic Voltage Regulator to stabilize the output voltage within $\pm 1\%$ of output set value against specified Main and Load variation.
- iv) One set – Current Limit Circuit ensuring drooping character for the charger.
- v) One set – Pulse Isolator Device.

(J) OUTPUT SECTION:

This will consist of:

- i) One no. Iron Core Inductor and a set of professional grade capacitor to reduce output ripple voltage to 2%, HRC Fuse will be connected in condenser circuit.

For protection - Automatic run down circuit shall be provided in the float charger by which excessive Inrush currents from the float charger to the Battery at the instant of resumption of Mains Supply is avoided.

- ii) One no double Pole moulded case Circuit Breaker. On the output side of the Charger one number double pole 250 Volts DC MCCB of suitable capacity shall be provided with overload and short circuit releases. Suitable number of NO & NC contacts shall be provided for Annunciation and interlocks. The circuit breaker shall be liberally rated. The continuous Current carrying capacity, fuses of suitable capacity surge suppression Device shall also be provided for back up protection. The MCCB and HRC Fuses should be of reputed make.
- iii) **Blocking Diodes:** Blocking Diode shall be provided in output circuit of each charger to prevent current flow from the DC battery into the charger. Two nos. out put HRC link type fuses shall be provided.

(K) DC INSTRUMENTS:

DC Voltmeter and Ammeter (with shunt) shall be provided. The instruments shall be flush mounting type, dust / vermin proof and moisture resistant. The instruments shall have easy excessive means for zero adjustment. They shall be of 0.5 Accuracy Class as per IS 1248 – 1968, the range of Instruments shall be as under:

S. No.	Particulars	220 Volts	110Volt	48Volt
		600AH	300AH	300AH
1	DC Ammeter (with centre zero for charge / discharger current)	100-0-100	50-0-50	75-0-75
2	DC Voltmeter	350	0-150	0-75

The bidder may please note that in addition to above 1 No. DC Ammeter of adequate rating shall also be provided in the charger to monitor float charging and boost charging current of chargers. The range of these ammeters shall start from zero onward as per float and boost charging current for each rating of charger specified elsewhere in the bid document.

(L) INDICATING LAMPS:

Pilot lamps shall be provided to show that the DC supply is available from the Rectifier.

1.12 BOOST CHARGER EQUIPMENT DETAILS:

During Boost charge operation, there shall be no load across the Bus used for Boost charging. The Load shall only be supplied by the Float Charger till such a time when the Voltage of the tapped Cell exceed the Float Charger voltage. Blocking silicon Diode shall be used in the tapped cell circuit to avoid current flow to the tapped cell from the Float charger. Load sharing can take place between the tapped cells and Float charger in case the capacity of the float charger is exceeded during the time when the voltage of the tapped cell is equal or greater than the float charger voltage.

In the event of AC mains failure during Boost charging full Battery shall get connected to the load through NC contacts of the DC contactors.

The component details of Boost charger equipment shall be similar to those given for the float charger but this shall be suitably rated for the Boost charger output voltage and current. In addition to these components Boost charger shall house the following components –

1. Three nos. HRC fuses at the input
2. One no. AC Volt meter with HRC Fuses and selector switch
3. One set Alarm annunciation
4. One no. DC Ammeter with shunt
5. One no. Blocking Diode
6. One set Blocking Diode mounted on Heat Sink
7. One no. DC contactor connected between Load Positive and full Battery for Battery charging unit.

1.13. ALARM RELAYS AND INDICATION LAMPS AND ALARM AND INDICATION SCHEMES:

The charger shall be provided with indication lamps on AC side as well as on the DC outside to indicated ON / OFF position of AC / DC supply.

For supervision of the following faults conditions, a Repeat Audio Alarm and Indication Scheme having a common bell / buzzer with Visual Indication Lamp and Auto Reset feature shall be provided for each charger. The arrangement shall be such that audible Alarm can be cancelled while Visual Indication conditions continue till the abnormal conditions persist. Repetitive Alarm Scheme shall be so provided that even during the time when a Fault is being attended and a second fault occurs, the Alarm shall sound and so on.

1. AC Main Fall / AC under voltage
2. Float charger AC MCCB Trip / Overload Alarm
3. Boost Charger AC MCCB Trip / Over Load Alarm
4. Float charge SCR / Diode fuse failure
5. Boost charger SCR / Diode fuse failure
6. Float charger DC MCCB Trip / Over load alarm
7. Boost charger DC MCCB Trip and over load Alarm
8. Float charger DC Output voltage failure
9. Boost charger DC Output voltage failure
10. Load DC over voltage
11. Load DC under voltage
12. Earth leakage (+ve) OR Earth leakage (-ve)
13. Capacitor fuse failure

In the event of Battery Earth Leakage Current exceeding 50 mA the Earth Leakage Relay provided on DCDB should operate.

1.14 PROTECTION OF RECTIFIER UNIT:

- a) In order to minimize the duty on Rectifier unit and Power System from disturbances arising from Diode Failures and Current short circuits, Protective switch gear and other protective equipment shall be adjusted for the shortest possible operating time consistent with selectivity. The first consideration must be rectifier devices because of their small thermal capacity. In addition to the protection against the over loads and faults currents the individual diode of the semi conductor rectifier must be protected against the voltage surges caused by lightning Diode used in semi – conductor power rectifier. It shall have a repetitive peak reverse voltage (PRV) rating greater than the normal working voltage which appears across them. The fault current must be interrupted very quickly to prevent extensive damages. The protection either be provided by fast acting current limiting fuses in series with semi conductor device or with some other suitable arrangement.
- b) **SINGLE PHASING IN INPUT AC SUPPLY:** Since the input supply to charger is 3 phase, 415/433 volts, 50 Hz supply, there is a possibility of single phasing, which may result into overloading of charger and may damage charger components. This may lead to un-wanted overloading on batteries also. To avoid such conditions, single phase preventer should be provided which should be able to cut off the AC supply and give visual indication and audible alarm as well. **The design of single phase preventer shall be either current operated type or voltage operated type.** This will ensure protection of variac/transformer and rectifiers etc. against unbalanced overloads. The single phase preventer should receive supply from all the three phases. Scheme for automatic switch off of the charger at the time of AC failure or single phasing should be such that even if any one of the three phases is switched off the whole supply should get disconnected.

Note: - Rating of different components to be selected for different rating chargers covered under this specification have been detailed out in Annexure-I enclosed. However Bidder may select higher rating components in case specified rated components are not available. Please note that under rated components shall not be accepted by purchaser.

1.15 SCHEDULE OF EQUIPMENT, ACCEPTABLE MAKES OF COMPONENT AND ACCESSORIES:

1.15.1 Schedule-IX enclosed brings out schedule of major components / equipments, rating of various major components. Photocopy of the same should be submitted with offer with addition/comments if any so that the purchaser may ensure of compliance of these requirement. No other format should be used.

1.15.2 Each rating of charger should be complete and include all such minor accessories also which may not be specifically mentioned in the Schedule-VIII but are essential for satisfactory operation of equipment. Bidders shall not be entitled for any additional cost in respect of such minor accessories though not specifically brought out in the bid.

1.15.3 Bidders shall furnish guaranteed technical particulars for the battery chargers in the format provided under enclosed Schedule-II.

1.16 TESTS: Following tests shall be carried out on the battery chargers at the manufacturer's works before dispatch.

- (i) **AUTOMATIC VOLTAGE REGULATION AND LOAD TESTS:**
This test is carried out on the Float charger. The load shall be increased gradually from zero to 100% and the DC output voltage and the power shall be measured. The ripple factor is also measured. Both the voltage and the ripple factor should be within the specified limits as mentioned in clauses 5.8.1 & 5.8.2 above.
- (ii) **BOOST CHARGER OUTPUT TEST.**
- (iii) **INSULATION TESTS**
- (iv) **ANNUNCIATION TEST.**
- (v) **TEMPERATURE RISE TEST:** Temperature rise test on both float charger and boost chargers shall be conducted. The temperature rise is to be measured on the following equipments (a) Diodes(b) SCRs (c) Transformers (d) Inductors (chokes) etc.,
- (vi) **CALIBRATION TESTS:** Calibration tests on the indicating instruments i.e. Ammeters and Voltmeters.

All these tests described above and other Special Tests if any required by the purchaser or his representative shall also be carried out, so that the purchaser and his representative is satisfied that the offered equipment shall meet our field requirements under adverse system conditions. All these Tests shall be carried out in presence of the representative of the purchaser prior to dispatch, if so desired by the purchaser and the test results in quadruplicate shall be submitted to the purchaser for approval. No material shall be dispatched by the supplier without prior approval of the test certificates by the purchaser.

1.17 DOCUMENTATION, DRAWINGS AND TEST REPORTS

1.17.1 Bidders shall submit with their bid all such drawings, instruction manuals, descriptive literature etc. as may be necessary for the proper understanding of his offer. Detailed write up describing the functioning of charger used, shall also be submitted.

Write up shall include the following:-

- i. Technical specification of the charger.
- ii. Detailed circuit description of the charger. It shall also include the functions of various components, various protections circuits/cards, various relays along with individual brief write-up/ leaflets.
- iii. Description on installation, commissioning and operation and maintenance of the charger.
- iv. List of the main components of the charger - separately for Boost and Float charger section.
- v. Circuit diagram of the complete charger shall be shown in a single sheet. The circuitry of various protection cards/relays should also be

incorporated in the same sheet. Following details are to be clearly indicated in the circuit diagram.

- a. Make of components used.
 - b. Ratings of the components.
 - c. All fuses for AC and DC circuits should be numbered and individual rating should be indicated.
- vi. Various Test point voltage levels for control cards and other specific points in the circuitry of the charger.

1.17.2 Bidders may please note that they shall carefully go through our specification and while submitting their offers, all requirements as described under specification should be complied with and complete details should be furnished. **In absence of non-furnishing of any of the confirmations or schedules or technical/commercial questionnaire, the offers shall be treated as in-complete and may be non responsive from technical angle.**

1.17.3 Successful Bidders shall, within two weeks of placement of order, submit four sets of final version of all the above drawings for purchaser's approval. The purchaser shall communicate his comments/approval on the drawings to the supplier within two weeks. The supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for purchaser's approval within two weeks from the date of comments. After receipt of purchaser's approval, the supplier shall, within three weeks, submit 4 prints per charger and two set of good qualities reproducible of the approved drawings for purchaser's use.

1.17.4 Successful Bidders shall also furnish two sets each of bound manuals covering operation and maintenance instructions and all relevant information and drawings pertaining to the main equipment as well as auxiliary devices alongwith each charger. Marked erection drawings shall identify the component parts of the equipment as shipped to enable erection by purchaser's own personnel. Each manual shall also contain one set of all the approved drawings, type test reports as well as acceptance reports of the corresponding consignment dispatched. Manufacture of equipments shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser.

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

1.18 COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS :

Bidders must furnish following information along with technical Offer.

1.18.1 Complete details of all the accessories which will be supplied with the battery charger should be furnished. While furnishing these details, items which will be

manufactured by the Bidders and balance items, which will be procured from sub-suppliers should be clearly identified and indicated in the bid.

1.18.2 It is obligatory on the part of Bidders to ensure that supply of all accessories along with Main equipment are simultaneously delivered to avoid any holdup in erection and commissioning. Responsibility for obtaining timely supplies of bought out items will rest on the Bidders and only on this basis, delivery period will be offered in the Bid.

1.18.3 It may be noted that in case of damages/shortages due to improper packing or any other negligence, replenishment shall be arranged within one month time. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and also in case defective supply of any item is reported, will rest on the Bidder. In case for attending to defects in any accessory or inspection/replacement of the accessory, which may be bought out item for the Bidder; if services of engineer of original manufacturer is required, the same will be organized on immediate basis by the Bidder at his cost.

1.19 EXPERIENCE: Bidder may please note that they should have adequate experience of offered equipment/ material as per Section-I Vol.II

1.20 INSPECTION:

- (i) Purchaser shall have access at all times to the works and all other places of manufacture, where the Materials are being manufactured and the Bidder shall provide all facilities for unrestricted inspection of Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed in the bidding document.
- (ii) Successful Bidder shall keep the purchaser informed in advance of the time of starting and of the progress of manufacture of Materials in its various stages, so that arrangement could be made for inspection.
- (iii) No material shall be dispatched from the point of manufacture unless the material has been satisfactorily inspected and tested.
- (iv) Acceptance of any quantity of the material shall in no way relieve the successful Bidder of this responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipment are later found to be defective.

1.21 QUALITY ASSURANCE PLAN: Bidders must establish that they are following a proper quality assurance programme for manufacture of Materials. Bidders shall invariably furnish following information alongwith his bid. Information shall be separately given for each type of Charger:

- (i) Statement giving list of important raw materials, names of sub-suppliers for the raw material, list of standards according to which the raw material is purchased and copies of test certificates thereof.
- (ii) Information and copies of test certificates as in (i) above in respect of bought out items.
- (iii) List of manufacturing facilities available.

- (iv) Levels 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) List of testing equipment available with the Bidder for final testing of material specified and test plant limitation, if any, vis-à-vis type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

Successful Bidder 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 Bid.
- (ii) Type test certificates of the raw material and bought out accessories.
- (iii) Quality Assurance Plan (QAP) with hold-up points for purchaser's inspection. The quality assurance plans and hold-up points shall be discussed between the Purchaser and supplier before the QAP is finalized.

1.21.1 Successful Bidder shall submit the routine test certificates of bought out items and raw material at the time of routine testing of charger.

1.22 DISCREPANCY IN TECHNICAL PARTICULARS:

Regarding discrepancy in technical particulars stipulation under Section-I Volume-II shall be applicable.

1.23 Bidder may please also note that any other accessories which are not included in the Annexure I and Schedule VIII, but may be necessary for satisfactory and trouble free operation of the equipment as per standard design specified in the bid document, the same should also be included in the schedule of equipments and cost of chargers should take into account all such items, if any.

2.0 TECHNICAL QUESTIONNAIRE:

It is obligatory on the part of Bidders to furnish technical questionnaire enclosed with the Bid document duly filled in complete in all respects. It has to be noted that the confirmations given in technical questionnaire will form the basis for Bid evaluation. In case technical questionnaire duly filled in complete in all respects is not furnished, the Bid may be treated as non-responsive.

3.0 GUARANTEED TECHNICAL PARTICULARS:

It is obligatory on the part of Bidders to furnish Guaranteed Technical Particulars enclosed with the Bid document duly filled in complete in all respects. In case Guaranteed Technical Particulars duly filled in complete in all respects is not furnished, the Bid may be treated as non-responsive

4.0 SCHEDULE OF REQUIREMENT OF ACCESSORIES ETC. :

It is obligatory on the part of Bidders to furnish Schedule of Requirement of Accessories provided with equipment in the Schedule VIII of the Bid document. In case Schedule VIII duly filled in complete in all respects is not furnished, the Bid may be treated as non-responsive.

5.0 Please ensure that Bid document containing number of pages have been properly numbered and signed by the Bidder. Bid document including all schedules and Annexures should be indexed properly and Index of the document should be enclosed / placed at the beginning of the Bid document.

APPENDIX- A1
SCHEDULE OF TECHNICAL REQUIREMENTS OF
BATTERY CHARGERS

S. No.	Particulars	Battery Charger		
		220 V	110V	48V
		600AH	300AH	300AH
1	Input AC supply Voltage(volts)	400 Volts		
2	Rated DC volts.	220	110	48
	Float charger Voltage	242	121	52.8
	Boost charger Voltage	297	148.5	64.8
3	Rated output DC current			
	a)Trickle charging current	1	1	1
	b) For float charging (Load Current)	60	40	32
	c) For Boost charging current	60	30	30
	Total DC current (Load + Boost)	120	70	62
4	Rating class(As per IS- 4540)	Class "A" Air Cooled		
5	Rated 2 Hr overload capacity.	105%		
6	Rated 1 min overload capacity.	110%		
7	Rated continuous overload capacity.	100%		
8	Class of insulation for:			
	a. Float Rectifier transformer	Class B		
	b. Boost Rectifier transformer	Class B		
	c. Reactors/Chokes	Class B		
9	X'mer ratings for float charging			
	a) DC out put voltage (float charging voltage)	242	121	52.8
	b) DC current rating (Float + Trickle)	61	41	33
	c) DC output VA rating (a x b)	14800	4961	1742
	d) Current through each cell of rectifier bridge	20.4	14	11
	e) Float main X'mer burden (VA)	15550	5250	1830
	f) Primary line current of X'mer at 360V line voltage & 60% efficiency	42	14	5
	g) AC contactor rating	80	32	15
	h) Rectifier Diodes & thyristars rating (Amps)	70	40	44
	i) Filter condenser	470	250	110
10	X'mer rating for Boost Charging			
	a) DC out put voltage (Boost charging voltage)	297	148.5	64.8
	b) DC current rating	120	70	62
	c) DC output VA rating(a x b)	35650	10395	4018

S. No.	Particulars	Battery Charger		
		220 V	110V	48V
		600AH	300AH	300AH
	d) Current through each cell of rectifier bridge	40	23.4	20.67
	e) Total Burden of main & series X'mer	3750 0	10950	4218
	f) Rating of main boost X'mer (VA)	2500 0	7300	2812
	g) Primary current of main Boost X'mer at 360V and 60% efficiency	67	19.6	7.81
	h) Rating of series boost X'mer (VA)	1250 0	3650	1406
	i) Primary current of series boost X'mer at 360V line voltage & 60% efficiency	33	9.8	3.91
	j) Total primary AC current of boost charger	100	29.4	12
	k) Rectifier Diodes & thyristors	100	50	83
	l) AC contactor rating	150	63	30
11	Total line current (AC)	142	43.4	17
12	Type of connections of transformers for			
	i. Boost X'mer	Double Wound, Star Delta X-mer		
	ii. Float X'mer	Double Wound, Star Delta X-mer		
13	Taps for primary voltage selections to be provided on xmer for			
	i. Boost transformer	(+) 10% and (-)15%		
	ii. Float transformer	(+) 10% and (-)15%		
14	Maximum charging current that can be fed to battery through			
	a. Float charging (Float +Trickle)	61	41	33
	b. Boost charging (including float charging) (Load + Boost)	120	70	62
15	Details of variac			
	a) Type	Motorised variac complete with run down facility for manual operation to be provided as per specification		
	b) Variac rating in Amps	60	15	7
16	Boost charging voltage after ten hours operation at rated voltage	297	149	65
17	Inherent voltage regulations			
	a. From no load to rated load	Better than 1 %		
	b. From light load (20%) to rated load	Better than 1 %		
18	voltage regulation	Automatic voltage regulation to be offered		
19	Percentage regulation with AVR.	Less than 1%		
20	Safety device to avoid voltage rise during no load.	Thyristor controlled automatic voltage regulator		
21	Efficiency at normal output voltage			
	100% full load	60% to 80%		
	75% full load	60% to 80%		

S. No.	Particulars	Battery Charger		
		220 V	110V	48V
		600AH	300AH	300AH
	50% full load	60% to 80%		
	25% full load	60% to 80%		
22	Efficiency at max. output voltage			
	100% full load	60% to 80%		
	75% full load	60% to 80%		
	50% full load	60% to 80%		
	25% full load	60% to 80%		
23	Power factor			
	a. rated load.	0.85		
	b. light load (20%)	0.7		
	Type of rectifier cell	Silicon		
24	Method of cooling for rectifier cell & Stacks	Natural Air cooled		
25	Method of cooling for transformer	Natural Air cooled		
26	Mounting of boost and float rectifier transformers	Boost & float rectifier X-mer to be mounted side by side		
27	Battery charger cubicle			
	a. Thickness of sheets steel	2 mm		
	b. Overall dimension (H x D x W)	1600x800xAs per requirement		
	c. Degree of protection	As Per IS 2147		
	d. Colour of finished paint(IS-692)	Out side smoke grey & inside egg shall white as per IS 692		
	e. Type of paint (enamel/epoxy paint)	Enamel		
28	Smoothing filter	To be offered by Bidder		
29	Method of voltage controls	FC-3 phase bridge, BC-Motorised variac		
30	Maximum permissible temp rise.			
	i. Rectifier transformers	< 65 deg C		
	ii. Reactors	< 65 deg C		
	iii. Rectifier cells.	< 55 deg C		
	iv. PCBs	<10 deg C over ambient		
31	Ripple at rated load.			
	a. with battery	1%	1%	2MV
	b. without battery	5%	5%	4MV
32	Rating of diodes/SCR			
	a. Type	Mono Crystalline silicon		
	b. RMS current rating	As per requirement		
	c. One cycle surge current.	As per requirement		
	d. Repetitive surge current	As per requirement		
	e. Peak inverse voltage continuous	1000V	600V	400V
	f. Peak inverse voltage surge	As per requirement		

S. No.	Particulars	Battery Charger		
		220 V	110V	48V
		600AH	300AH	300AH
	g. Type of protection.	Surge suppressor across each device		
33	Rating and make of tap cell Diode	As per requirement		
34	Range of voltage variation			
	i. Boost (Rated Voltage x 1.4)	220 to 308	110 to 154	48 to 67
	ii. Float (Rated Voltage x 1.15)	220 to 253	110 to 127	48 to 55
35	Range of current variation			
	i. Boost	25% to 110% of Rated Current		
	ii. Float	25% to 110% of Rated Current		
36	Rating of DC contactor.	150	75	120
37	Rating of end cell cutting switch.	As per requirement		
38	Rating of MCCB to be provided for protection purpose			
	a) AC circuit protection for Boost Charging	160	40	24
	b) AC circuit protection for Float Charging	50	20	10
	c) Boost Charger DC circuit Isolation	125	100	124
	d) Float Charger DC circuit Isolation	80	50	66
	e) Milking Charger circuit Isolation	30		
39	Rating of HRC Fuses			
	a) For protection of rectifier Diodes in Boost charger circuit	80	50	40
	b) For protection of rectifier Diodes & Thyristors in Float charger circuit	63	32	22
	c) For protection of rectifier Diodes in Milking charger circuit	30		
	d) Rating of HRC Fuses / Glass Fuses required for other circuits	As per requirement		

NOTE:-

(a) Bidders may please note that any other accessories which are not included in the above list, but may be necessary for satisfactory and trouble free operation of the equipment as per standard design specified in the bid document, the same should also be included in the schedule of equipments and cost of chargers should take into account all such items, if any.

(b) Bidder may select higher rating components in case of non availability of above rated items. Please note that under rated components shall not be accepted by purchaser.

APPENDIX-A2

DETAILS OF FITTING & ACCESSORIES TO BE PROVIDED WITH EACH TYPE OF BATTERY CHARGERS

The charger should be housed in sheet steel cubicle as per design and dimensions indicated in the specification, suitable for natural air cooled operation. The unit shall comprise of;

Sl. No.	Particulars	Purchaser's Requirement		Rating/Make of equipment offered by the Bidders		
				220V	110 V	48V
		Qty	Rating	600AH	300AH	300AH
A	COMMON EQUIPMENTS FOR BATTERY CHARGER					
1	Blocking diode for tap cells connection from 44th & 19 cell for Chargers	One	As per Annexure-A			
2	Center zero ammeter for battery charge/ discharge current.	One	(CL 1.11 (k))			
3	DC volt meter with selector switch for float/boost/load/ & battery/battery taps voltage	One	(CL 111 (k))			
4	AC voltmeter with selector switch for 3 phase input voltage	One	(CL 1.11 (h))			
5	Trickle charge indication lamp/LED	One	Standard			
6	Single phasing preventor, over voltage, under voltage earth, leakage, short circuit, input , rectifier fuse fail, O/L	One	Standard			
7	AC Contactors for cutting off AC supply	Two	Standard			
8	Annunciation facia with accept reset and test facility. This should have audio/visual alarms for various protections & also two spares	One	Standard			
9	Bell for alarm	One	Standard			
10	Input switch	One	Annexure-A			
11	DC contactor for change over of load to boost charger during float failure.	One	-Do-			
12	RF filter (1000V rating) for Float Charger	One	-Do-			

Sl. No.	Particulars	Purchaser's Requirement		Rating/Make of equipment offered by the Bidders		
				220V	110 V	48V
		Qty	Rating	600AH	300AH	300AH
13	RF filter (1000V rating) for Boost Charger	One	-Do-			
14	AC surge suppressor	One	-Do-			
15	DC contactor for automatic by pass of tap cell in the event of supply failure	One	-Do-			
16	Four position single pole selector switch for end cell cutting	One	-Do-			
17	Set of indicators for i. Main incoming AC supply `ON' ii. AC supply to boost charger `ON' iii. AC supply to float charger ON iv. DC output from boost charger `ON' v. DC Output from float charger `ON"	One	-Do-			
18	DC contactor for automatic by pass of tap cell in the event of supply failure	One	-Do-			
19	Four position single pole selector switch for end cell cutting	One	-Do-			
20	Floor mounted motorised variac with automatic rundown facility complete with provision for manual operation for boost circuits	One	-Do-			
B	EQUIPMENTS FOR BOOST CHARGING UNIT					
1	Input transformer VA rating	One	As per Annex-A			
2	AC Contractor rating					
3	Rectifier Diodes & thyristors rating					
4	MCCB rating AC circuit					
5	Rating of DC contractor					
6	HRC Fuses	Three	-Do-			
7	Lamp to indicate boost on.	One	-Do-			
8	Silicon rectifier stack for 3	One	-Do-			

Sl. No.	Particulars	Purchaser's Requirement		Rating/Make of equipment offered by the Bidders		
				220V	110 V	48V
		Qty	Rating	600AH	300AH	300AH
	phase full wave rectification					
9	HRC Fuses at DC output	Two	-Do-			
10	Switch for energizing circuit	ONE	-Do-			
C	EQUIPMENTS FOR FLOAT CHARGING UNIT					
1	Input transformer VA rating	One	As per Annex-A			
2	AC Contractor rating					
3	Rectifier Diodes & thyristors rating					
4	MCCB rating AC circuit					
5	Rating of DC contractor					
6	HRC Fuses	Three	-Do-			
7	Lamp to indicate float on	One	-Do-			
8	Silicon rectifier stack for 3 phase full wave rectification, complete with thyristor circuit for automatic voltage control	One	-Do-			
9	Ammeter to indicate output current(96 sqmm)	One	-Do-			
10	Switch for energising circuit	One	-Do-			
11	Fuses HRC type, at DC output	Two	-Do-			

Note:-

- 1) All the information in this schedule is essentially required to be mentioned.
- 2) The Bidders may also mention the name of other items, if any, required for satisfactory operation of offered chargers

SCHEDULE-I (A)
DESCRIPTION OF EQUIPMENT FOR
SCHEDULE FOR RATES AND PRICES TO BE FURNISHED
IN BIDDING FORM OF, VOLUME-VI

S. No.	Particulars of equipment/ Item	Qty.
1	220 Volts, 600 AH Battery Charger Complete with accessories confirming to all technical requirement as per specification	As per price schedule
2	110 Volts, 300 AH Battery Charger Complete with accessories confirming to all technical requirement as per specification	
3	48 Volts, 300 AH Battery Charger Complete with accessories confirming to all technical requirement as per specification.	

- NOTE:1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.**
- 2. The quantity of above equipments has been mentioned in Volume VI**

SECTION - II (A)
2.3.3 TECHNICAL SPECIFICATION FOR AC & DC
DISTRIBUTION BOARDS

1.0 SCOPE:

1.1 The scope of this specification covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the MPPTCL.”

In case bidder is not OEM, sole responsibility of offering equipments/material of manufacturer as per this specification requirement shall rest on the bidder.

1.2 SYSTEM PARTICULARS:

Supply Boards offered under this specification shall be utilized at EHV sub-stations having following parameters. Bidders may please note that Neutrals at these sub-stations are solidly or effectively earthed.

S. No.	PARTICULARS	SYSTEM PARAMETERS			
1	Nominal system voltage	400KV	220KV	132KV	33KV
2	Highest system voltage	420KV	245KV	145KV	36KV
3	Frequency	50 Hz	50 Hz	50 Hz	50 Hz
4	Earthing	Effectively Earthed			
5	Basic insulation level (KV peak)	1425	1050	650	250

1.3 CLIMATIC CONDITIONS:

Applicable climatic conditions shall be as per Section-I Volume-II of this bid.

1.3.1 STANDARDS -

Applicable Standards for the offered equipments/items shall be as per Section-I Volume-II.

1.3.2 ACCEPTANCE OF OTHER AUTHORITATIVE STANDARDS -

In the paragraph 1.3.1 above relevant Indian Standard have been mentioned. However, the Materials meeting any other authoritative International Standard, which ensures equal or better quality than the standards, mentioned shall also be acceptable. Please attach photocopy of all such standards according to which the Material has been offered.

1.3.3 In this Bid, the Bidders will have to furnish confirmation in regard to compliance of our entire technical requirement. The Bid should clearly describe various technical particulars of the Materials as per details given in this specification. Based on above information all details required in Schedule-I to Schedule XII should be furnished so that we may be able to examine whether the Bid submitted is technically acceptable

or not. Also all details and confirmation required as per Schedule-I to Schedule XII will form part of technical Bid.

1.4 GENERAL REQUIREMENT:

1.4.1 AC Boards shall be provided with incoming supply of 3 phase, 4 wire, 415Volts AC through MCCB and bus bar/bus section of adequate rating. Distribution of single/three phase shall be arranged through MCCBs to various load points in the substation.

1.4.2 220V & 110V DC distribution boards shall comprise of MCCB, bus section of busbars of adequate ratings suitable for 220V & 110V DC, two wire, ungrounded supply from the battery charger.

1.5 CONSTRUCTIONAL REQUIREMENTS FOR AC / DC DISTRIBUTION BOARDS:

1.5.1 AC/DC Boards shall be metal enclosed and floor mounted. Boards shall be provided with metal frame made of structural steel channel section properly drilled for mounting the switchgear. These shall be of single front execution with a height (H x B x D) not exceeding 2000 x 1600 x 400 (H x B x D) and having provisions for cable entry from the bottom with removable gland plate. Provision shall also be available for putting labels on the front doors indicating the switchgear designation. Suitable gaskets shall be provided all round the perimeter of covers, gland plates, door etc. Tentative drawing of the AC/DC Boards have been enclosed at end of this Section.

1.5.2 Boards shall have two doors, one at the front and other at the backside. Both the doors shall have pistol grip or allenkey operated door shuttering arrangement.

1.5.3 AC/DC distribution boards shall have an equipment mounting plate provided at suitable position between the doors. All equipments shall be mounted on front side of this plate and busbars on its back side. Boards shall be painted in accordance with the pre-treatment and painting process as per clause '3.0'. Each board shall be given two coats of zinc chromate primer, followed by two finishing coats of shade of IS:5 (i.e. light grey) for exterior and glossy white for the interior surfaces.

1.5.4 Switchgear shall be divided into distinct vertical sections each comprising of:

- i. Individual feeder modules arranged in the multitier formation vertically on both sides of the Bus.
- ii. Enclosed vertical busbar running in vertical section in the middle.
- iii. Vertical cable alley covering the entire height on the sides.
- iv. Metal sheets shall be provided between two adjacent vertical sections running to the full height of the switchgear.

1.5.5 Incoming and the outgoing feeders of the AC/DC Boards shall be provided with label inserting blocks in front of the MCCB Chamber, so that the destiny of the feeders could be inscribed by the purchaser.

Note:- On the basis of above arrangement successful Bidders will submit drawings for approval of MPPTCL.

1.5.6 CABLE TERMINATIONS:

1.5.6.1 Suitable double compression type of brass cable glands mounted on a removable gland plate shall be provided to support all 2.5 sq mm and copper control cable of 19,4 & 2 Cores cables entering the switchgear. Cable glands shall incorporate built in facilities for earthing the wire armour of cables. All cable cores shall be adequately supported at regular interval inside the cable alleys by means of suitable rubber lined clamps upto the respective terminal blocks. Necessary crimping type of cable lugs for connecting the individual cores to the respective terminals shall be provided.

1.5.6.2 Cable alley shall be provided with suitable doors or removable covers. It shall be possible to safely carry out maintenance and rectification works on cable connection to any CIRCUIT with the busbars and adjacent circuits live.

1.5.6.3 AC/DC boards shall have provision of multiple cable entries from the bottom. Cable entry shall be from the bottom and suitable removable gland plates shall be provided on the cabinet for this purpose. Necessary number of cable glands shall be supplied duly fitted on the removable gland plate. Cable glands shall be screw on type, made of brass and shall be of excellent quality. Number of cable glands required for AC & DC Boards have been mentioned in clause No. 1.5.12 of specification.

1.5.6.4 Cable lugs for copper cables shall be of tinned copper only and shall be double compression brass nickel plated type. Suitable washers shall be provided with lock nuts to tighten the lugs on the terminal block.

1.5.7 Cabinet shall have one space heater with switch.

1.5.8 TERMINAL BLOCKS:

1.5.8.1 All terminal blocks (both for power and control circuits) shall be of the 1100V grade stud type comprising finely threaded pairs of brass studs of atleast 6mm diameter, links between each pair of studs, washers, nuts and lock-nuts. The studs shall be securely locked within the mounting base to prevent turning. Insulated barriers shall be provided between adjacent terminals.

1.5.8.2 All terminal shall be shrouded. "The screw terminal block shall be manufactured as per IEC60947-7-1. The insulating material of the terminal block shall be polyamide 6.6 meeting V0/V2 inflammability class as per UL94. All metal parts including screws shall be copper of alloy. The terminal block shall be suitable for mounting on both 'DIN' as well as 'G' type rail. All the metal parts shall be captive and touch proof. The terminal block shall have screw locking design so that it can withstand vibration level upto 5kg and also prevent accidental loosening of conductors."

1.5.8.3 Terminal blocks shall be adequately rated to carry the current of associated circuit. Minimum rating of the terminal blocks is 10Amp.

1.5.8.4 Where duplication of a terminal block is necessary, it shall be achieved by solid bonding links.

1.5.8.5 Terminal blocks shall be arranged in such a way that atleast 100mm clearance is maintained between two sets of terminal blocks.

1.5.8 .6 Each terminal point shall be marked with relevant designations.

1.5.8 .7 Bottom of terminal blocks shall be spaced atleast 200mm above the cable glands.

1.5.9 SHEET METAL WORKS:

1.5.9.1 Switchgear frame shall be fabricated using suitable mild steel structural section or pressed and shaped cold rolled sheet of adequate thickness not less than 2.5mm

1.5.9.2 Steel enclosure shall be smoothly finished, levelled and shall be free from flaws. The thickness of sheet steel shall be 2.5 mm. Doors shall be made of cold rolled sheet of thickness of 2.5mm. Suitable stiffeners shall be provided wherever necessary.

1.5.9.3 All panels edges and door edges shall be adequately reinforced to avoid distortion, bending etc.

1.5.9.4 All cut-outs shall be true in shape and shall be free from sharp edges.

1.5.9.5 Complete structure shall be rigid, self-supporting and free from vibrations, twists and bends.

1.5.10 MAIN BUSBARS :

1.5.10.1 Switchgear shall be provided with three phase and a neutral busbars for AC distribution boards and two busbars for DC distribution boards and shall be suitable for carrying continuous current and short circuit current as indicated in the drawings appended to this specification .

1.5.10.2 Busbar shall be of uniform cross section throughout the length of the switchgears.

1.5.10.3 All busbars shall be made of Electrolytic copper Grade Copper Bars having size not less than 25x8 sq.mm.

1.5.10.4 Minimum clearance in air between busbars shall be maintained as specified in IS:4237 for 500V, 3 phase AC system & 110V DC system. All busbars, bus-taps and joints shall be PVC taped.

1.5.10.5 Busbar shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents for the associated switchgear. Busbar supports shall be made of hylam sheets, moulded plastic material, permaliwood or porcelain. Separate supports shall normally be provided for each phase of the busbars. If however, the Bidder chooses to provide a common support for all the three phases, anti tracking barriers shall be incorporated.

1.5.10.6 Busbar joints shall be of bolted type complete with believeille washers, Busbars shall be thoroughly cleaned at the joint locations and suitable contact grease shall be applied before making a joint. The interconnection between main bus bar and incoming/outgoing MCCB's shall be done with copper links of adequate ratings.

1.5.10.7 In case of DC switch-boards, positive and negative busbars shall be completely separated from each other by sheet steel partition. Separate supports shall be provided for DC Busbar of each polarity. If however, the Bidder chooses to provide a common support for both the busbars, anti tracking barriers shall be provided.

1.5.10.8 Maximum temperature of the busbars when carrying rated current under operating condition shall not exceed 45 deg. centigrade above ambient.

1.5.11 MOULDED CASE CIRCUIT BREAKERS:

1.5.11.1 Moulded case circuit breakers shall be quick acting, preferably with a total arc extinction time of not less than 25 milliseconds, trip-free, and should be able to operate satisfactorily under, (i) over load and (ii) short circuit conditions.

1.5.11.2 Moulded case circuit breakers shall be provided with arrangement of separate tripping system for over load and short circuit conditions. For instance, over-load tripping could be provided through a suitably calibrated bimetallic strip and tripping under short circuit conditions could be achieved through a solenoid coil. Any other arrangement of tripping, reliable and sturdy in design, would be acceptable.

1.5.11.3 In case of AC Boards the MCCB shall be provided with a common trip bar for 3 phase supply, so as to ensure opening of all threephase even when fault occurs in only one phase.

1.5.11.4 Current carrying contact of the MCCB shall be silver plated and sturdy in design. MCCBs should be housed in a heat resistant moulded insulated housing.

1.5.11.5 Following information regarding MCCBs of various rating shall be furnished alongwith the offer.

- i. Make of MCCB offered and experience of the manufacturer.
- ii. A copy of type test report in regard to short time current rating of the MCCB should be furnished.
- iii. Complete constructional details of the MCCB illustrated in suitable cross sectional drawings should be furnished indicating type of housing, type of contacts, type and arrangement of various types of operating mechanism, arrangement of quenching of arc, mounting details etc.
- iv. Suitable pamphlet explaining the working of MCCB.

1.5.12 RATING & POSITIONING OF INCOMING & OUTGOING FEEDERS:

1.5.12.1 415 VOLTS AC BOARDS:

- i. One set of 3 phase, 4 wire, 50 Hz, 400Amps busbar of the size not less than 25x8 sqmm electrolytic grade copper for AC Boards.
- ii. One number incoming feeder shall be provided with 300Amp phase MCCB. The size of cable gland at the bottom shall be suitable for 3-1/2 core 300sqmm aluminium cable.
- iii. Outgoing feeders will be provided with MCCB as per the following details:-

S. NO.	Ampere rating	Type of MCCB	Number of feeders	Size of cable to be used
1	300 Amps.	Three phase	1	3 ½ Core 300 sq.mm Incoming Feeder
2	50 Amps.	Three phase	4	2.5 sq mm 19 core copper control cable. All out going feeders.
3	20 Amps.	Three phase	5	
4	16 Amps.	Three phase	3	
5	10 Amps.	Single phase	3	

- iv. A total of 18 Nos. cable glands for Cable entry from the bottom suitable for 2.5 sq.mm 19 core copper control cables shall be provided for out going feeders from Board, whereas 1 no. incoming cable gland shall be suitable for 300 Amps, 3 ½ core 300 sq.mm.
- v. One number AC voltmeter, 0-500V range, with selector switch to measure all the 3 phase voltages separately, shall be provided. This will be mounted on top but in the middle as shown in Annexure-I.
- vi. One number AC ammeter connected to LTCT ratio 300-150/5 amps. with selector switch to measure the phase currents shall be provided. Ammeter shall be mounted as indicated in Annexure-I. The accuracy of ammeter should not be less than 1.0

1.5.12.2 **DC BOARDS:**

- i. One set of busbars of rating 200 amps DC of the size not less than 25x8sqmm electrolytic grade copper.
- ii. One number incoming feeder 200 amps with two phase 220V/110V MCCB shall be provided. The size of the cable gland shall be suitable for 2.5 sqmm 19 core copper control cable sq mm cable each for positive & negative terminal
- iii. Details about Incoming and outgoing feeders to be provided on DC distribution Board shall be as under :

S.No.	Feeders	Quantity	Ratings	Size of cable
1	Incoming	1 no.	200 Amps	2.5 sq mm 19 core copper control cable
2	Outgoing	13 nos.	40 Amps.	2.5 sq mm 2 core or 4 core control cable
3	Emergency Lighting	1 no.	10 Amps.	

Note: Disposition of feeders indicated above shall be identical for 600 Ah, 300 Ah. as well as 200 Ah Batteries. Bidders shall make use of appropriate size of two core cables and indicate their sizes in their offer.

- iv. A total of 18 Nos. Cable glands for cable entry from the bottom for out going feeder shall be provided for 2.5 sq.mm copper control cable and

2 nos, cable glands suitable for 2.5 sq mm 19 core copper control cable for incoming supply from battery

1.6 TESTS:

Type and routine tests shall be carried out on all equipment as per relevant Indian Standards.

1.6.1 AC/DC Boards shall be subjected to following tests -

- (i) Temperature rise test on power circuits.
- (ii) Short time current tests on power circuits.
- (iii) Mechanical operation test.
- (iv) Verification of the degrees of protection as per IS:2147.
- (v) Electrical control interlock and sequential operation tests.
- (vi) High voltage test (2KV for 1 minute).
- (vii) Verification of wiring as per approved schematic.

1.6.2 Certified copies of all type and routine test certificates shall be submitted for purchaser's approval before despatch of the equipment.

2.0 SUBMISSION OF DESIGN DETAILS:

2.1 Requirements for participating in this Bid are as under:-

- a. Bidders must have established manufacturing facility in his factory to manufacture the materials as specified in this Bid. The Bidders shall clearly state his experience and capability to undertake the manufacture of these items. Minimum acceptable experience is five years.
- b. Details of such manufacture specified above and supply including type, quantity, date of order, date of commencement and completion of supplies, name of purchaser shall be furnished with the Bid alongwith his full address.
- c. Bidders should have adequate testing facilities to test the product offered in his factory to the satisfaction of the purchaser. Bid shall include complete details of testing facilities available in manufacturer's works.

3.0 PRE-TREATMENT AND PAINTING PROCESS -

Sheet steel fabricated members for Distribution Boards shall be subjected to pretreatment process before painting. The process shall be carried out as under. It can broadly be divided as 'Metal treatment and painting'.

3.1 METAL TREATMENT:

- i. Degreasing: This can be achieved either by immersing in hot alkaline degreasing bath or in hot dry chloroethelence solution. In case degreasing is done by alkaline bath rinse with cold water thoroughly.

- ii. Pickling : This is to remove rust and metal scales. Immersing in diluted sulphuric acid (approximately 20%) at nearly 60 deg. Centigrade. Unit scale and rust are totally removed.
- iii. Rinse it in cold water twice to remove traces of acids.
- iv. Treat with phosphoric acid base neutraliser for removal of chlorine from the above acid pickling and again wash with running water.
- v. Phosphating : Immerse in grenodine `zinc phosphate solution for about 20 minutes at 80 to 90 deg. centigrade. The uniform phosphate coating of 4 to 5 gms per sq.meter shall be achieved.
- vi. Swill in cold water.
- vii. Rinse in Deorylyte bath at 70 to 80 deg. centigrade to neutralise any traces of salts.
- viii. Seal the above phosphate coating with hot/dilute chromoto solution.
- ix. Dry with compressed air.

3.2 PAINING:

- i. Primer : spray one coat wet on wet specially developed `High lusture' zinc chromote primer and stove at 150 deg. centigrade to 160 deg. centigrade for 25 to 30 minutes. Alternatively red-oxide primer with zinc chromate contents may be used. However, former process is preferred.
- ii. Rubbing and puttying : Apply putty to fill up the scars if any to present smooth surface and stove 15 to 20minutes. Apply putty several times to get the perfectly smooth finish.
- iii. Surfacing: Sand down with mechanical abrasive and stove for 20 minutes.
- iv. Primer: Spray second coat of primer as per (i) above or grey primer surface wet on wet and stove for 20 to 40 minutes at 150 deg. centigrade.
- v. Finish paint: Rubbing down dry and spray first coat of synthetic enamel finish paint wet on wet and stove for 30 minutes.
- vi. Surfacing: Sand down or rub dry to prepare for final finish spray. Final finish shall be obtained after spraying 2 Coats of synthetic enamel finish paint wet on wet and stove it at 150 deg. centigrade for 30 minutes.
- vii. Colour of finishing paint for AC/DC Boards & Junction Boxes shall be light grey shade as per 631 of ISS. On the interior surface, the finishing coat shall be of glossy white colour.

NOTE:

- i. Necessary stiffners may be welded between large cut outs to provide rigidity before painting process.
- ii. Painting process shall be done within 24 hours of completion of treatment.
- iii. Small coating paint shall be supplied alongwith equipment for touching up at site.

4.0 DATA AND DRAWINGS:

Bidders shall furnish one set of following drawings and data alongwith the Bid for preliminary study:-

- i. Complete assembly drawings of the switchgear showing plan, elevation and typical sectional views and locations of terminal blocks for external wiring connections.
- ii. Foundation plan showing location of channels sills, anchor bolts etc.
- iii. General arrangement drawing of each switchgear showing the equipment mounted.
- iv. Time- current characteristics curves for each type and rating of MCCBs.
- v. Developed diagram of electrical switches,
- vi. Outline drawings of cable pot heads showing dimensions and rating.
- vii. Item wised bill of material listing all devices mounted or otherwise furnished indicating manufacturers type.
- viii. Operation and maintenance manual for individual equipment and complete switchgear.
- ix. Illustrated literature/write-up for each equipment i.e. CTs, Voltmeter, ammeter, switches, lamps, MCCB etc.,

Please note that above mentioned drawing/literature etc., shall be accompanied along-with the offer, otherwise the offer shall be treated as non responsive.

5.0 PACKING AND TRANSPORT:

5.1 All equipments/material shall be protected for transport carriage at site and outdoor storage during transit.

5.2 Supplier shall be responsible for any damage to the equipment during transit due to improper and inadequate packing.

5.3 Only packages constructed out of wooden material and of dimensions proportional to the size and weight of contents shall be used.

5.4 Bundled materials shall be rigidly steel strapped over the protective covering such as gunny bags.

5.5 Fragile materials shall be securely braced within the container or otherwise amply fastened and packed to prevent shifting of ratting soft non-hygroscopic packing materials shall be placed between the hard packing materials and the fragile equipment.

5.6 Loose material e.g. bolts, nuts etc., shall be packed in gunny bags and sealed in polythene bags with proper tagging.

5.7 All opening in the equipment shall be tightly covered, plugged or capped to prevent foreign material from entering.

5.8 Proper arrangements for attaching slings for lifting shall be provided.

5.9 Each package shall be clearly, legibly and durably marked on both sides as follows:-

- a. Name & designation of the consignee (to be furnished by the purchaser.)
- b. Ultimate destination (as required by the purchaser)
- c. Items and respective quantities contained in the package to be furnished by the purchaser.)
- d. Net and gross weight of the material.
- e. Gross weight of each package

6.0 INSPECTION:

- (i) Purchaser shall have access at all times to the works and all other places of manufacture, where the Material are being manufactured and the Bidder shall provide all facilities for unrestricted inspection of Bidder's works, raw material, manufacture of all the accessories and for conducting necessary tests as detailed in the bidding document.
- (ii) Successful Bidder shall keep the purchaser informed in advance of the time of starting and of the progress of manufacture of Material in its various stages, so that arrangement could be made for inspection.
- (iii) No material shall be dispatched from the point of manufacture unless the material has been satisfactorily inspected / tested and despatch clearance issued.
- (iv) Acceptance of any quantity of the material shall in no way relieve the successful Bidder of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipment are later found to be defective.

7.0 QUALITY ASSURANCE PLAN:

7.1 Bidders must establish that they are following a proper quality assurance programme for manufacture of Material. They shall invariably furnish following information along with their Bid. Information shall be separately given for AC and DC supply Boards.

- (i) Statement giving list of important raw materials, names of sub-suppliers for the raw material, list of standards according to which the raw material is purchased and copies of test certificates thereof.
- (ii) Information and copies of test certificates as in (i) above in respect of bought out items.
- (iii) List of manufacturing facilities available.
- (iv) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- (v) List of testing equipment available with the Bidders for final testing of material specified and test plant limitation, if any, vis-à-vis type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

7.2 Successful Bidders shall within 30 days of placement of order, submit following information to the Purchaser:

- (i) List of raw material as well as bought out items/accessories and the names of sub-suppliers selected from the lists furnished along with Bid.
- (ii) Type test certificates of the raw material and bought out accessories.
- (iii) Quality Assurance Plan (QAP) with hold-up points for purchaser's inspection. Quality assurance plans and hold-up points shall be discussed between the Purchaser and supplier before the QAP is finalized.

8.0 SCHEDULE:

Schedules, questionnaire and annexure attached with this specification are the integral part of the specification and shall be submitted duly filled in by the Bidders alongwith the offer. Bill of material for each equipment shall be submitted by the Bidder separately. Makes of the equipment shall be clearly indicated. Bidders may please note that a general mention that the components shall be of reputed make will not be acceptable.

9.0 DISCREPANCY IN TECHNICAL PARTICULARS:

It has been noticed that some of the information furnished in the schedule of technical particulars, technical questionnaire and price schedule do not match with each other. In order to avoid any discrepancy, it may be noted that for the purpose of price evaluation the details brought out by the Bidders in "Schedule-III' Technical Questionnaire" will be treated as final and evaluation will be done based on the information which will be given in this Schedule -III. In case of any discrepancy in regard to information given in any other table, responsibility will rest on the Bidders. While this condition shall be applicable for the purpose of price evaluation, at the time of acceptance of Bid, the Purchaser will have the right to take such of the values which are advantageous to the Purchaser

10.0 COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS:

10.1 Bid shall be complete in all respects and shall include all minor accessories, small wiring etc., not specifically mentioned in the Schedule, specifications etc; but essential for the completeness of the system. Bidders shall not be eligible for extra charges in respect of such minor accessories, small wiring etc., though not included specifically in this specification but requires for satisfactory operation of equipment offered.

10.2 Bidders must furnish following information along with technical Bid.

10.2.1 Complete details of all the accessories which will be supplied with Distribution Boards.

10.2.2 It is obligatory on the part of Bidders to ensure that supply of all accessories along with Main equipment are simultaneously delivered to avoid any holdups. Responsibility for obtaining timely supplies of bought out items will rest on the Bidders and only on this basis, delivery period will be offered in the Bid.

10.2.3 It may be noted that in case of damages/shortages due to improper packing or any other negligence ,replenishment shall be arranged within one months time. For bought out items, responsibility for guarantee and obtaining

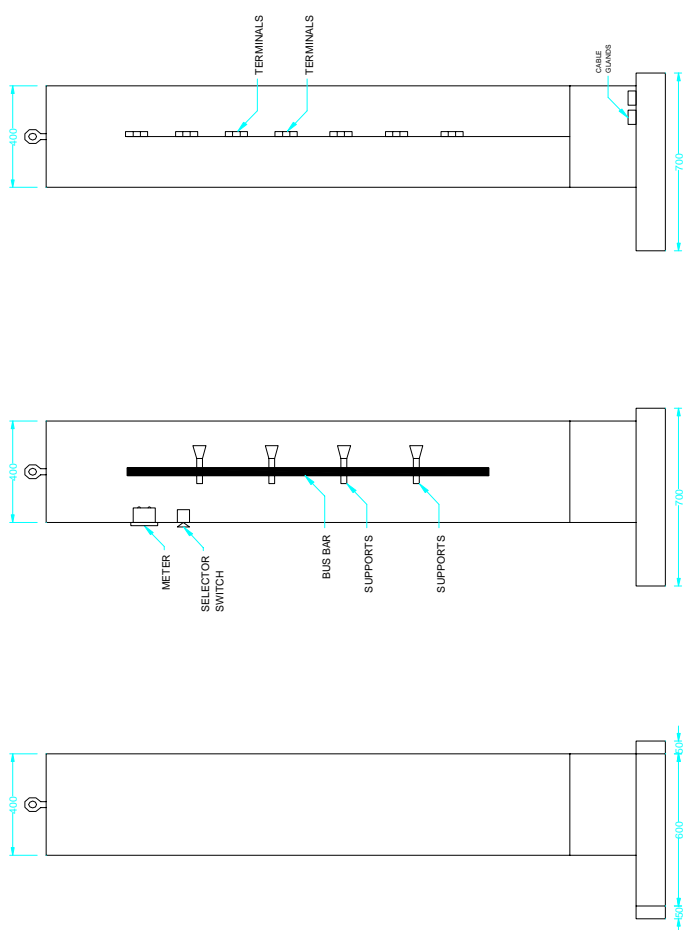
immediate replacement in case any defects are noticed and also in case defective supply of any item is reported, will rest on the Bidders.

11.0 SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS AND TECHNICAL QUESTIONNAIRE:

Bidders shall furnish Guaranteed Technical Particulars and Technical Questionnaire for offered equipments in the format provided under enclosed schedule-II & Schedule-III.

APPENDIX-B
DRAWINGS

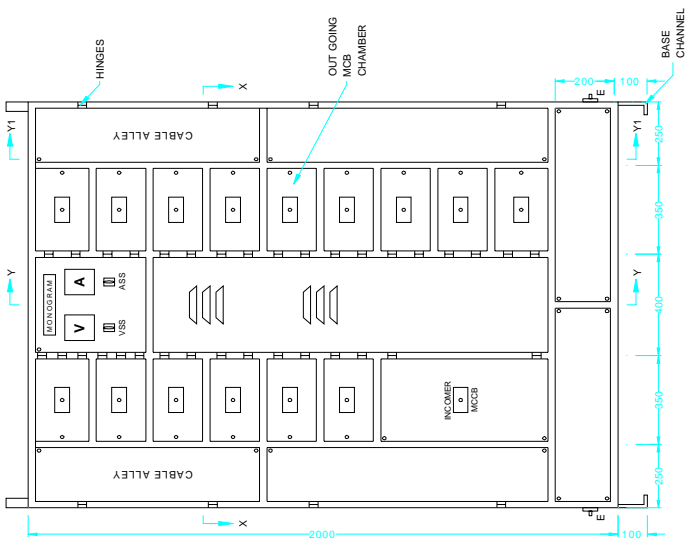
S.No.	Drawing No.	Description
1	JICA/MPPTCL/TR-101 TO 107/ GA 415V AC Board	General Arrangement Drawing for 415V AC Distribution Board
2	JICA/MPPTCL/TR-101 TO 107/ GA 220/110V DC Board	General Arrangement Drawing for 220/110V DC Distribution Board



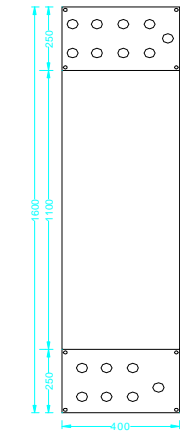
SECTIONAL VIEW Y1-Y1

SECTIONAL VIEW Y-Y

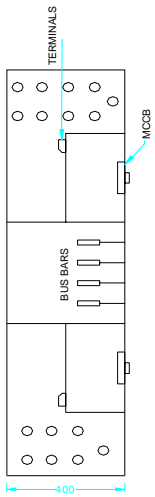
SIDE VIEW



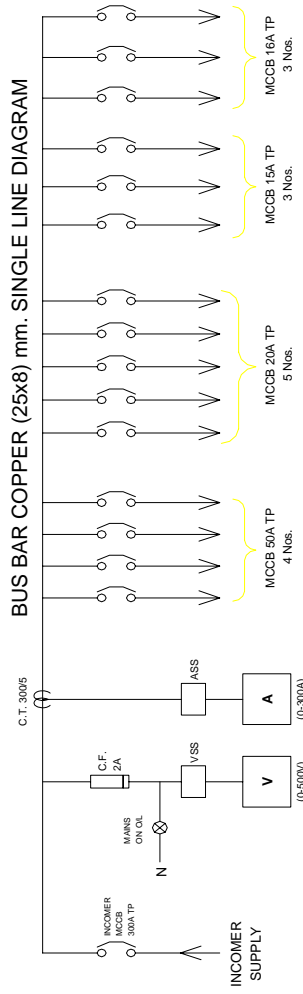
FRONT VIEW



BOTTOM VIEW



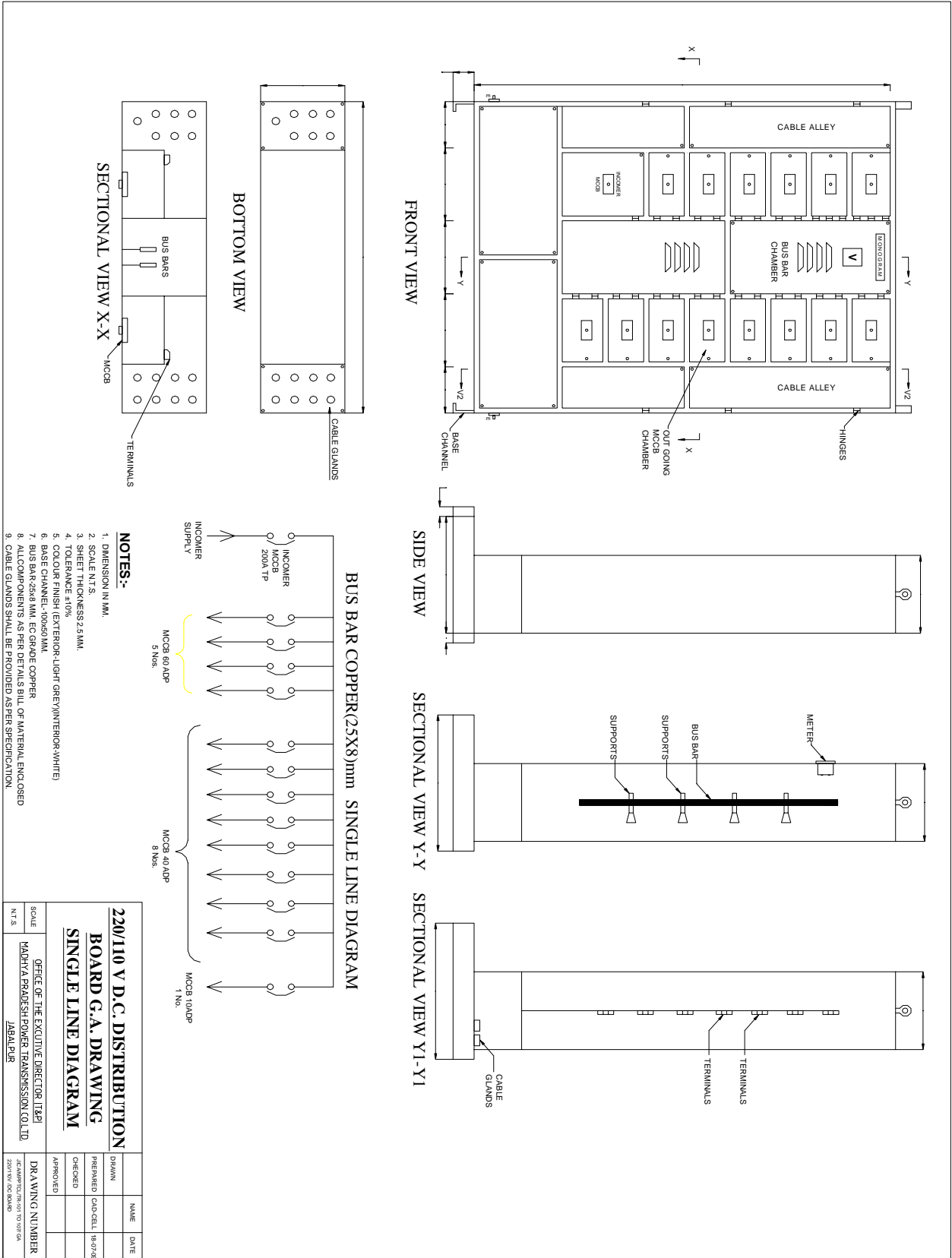
SECTIONAL VIEW X-X



NOTES:-

1. DIMENSION IN MM.
2. SCALE N.T.S.
3. SHEET THICKNESS 2.5 MM.
4. TOLERANCE ±10%
5. COLOUR FINISH (EXTERIOR-LIGHT GREY/INTERIOR-WHITE)
6. BASE CHANNEL-100x50 MM.
7. BUS BAR-25x8 MM. EC GRADE COPPER
8. CABLE GLANDS SHALL BE PROVIDED AS PER SPECIFICATION

415 VOLTS A.C. DISTRIBUTION BOARD		NAME	DATE
G.A. DRAWING		DRAWN	
SINGLE LINE DIAGRAM		PREPARED	DATE
SCALE	N.T.S.	CHECKED	
		APPROVED	
DRAWING NUMBER			
OFFICE OF THE EXECUTIVE DIRECTOR, I.T.&P			
MADHYA PRADESH POWER TRANSMISSION CO.LTD.			
JABALPUR			
JICA/MPPTCL/TR-101 TO 107/GA 4.15V AC BOARD			



SCHEDULE-I (A)
DESCRIPTION OF EQUIPMENT FOR
SCHEDULE FOR RATES AND PRICES TO BE FURNISHED
IN BIDDING FORM OF SECTION-IV, VOLUME-I

S.No.	Particulars of equipment/ Item	Qty.
1	Supply of 415V AC Distribution Board meeting all Technical requirements as prescribed in Bid document.	Price
2	110V / 220 VDC Distribution Board meeting all Technical requirements as prescribed in Bid document.	As per Schedule

- NOTE:** 1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.
2. The quantity of above equipments has been mentioned in Volume VI

SECTION-II (B)
TECHNICAL SPECIFICATION FOR JUNCTION BOXES

1.0 SCOPE:

1.1 The scope of this specification covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the MPPTCL.”

In case bidder is not OEM, sole responsibility of offering equipments/material of manufacturer as per this specification requirement shall rest on the bidder.

1.2.1 STANDARDS -

Applicable Standards for the offered equipments/items shall be as per Section-I Volume-II.

1.2.2 ACCEPTANCE OF OTHER AUTHORITATIVE STANDARDS

In the paragraph 1.2.1 above relevant Indian Standard have been mentioned. However, the Materials meeting any other authoritative International Standard, which ensures equal or better quality than the standards, mentioned shall also be acceptable. Indian Standards for which are not available, the relevant equivalent International Standards will be applicable. Please attach photocopy of all such standards according to which the Material has been offered.

1.2.3 In this bid, the Bidders will have to furnish confirmation in regard to compliance of our entire technical requirement. The bid should clearly describe various technical particulars of the Materials as per details given in this specification. Based on above information all details required in Schedule-I to Schedule XII should be furnished so that we may be able to examine whether the Bid submitted is technically acceptable or not. Also all details and confirmation required as per Schedule-I to Schedule XII will form part of technical bid.

1.2.4 CLIMATIC CONDITIONS -

Applicable climatic conditions shall be as per Section-I Volume-II.

1.2.5 SYSTEM PARTICULARS -

Materials offered under this specification shall be utilized at EHV sub-stations having following parameters. Bidders may please note that Neutrals at these sub-stations are solidly or effectively earthed.

S. No.	PARTICULARS	SYSTEM PARAMETERS
1	Nominal system voltage	400KV 220KV 132KV 33KV
2	Highest system voltage	420KV 245KV 145KV 36KV
3	Frequency	50 Hz 50 Hz 50 Hz 50 Hz
4	Earthing	Effectively Earthed
5	Basic insulation level (KV peak)	1425 1050 650 250

2.0 CONSTRUCTION -

Junction (Marshalling) boxes shall be made of MS sheet steel of thickness 2.5 mm. with suitable rubber beading and gaskets so as to make the box completely water proof and suitable for outdoor installation. Quality gaskets shall be utilized to prevent ingress of rain water inside the box.

2.1.1. Suitable mounting arrangement shall be provided for the Junction (Marshalling) boxes.

2.1.2 Boxes shall be suitable for outdoor mounting as stated above and shall be provided with knock-outs both in top and bottom plated for cable/conduit connectors. The box cover should be hinged at one end in addition nuts/bolts shall be provided in all four corners for tightening the box cover. All hardwares used in junction boxes shall be zinc passivated.

2.1.3 Junction (Marshalling) boxes shall be provided with two earthing terminals and shall be complete with end plate, end clamps, fixing channels, flange, covers and brass cable glands etc.

2.1.4 Box shall be painted in accordance with the pre-treatment and painting process as per clause '3.0'. Each box shall be given two coats of zinc chromate primer, followed by two finishing coats of shade of IS:5 (i.e. light grey) for exterior and glossy white for the interior surfaces.

2.1.5 Moulded barriers of suitable size shall be provided between terminals to prevent flashover. The terminals shall have a voltage withstand capability of at least 5KV between phase to earth as well as between two adjacent blocks for one minute. Each junction (marshalling) box shall have provision of addition of one more row terminal blocks in future and each row shall have provision for 5 to 10 terminal blocks, if required.

2.1.6 Terminal blocks shall be Elmex reputed make and shall be of the disconnectable type only. Our approved type of terminal connector is ELMEX make KLTD4. Please note that non disconnecting type terminal blocks are not required and all such Boxes shall not be accepted.

2.1.7 All terminals shall be complete with insulated barriers, terminals, studs, washers, nuts, lock nuts & identification strips and shall have facility for measurement of voltage/current using banana pins.

2.2 IMPORTANT DESIGN REQUIREMENT -

Following should be kept in view while designing the box:-

2.2.1 Terminal blocks should necessarily be of disconnecting type only.

2.2.2 The cover of the box should cover the complete surface of the box, so that installation may be water proof. A stopper should be provided so that at the times of opening full load may not come on the hinges.

2.2.3 It may be ensured that the Junction/Marshalling box is manufactured in the best possible way to ensure that the box is completely dust and water proof. For this

purpose it may be noted that all joints in the boxes should be of "TONGUE GROOVE" type.

2.2.4 Earthing arrangement for the box should be provided.

2.2.5 A small copper strip of adequate size with three or five nuts should be provided inside the box so that earthing of three or five star points of CT secondary could be possible without any difficulty.

2.2.6 Terminal blocks should be numbered serially.

2.2.7 Double compression type Brass cable glands, rubber gaskets and Elemex make terminal blocks should be of best quality.

2.2.8 Suitable handle type locking arrangement shall be provided for the box.

2.2.9 Thickness of the sheet metal should not be less than 2.5 mm.

2.2.10 Junction boxes shall be made by using 4 pieces of sheet metal only. Out of these 4 pieces, one shall be used for three sides of the box, another one for cover and two pieces shall be used for balance two sides of the box.

2.2.11 Junction Boxes in which more than 4 pieces of sheet metal will be used shall not be acceptable.

2.2.12 A small circular plate should be provided with each of the cable gland, so that the gland not in use may be closed properly, so as to avoid entry of rain water in the box.

2.3.0 GENERAL REQUIREMENT -

2.3.1 **Requirement of 128 Ways, 64 Ways and 36 Ways Junction boxes shall be as per price schedule enclosed with each package.**

2.3.2 Number of ways required for different types of Junction (Marshalling) boxes and the inside clear dimensions in these boxes shall be as follows:-

S.No	Particulars	Width (mm)	Depth (mm)	Height (mm)
1	128 ways (64 terminal blocks)	700	300	800
2	64 ways (32 terminal blocks)	700	300	800
2	36 ways (18 terminal blocks)	410	100	340

2.3.3 Terminal blocks shall be mounted in 2 rows of 64ways for 128 ways box, 2 rows of 32 ways for 64 way box and 1 row of 36 ways for 36 way box. The box shall, however, have a provision for one additional row of terminal blocks to be added in future. The row of terminal blocks shall be on Cadmium passivated slotted steel channels of 14 SWG size and each row shall have provision for addition of 5 to 10 terminal blocks, if required.

2.3.4 CABLE ENTRY AND GLANDS -

In all the Junction (Marshalling) box cable entry shall be from bottom and cable gland fixing plate shall be removable type. The 128 Ways Junction boxes shall have 20 Nos. brass, cable glands, suitable for 4 core, 10 sq.mm. PVC insulated armoured cables and 64 ways Junction (Marshalling) box shall have total 16 nos. brass cable glands out of which 8 nos. brass cable glands suitable for 4 core, 4 sq.mm.PVC insulated unarmoured cables and 8 Nos. glands for 8 core, 4 sq. mm. PVC insulated unarmoured cable. The 36 ways box shall have 9 No. brass cable glands suitable for 4 core , 2.5 sq.mm. PVC insulated unarmoured cables. Brass cables glands shall be of double compression type and preferably of COMET make.

2.4 SUBMISSION OF DESIGN DETAILS -

2.4.1 Requirements for participating in this Bid are as under:-

- a. Bidder must have established manufacturing facility in his factory to manufacture the materials as specified in this Bid. The Bidder shall clearly state his experience and capability to undertake the manufacture of these items. The minimum acceptable experience is five years as per Section – I qualifying requirement.
- b. Details of such manufacture specified above and supply including type, quantity, date of order, date of commencement and completion of supplies, name of purchaser shall be furnished with the Bid alongwith his full address.
- c. Bidder should have adequate testing facilities to test the product offered in his factory to the satisfaction of the purchaser. The Bid shall include complete details of testing facilities available in manufacturer's works.

3.0 PRE-TREATMENT AND PAINTING PROCESS -

Sheet steel fabricated members for Junction Boxes shall be subjected to pretreatment process before painting. The process shall be carried out as under. The process can broadly be divided as 'Metal treatment and painting'.

3.1 METAL TREATMENT -

- i. Degreasing: This can be achieved either by immersing in hot alkaline degreasing bath or in hot dry chlorothelence solution. In case degreasing is done by alkaline bath rinse with cold water thoroughly.
- ii. Pickling: This is to remove rust and metal scales. Immersing in diluted sulphuric acid (approximately 20%) at nearly 60 deg. Centigrade. Unit scale and rust are totally removed.
- iii. Rinse it in cold water twice to remove traces of acids.
- iv. Treat with phosphoric acid base neutraliser for removal of chlorine from the above acid pickling and again wash with running water.
- v. Phosphating : Immerse in grenodine `zinc phosphate solution for about 20 minutes at 80 to 90 deg. centigrade. The uniform phosphate coating of 4 to 5 gms per sq.meter shall be achieved.
- vi. Swill in cold water.

- vii. Rinse in Deorylyte bath at 70 to 80 deg. centigrade to neutralise any traces of salts.
- viii. Seal the above phosphate coating with hot/dilute chromoto solution.
- ix. Dry with compressed air.

3.2 PAINING -

- i. Primer : spray one coat wet on wet specially developed 'High lusture' zinc chromote primer and stove at 150 deg. centigrade to 160 deg. centigrade for 25 to 30 minutes. Alternatively red-oxide primer with zinc chromate contents may be used. However, former process is preferred.
- ii. Rubbing and puttying : Apply putty to fill up the scars if any to present smooth surface and stove 15 to 20 minutes. Apply putty several times to get the perfectly smooth finish.
- iii. Surfacing: Sand down with mechanical abrasive and stove for 20 minutes.
- iv. Primer: Spray second coat of primer as per (i) above or grey primer surface wet on wet and stove for 20 to 40 minutes at 150 deg. centigrade.
- v. Finish paint: Rubbing down dry and spray first coat of synthetic enamel finish paint wet on wet and stove for 30 minutes.
- vi. Surfacing: Sand down or rub dry to prepare for final finish spray. Final finish shall be obtained after spraying 2 Coats of synthetic enamel finish paint wet on wet and stove it at 150 deg. centigrade for 30 minutes.
- vii. Colour of finishing paint for Junction Boxes shall be light grey shade as per 631 of ISS. On the interior surface, the finishing coat shall be of glossy white colour.

NOTE -

- i. Necessary stiffners may be welded between large cut outs to provide rigidity before painting process.
- ii. Painting process shall be done within 24 hours of completion of treatment.
- iii. Small coating paint shall be supplied alongwith equipment for touching up at site.

4.0 DATA AND DRAWINGS -

Bidders shall furnish one set of following drawings and data alongwith the Bid for preliminary study:-

- i. Complete assembly drawings of the Junction boxes showing plan, elevation and typical sectional views and locations of terminal blocks for external wiring connections.
- ii. Foundation plan showing location of channels sills, anchor bolts etc.
- iii. General arrangement drawing of each rating Junction box showing the terminal connectivity mounted.

- iv. Outline drawings of cable pot heads showing dimensions and rating.
- v. Itemised bill of material listing all devices mounted or otherwise furnished indicating manufacturers type.

Please note that above mentioned drawing/literature etc., shall be accompanied alongwith the offer, otherwise the offer may be treated as non responsive.

5.0 PACKING AND TRANSPORT -

5.1 All equipments/material shall be protected for transport carriage at site and outdoor storage during transit.

5.2 Supplier shall be responsible for any damage to the equipment during transit due to improper and inadequate packing.

5.3 Only packages constructed out of wooden material and of dimensions proportional to the size and weight of contents shall be used.

5.4 Bundled materials shall be rigidly steel strapped over the protective covering such as gunny bags.

5.5 Fragile materials shall be securely braced within the container or otherwise amply fastened and packed to prevent shifting of ratting soft non-hygroscopic packing materials shall be placed between the hard packing materials and the fragile equipment.

5.6 Loose material e.g. Bolts, nuts etc., shall be packed in gunny bags and sealed in polythene bags with proper tagging.

5.7 All opening in the equipment shall be tightly covered, plugged or capped to prevent foreign material from entering.

5.8 Proper arrangements for attaching slings for lifting shall be provided.

5.9 Each package shall be clearly, legibly and durably marked on both sides as follows:-

- a. Name & designation of the consignee (to be furnished by the purchaser.)
- b. Ultimate destination (as required by the purchaser)
- c. The items and respective quantities contained in the package to be furnished by the purchaser.)
- b. Ultimate destination (as required by the purchaser)
- c. The items and respective quantities contained in the package.
- d. The net & gross weight of the materials
- e. Gross weight of each package

5.10 Successful Bidder shall furnish detailed dimensioned drawings for purchaser's approval.

6.0 INSPECTION –

- (i) The purchaser shall have access at all times to the works and all other places of manufacture, where the Materials are being manufactured and the Bidder shall provide all facilities for unrestricted inspection of Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed in the Bid document.
- (ii) The successful Bidder shall keep the purchaser informed in advance of the time of starting and of the progress of manufacture of Materials in its various stages, so that arrangement could be made for inspection.
- (iii) No material shall be dispatched from the point of manufacture unless the material has been satisfactorily inspected and tested.
- (iv) The acceptance of any quantity of the material shall in no way relieve the successful Bidder of this responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipment are later found to be defective.

7.0 QUALITY ASSURANCE PLAN -

7.1 The Bidders must establish that they are following a proper quality assurance programme for manufacture of Materials. The Bidder shall invariably furnish following information along with their bid. Information shall be separately given for each type of cable:

- (i) Statement giving list of important raw materials, names of sub-suppliers for the raw material, list of standards according to which the raw material is purchased and copies of test certificates thereof.
- (ii) Information and copies of test certificates as in (i) above in respect of bought out items.
- (iii) List of manufacturing facilities available.
- (iv) Levels 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) List of testing equipment available with the Bidder for final testing of material specified and test plant limitation, if any, vis-à-vis type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

7.2 The successful Bidder 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 Bid.
- (ii) Type test certificates of the raw material and bought out accessories.

- (iii) Quality Assurance Plan (QAP) with hold-up points for purchaser's inspection. The quality assurance plans and hold-up points shall be discussed between the Purchaser and supplier before the QAP is finalized.

8.0 SCHEDULE -

The Schedules, questionnaire and annexure attached with this specification are the integral part of the specification and shall be submitted duly filled in by the Bidders alongwith the offer. The bill of material for each equipment shall be submitted by the Bidders separately. The makes of the equipment shall be clearly indicated. A general mention that the components shall be of reputed make will not be acceptable.

9.0 DISCREPANCY IN TECHNICAL PARTICULARS -

It has been noticed that some of the information furnished in the schedule of technical particulars, technical questionnaire and price schedule do not match with each other. In order to avoid any discrepancy, it may be noted that for the purpose of price evaluation the details brought out by the Bidders in "Schedule-III' Technical Questionnaire" will be treated as final and evaluation will be done based on the information which will be given in this Schedule -III. In case of any discrepancy in regard to information given in any other table, responsibility will rest on the Bidder. While this condition shall be applicable for the purpose of price evaluation, at the time of acceptance of bid, the Purchaser will have the right to take such of the values which are advantageous to the Purchaser

10.0 COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS -

10.1 The Bid shall be complete in all respects and shall include all minor accessories, small wiring etc., not specifically mentioned in the Schedule, specifications etc; but essential for the completeness of the system. The Bidders shall not be eligible for extra charges in respect of such minor accessories, small wiring etc., though not included specifically in this specification but requires for satisfactory operation of equipment offered.

10.2 The Bidders must furnish the following information along with technical bid.

10.2.1 Complete details of all the accessories which will be supplied with Junction Box should be furnished.

10.2.2 It is obligatory on the part of Bidders to ensure that supply of all accessories along with Main equipment are simultaneously delivered to avoid any holdup in erection and commissioning. The responsibility for obtaining timely supplies of bought out items will rest on the Bidders and only on this basis, delivery period will be offered in the Bid.

10.2.3 It may be noted that in case of damages/shortages due to improper packing or any other negligence, replenishment shall be arranged within one month time. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and also in case defective supply of any item is reported, will rest on the Bidders.

SCHEDULE-I (A)
DESCRIPTION OF EQUIPMENT FOR
SCHEDULE FOR RATES AND PRICES TO BE FURNISHED
IN VOLUME-VI

S.No.	Particulars of equipment/ Item	Qty.
1	Supply of 128 ways (64 terminal blocks) Junction Boxes meeting all Technical requirements as prescribed in Bid document.	As per Price Schedule
2	64 ways (32 terminal block) Junction Boxes meeting all Technical requirements as prescribed in Bid document.	
3	36 ways (18 terminal block) Junction Boxes meeting all Technical requirements as prescribed in Bid document.	

NOTE: 1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.

2. The quantity of above equipments has been mentioned in Vol. VI

SECTION-II

2.3.4 TECHNICAL SPECIFICATION FOR LIGHTING EQUIPMENTS

1.0 SCOPE:

1.1 The scope of this specification covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the MPPTCL.”

In case bidder is not OEM, sole responsibility of offering equipments/material of manufacturer as per this specification requirement shall rest on the bidder.

1.2 SYSTEM REQUIRMENTS WHICH ARE TO BE CONSIDERED FOR DESIGN OF LIGHTING EQUIPMENTS

NOTE : In this part of specification we have brought out details of climatic conditions and system requirements which have to be taken into account for the purpose of design of Lighting Equipments. Also in this section various standards have been detailed out which are to be followed and confirmed by the bidders for selecting various components in designing the equipment:

1.2.1 CLIMATIC CONDITIONS:

Climatic conditions at site under which the equipments shall be guaranteed to operate satisfactorily are as under:-

S. No.	Particulars	Conditions
i	Location	Indoor
ii	Maximum ambient air temp	50 ⁰ Centigrade
iii	Minimum ambient air temp	1 ⁰ Centigrade
iv	Average daily ambient temp	35 ⁰ centigrade
v	Maximum Relative humidity	95% (sometime approaches saturation)
vi	Maximum altitude above mean sea level	1000 (Meters)
vii	Average Annual rainfall	1250 (mm)
viii	Maximum wind pressure	150 Kg/m ²
ix	Isoceraunic level	90 days per year
x	Seismic level (Horizontal acceleration)	0.3
Moderately hot and humid tropical climate, conducive to rust and fungus growth.		

1.2.2 STANDARDS:

Offered Lighting Equipments shall be manufactured tested and supplied with all guaranteed technical particulars generally confirming to meet the requirement of the latest revisions of relevant standards of international Electro-technical commission

or equivalent national standards of India with latest amendments of relevant standards, rules and codes. Unless otherwise specified, the equipment shall conform to the latest applicable Indian, IEC, British or any other authoritative standards, and in particular to the following standards:

IS No.	Particulars
IS:1913	General and safety requirements for electric lightning fittings
IS:3287-1965	Industrial Lighting fitting with plastic reflectors
IS:1777-1978	Industrial Luminaries with metal reflectors
IS:9974-1981 (Part-I & II)	High Vacuum Sodium Vapour Lamp
IS:8019	Vitreous enamelled reflectors for use with illuminating device.
IS:10322-1987 (Part-I to V)	Luminaries
IS:3528	Water Proof electric lightning fitting
IS:4013	Dust proof electric lightning fitting
IS:3480	For flexible conduits
IS:1653	Steel conduit
IS:2147	Degree of protection for Switchgear and control gear
IS:1034-1990	Electric Ballast
IS:6616-1982	Ballast for Lamps

Bidders shall clearly state the standards to which the equipment offered by him conforms. In the event of offering of equipment conforming to standards other than IS, the salient points of comparison between standards adopted and the relevant IS shall be indicated in the proposal alongwith copies of adopted standards. It will be sole responsibility of the bidder to prove that the salient features of offered equipment are equivalent or better than standards specified above.

1.3 SYSTEM DETAILS

Frequency	50 Hz
No. of phases	3
Earthing	Effectively earthed
AC SUPPLY SYSTEM	
Nominal supply voltage	240 Volts, single phase 415 Volts, 3 Phase, 4 wire, Neutral grounded system
Nominal frequency	50 Hz
Variation in supply voltage	± 10%
Combined Voltage and frequency variation	± 15%
Variation in frequency	± 5%

1.4 FLOOD LIGHTING LUMINARIES

Luminaire shall comprise of die-cast aluminium alloy housing with low copper content, high degree of corrosion resistance. The housing should be provided with

cooling fins for effective heat dissipation. The optical system (reflector) should be made from high purity aluminium electro chemically brightened and anodized. The front closing of housing should be by a heat resistant toughened glass and a profile gasket. For rigidity to glass four clamps shall be provided. For aiming light in the proper direction, a graduation disc should be provided.

Rear cover made of cast aluminium alloy and also provided with cooling fins shall be fixed to main housing by two knurled headed loss proof stainless steel screw. The alignment of rear cover shall be achieved by two guide fins. The material & finish of various items shall be as follows :-

Housing	Gravity Die cast aluminium, LM Aluminium, Hammer tone Grey
Front clamps	Stainless steel
Mounting bracket	MS Hot dip galvanized
Reflector	High purity aluminium electro-chemically brightened and anodised
Gasket	Ethylene propylene
Electrical & mechanical data	Suitable for use with single 250 Watts High Pressure Sodium Vapour (HPSV) lamp/ High Pressure Metal Halid (HPMH)
Lamp Voltage	220/240 Volts Nominal p.f. 0.9

1.5 HIGH PRESSURE SODIUM VAPOUR LAMPS

HPSV Lamp of 250 Watts shall be polycrystalline, translucent, aluminium oxide discharge tube. The inside of tubular clear lamp avoid shell shall be coated with a film of uniform layer of diffusing powder (which shall be applied electro statically).

Discharge tube shall contain an amalgam of mercury sodium along with xenon gas as starter. The outer shell shall be evacuated. The accessories for optimum performance needed are ballast, an electronic igniter and a capacitor. The lamp shall have diameter 47mm, base E40. The 250 Watts lamp shall have nominal lamp current of 3.0 Amps. The 100 hours luminous flux shall be 27,000 Lumens for 250 Watts lamps. The lumen maintenance at the end of 12000 Hours shall be above 78%.

1.6.0 GENERAL REQUIREMENT OF OUTDOOR TYPE FLOOD LIGHTING LUMINARIES

1.6.1 Equipments in all respect shall incorporate highest quality of modern engineering and workmanship. Collaboration arrangements with reputed supplier, if any, may be clearly stated.

1.6.2 Materials offered shall be complete with all components and accessories, which are necessary or usual for their satisfactory performance and efficient maintenance. Such parts or accessories shall be deemed to be within the scope of the specification.

1.6.3 Design, manufacturing process and individual control of all the fixtures shall be such as to give maximum factor of safety with minimum weight in respect of maximum working load, highest mobility, complete elimination of sharp edges and corners, best resistance to corrosion and good finishing, and suitable for outdoor execution, in respect of switchyard fixtures.

1.6.4 All castings shall be free from shrinkages, blow holes, cracks and other defects and quality of the product shall be uniform throughout.

1.6.5 All AC outdoor lighting fixtures shall be suitable for operation on single phase 2 Wire AC supply specified under clause 5.3.

1.6.6 Fixtures shall be designed to have low temperature rise, and suitable heat radiation devices. The protective glass wind shields shall be fixed at proper distance to avoid localised intensive heat and also cracking due to extreme temperature differential inside and out side the fixtures.

1.6.7 Lighting fixtures shall be designed for minimum glare. Finishing of fixtures shall be such that no bright spots are produced either by direct light sources or by reflection.

1.6.8 All fixtures shall be complete with accessories like Ballast, power factor improvement capacitors etc. It is desired to mount these fixtures on the sub-station structures only and accessories listed above should be part of fitting assembly. If, however, the accessories can not be accommodated inside, then a separate metal enclosed water proof box shall be included in the scope to accommodate these accessories along with a fuse and a set of terminal blocks suitable for loop-in and loop-out connections. The fixtures shall be provided with weather proof and vermin proof boxes.

1.6.9 Each fixture shall have a terminal block suitable for loop-in, loop-out and T-off connection by cable, type and size of which shall be as specified. Internal wiring should be completed by manufacturer by means of stranded copper wire of adequate size and terminated on the terminal block.

1.6.10 Each lighting fixtures shall be provided with an earthing terminal suitable for connection to purchaser's earthing conductor (SGW-12).

1.6.11 All metal or metal enclosed parts of the housing shall be bonded and connected to the earthing terminal so as to ensure satisfactory earthing continuity through out the fixtures.

1.6.12 Mounting facility and conduit knock-outs for the fixtures shall be specified.

1.6.13 On completion of the manufacture, all surface of the fixtures shall be thoroughly cleaned and degreased. The fixtures shall be free from scales, rust, sharp edges, and burrs.

1.6.14 Where enamel finish is specified, it shall have a minimum thickness of 2 mills for outside surface and 1.5 mills for inside surface. The finish shall be highly polished, nonporous and free from blemishes, blisters and fading.

1.6.15 Housing shall be stove-enamelled or anodised aluminium or epoxy coated aluminium.

1.6.16 Surface shall be scratch resistant and shall show no signs of cracking or flaking when bent through 90°C over ½" dia mandrel.

1.6.17 All lightning reflecting surfaces shall have optimum light reflecting coefficient, so as to ensure the overall light output as specified by the manufacturer.

1.7.0 ACCESSORIES FOR LIGHTING LUMINARIES

1.7.1 REFLECTORS

Reflectors shall be manufactured from sheet steel or aluminium of not less than 20 SWG thickness. They shall be readily removable from the housing for cleaning and maintenance without disturbing the lamps and without use of tools. They shall be securely fixed to the housing by means of positive fastening device of captive type.

1.7.2 BALLASTS

Ballasts shall be designed, manufactured and supplied in accordance with the relevant standard and function satisfactorily under site conditions specified in this specification. The ballasts shall be designed to have a long service life and low power loss. Ballasts shall be mounted using self locking, antivibration fixings and shall have ease of removal without dismantling the fixtures. They shall be totally enclosed units. The ballasts shall be of the inductive, heavy duty type filled with thermosettings, insulating, moisture repellent, polyester compound filled under pressure or vacuum. Ballasts shall be provided with 2 tappings to set the voltage within the range of 220 or 240 volts. End connections and taps shall be brought out into a suitable terminal block, rigidly fixed to the ballast enclosure. The ballast wiring shall be of copper wire. They shall be free from hum and vibration. Ballasts, which produce humming, shall be replaced free of cost by the supplier.

1.7.3 CAPACITORS

- i. Capacitors shall have a constant value of capacitance and shall be connected across the supply of individual lamp circuits.
- ii. Capacitors shall be suitable for operation at supply voltage as specified and shall have a value of capacitance so as to correct the power factor of its corresponding lamp circuit to the extent of 0.98 lag.
- iii. Capacitors shall be hermetically sealed preferable in a metal enclosure to prevent seepage of impregnant and ingress of moisture.

1.7.4 FUSES AND FUSE HOLDERS (FOR FLOOD LIGHT FIXTURES)

Fuse shall be housed in non-hygroscopic insulated housing of totally enclosed dead front type provided with a pull out type fuse carrier. The fuse holder shall be mounted within the fixture housing, remote from other control gear as ballast etc. and accessible from the outside of the fixtures. It shall be possible to replace the fuse without disturbing the reflector or lamp and without demounting the fixture. The fuse shall be non-deteriorating, high conductivity, high rupturing capacity type and suitable for operation on a supply voltage as specified.

1.8 DISCREPANCY IN TECHNICAL PARTICULARS

It has been noticed that some of the information furnished in the schedule of technical particulars, technical questionnaire and price schedule do not match with each other. In order to avoid any discrepancy, it may be noted that for the purpose of price evaluation the details brought out by the Bidders in "Schedule-III: Technical Questionnaire" will be treated as final and evaluation will be done based on the information which will be given in this Schedule –III. In case of any discrepancy in regard to information given in any other table, responsibility will rest on the Bidders.

While this condition shall be applicable for the purpose of price evaluation, at the time of acceptance of bid, the Purchaser will have the right to take such of the values which are advantageous to the Purchaser.

1.9. DRAWING AND LITERATURES

Bidders shall furnish relevant descriptive and illustrative literature on lighting fixtures and accessories and following drawings/data for the respective lighting fixtures :-

- 1.9.2 Six sets of dimensional drawing
- 1.9.3 Mounting details, cable entry facility and weights.
- 1.9.4 Light distribution diagrams (Zonal and iso candela).
- 1.9.5 Lamp output vs. temperature curve.

Six sets of complete final drawings, instructions manuals and test report of each type of luminaries shall be furnished by the successful bidder one month prior to the commencement of actual supply of equipments.

1.10 QUALITY ASSURANCE PLAN

Bidders shall invariably furnish following information along with his offer, failing which his bid may be treated as non responsive. Information shall be separately given for individual type of equipment offered.

- i) Statement giving list of important raw materials, names of sub supplies 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 accessories.
- iii) List of manufacturing facilities available.
- iv) Level of automation achieved and list of areas where manual process 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 available with the bidder for final testing of equipment specified and test plant limitation. If any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviation from specified test requirements.

1.11 TEST AND TEST REPORTS

1.11.1 Type tests, acceptance test and routine test for the lighting fixtures and accessories covered by this specification shall be carried out as per the relevant Indian Standards/British Standards for the respective fixtures and their accessories.

1.11.2 Manufacturer's type and routine test certificates shall be submitted for tests conducted as per relevant IS for the fixtures and accessories.

1.12 INSPECTION

Equipment shall be subject to inspection by a duly authorised representative of purchaser. Inspection may be made at any stage of manufacture at the option of purchaser. The equipment if found unsatisfactory in regard to material or workmanship is liable for rejection. Bidder shall grant free access to the places of manufacture to purchaser's representative at all reasonable times when the work is in progress. Inspection by the purchaser or his representative shall not relieve the bidder of his obligation of furnishing materials in accordance with the specification.

1.13 SAMPLES

Bidders shall supply, without extra cost, one sample of each of the following items as per the deadline specified in under clause no.52.0 of Section-I;

- (i) Flood lighting luminaries complete with fixture & high pressure sodium vapour lamp of 250 watts.

Each sample shall necessarily be engraved with manufacturer's identification mark and type designation of the item. The purchaser shall be at liberty to subject these samples to any tests which he may deem fit. The purchaser shall not be responsible for any damage, which may occur to these free samples during such testing. The samples shall not be returned to the Bidder.

All Bidders shall meet this requirement of submission of samples of specified items, irrespective of whether they had earlier supplied these items to the purchaser in the past or not.

1.14 COMPONENTS OF EQUIPMENTS

Each equipment should be complete and include all minor accessories and fixing devices etc. though not specifically mentioned in this specification but which is essential for the mounting and use of equipments.

1.15 MARKING

Equipment shall be legibly and identibly marked with trade mark or name of manufacture, country of manufacture and month and year of manufacture and certification mark. All labels to be used on wooden boxes are tin tags, containing the fitting shall be tin securely bond with the wire and shall have the descriptive marking stamped thereon.

1.16 PACKING

All accessories shall be supplied in strong wooden boxes crates of approved design with steel loop and strap bands for strength and durability withstand rough handling during transportation handling and also during storage. The gross weight of packing shall not normally exceed 50 Kgs. Different fittings shall be packed in different cases and shall be complete with their minor accessories fitted in place. All fragile, fixtures of glass, Perspex or other items shall be properly and securely packed to prevent, oscillation in transit, or even two units striking each other. All nuts shall be hand

tightened over the bolts upto farthest point. All packages shall be marked on the side as follows:-

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

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

Bidder shall ensure that the packing list and bill of material are approved by the purchaser before despatch.

1.17. All schedules, and questionnaire attached with the specification are integral part of the bid specification and shall be submitted duly filled-in by the bidders along with the bid. In the absence of any of the schedules, the bid may be treated as non-responsive.

2.0 Please ensure that bid document containing number of pages have been properly numbered and signed by the bidder. Bid document including all schedules and Annexures should be indexed properly and Index of the document should be enclosed / placed at the beginning of the bid document.

SCHEDULE-I (A)**DESCRIPTION OF EQUIPMENT FOR RATES AND PRICES TO BE
FURNISHED IN VOLUME VI**

S.No.	Particulars of equipment/ Item	Qty.
1	250 Watt HPSV Flood lighting luminaries complete with lamp and fixture	As per Price Schedule

NOTE: 1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.

2. The quantity of above equipments has been mentioned in Volume VI.

SIGNATURE OF BIDDER

SECTION-II

2.3.5 TECHNICAL SPECIFICATION FOR TUBULAR POLES, LIGHTING PANELS AND LIGHTING FIXTURES AND GI PIPE

(A) TUBULAR POLES

- a) The contractor shall supply the steel tubular lighting poles required for street lighting conforming to the enclosed drawing.
- b) Tubular poles shall be supplied with junction boxes. Junction boxes should be mounted one meter above ground level.
- c) The tubular poles shall be coated with bituminous perseverating paint on the inside as well as on the embedded outside surface. Exposed outside surface shall be coated with two coats of metal primer (comprising of red oxide and zinc chromate in a synthetic medium) and two coats of Aluminium paint of standard make like Asian/Nerolac/ Berger/Dulex etc.
- d) The galvanized sheet steel junction box for the tubular poles shall be completely weather proof conforming to IP-55 and provided with a lockable door and HRC fuse mounted on a fuse carrier and fuse base assembly. Its terminals shall be stud type and suitable for 2 nos. 2.5 sq.mm cable.

(B) LIGHTING PANELS

Out door type AC lighting panel with 415V, 63A, 3 phase 4 wire bus and one no. 63A, TPN, MCB with neutral unit as in-comer and 3 nos. 32A Triple pole MCB with neutral for out going. The panel shall be made of sheet steel, phosphate powder painted, MCB, Distribution Board with bus bar, neutral link earth bar Din Rail and Blanking plates of standard make like (HAVELLS).

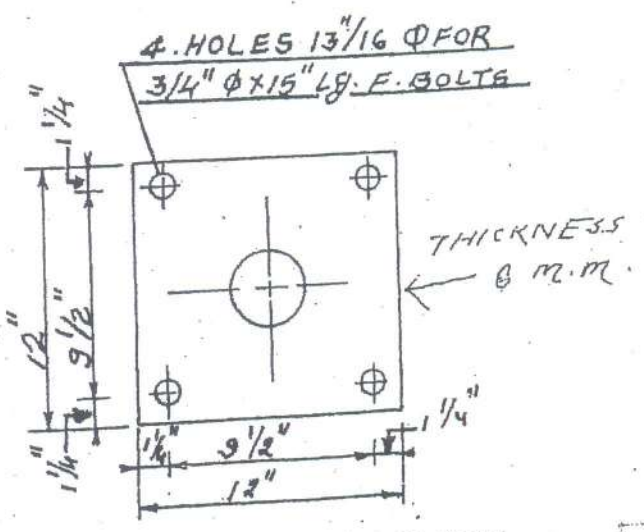
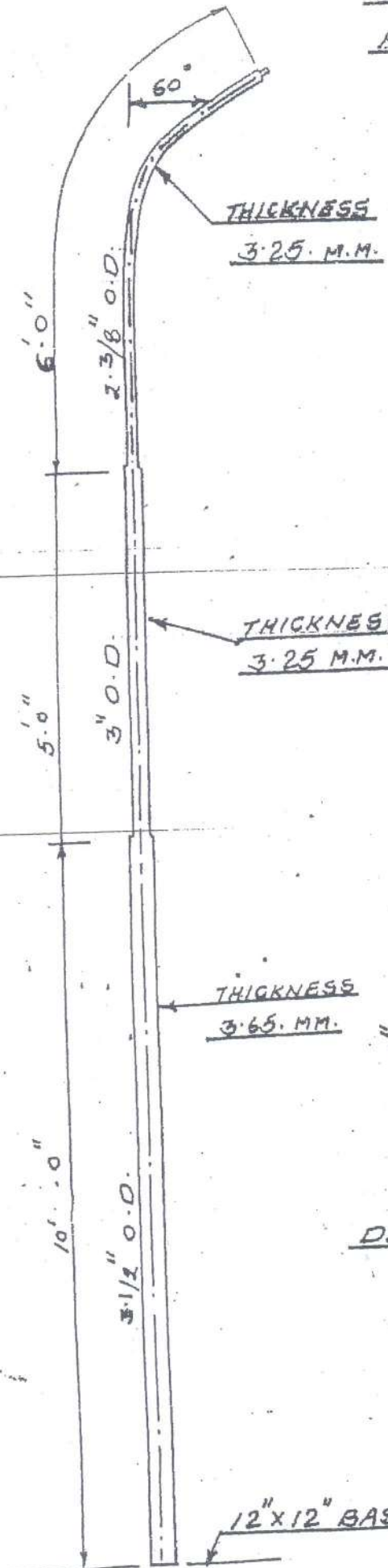
(C) LIGHTING FIXTURES

1x36 W CFL yard lighting luminaries fitting complete with lamp of standard make like Philips/ CGL/Bajaj suitable for mounting on tubular poles complete in all respect.

(D) GI PIPE

GI Mild steel pipe conforming IS-1239 are latest embossed at both the ends without socket. The length of pipe should be 6 meters with ISI Mark, It should be of Class "C" with test certificate and guarantee certificate. The wall thickness should be 4mm, bore dia 40mm weight 4.37 Kg/Mtr. length

DRG. OF TUBLER POLE FOR PERIPHERAL LIGHTING IN.
EHV S/S



12" x 12" BASE PLATE.

SECTION – II

2.4.1 TECHNICAL SPECIFICATIONS FOR 400 KV, 220 KV, 132 KV AND 33 KV SUBSTATION SWITCHYARD STRUCTURES

1.0 SCOPE -

This scope of this specification covers design, manufacturing supply of 400 KV, 220 KV, 132 KV and 33 KV Substation Switchyard Structures as per Section-I, Volume-II. The bidder mentioned in the Section of Technical specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment / material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS -

Applicable standards for offered equipment / material shall be as per Section-I, Volume-II.

3.0 CLIMATIC CONDITIONS –

Applicable climatic conditions shall be as per Section-I, Volume-II.

4.0 SYSTEM PARTICULARS -

Applicable system particulars shall be as per Section-I, Volume-II.

5.0 BREAK-UP OF OFFERED PRICES -

The Bidders may please note the following:

- (i) While exact weight of different type of Structures required under Bid Specification have been furnished for the purpose of offering prices by the Bidders, a situation may arise wherein due to approved design of prototype structure, minor variation in weight of structure as compared with unit weight specified in bid document may take place. Under such circumstances, the payment will be made to the supplier based on BOM Weights as per approved design or Unit Weight as specified in Bid Document which ever happens to be less. Further, the structures shall be supplied as per approved drawings/Bill of Material and the payment will be restricted to the extent mentioned above.
- (ii) In view of above, while the average rates on per Structure basis only will have to be offered by the bidders as mentioned under clause 4.0, in Schedule-I the bidders may furnish break-up of offered prices of each type of Structures into following elements:
 - (a) Price of fabricated, galvanized steel sections per Metric Tonne.
 - (b) Price of galvanized foundation bolts alongwith accessories per structure as specified in Annexure-I, II & III.
 - (c) Price of galvanized nuts, bolts, washers and other accessories per structure as specified in Annexure-I, II & III.

6.0 DRAWING AND DESIGN -

The successful bidder will be required to supply Structures as per the details furnished by the MPPTCL. In order to facilitate, preparation of shop drawings and taking up the fabrication work, the detailed drawings of each type of Structure and all other relevant details will be made available by the MPPTCL alongwith the contract. However, sample drawings for reference purpose are available with this specification (Appendix-I, II & III). By and large, steel sections like; Channels, Angles, Flats, Plates and RS Joists would be required for fabrication of various Structures covered in this specification. Tubular type Structures will not be required.

7.0 SHOP DRAWINGS -

The successful bidder shall prepare shop drawings for fabrication of Structures and 4 sets of Structural drawings of each type of Structure shall be made available to the MPPTCL for its record. Soft copy of the drawings developed in Auto CAD are also required to be furnished immediately after approval of drawings of all the structures for which orders are placed.

8.0 PROTOTYPE OF STRUCTURES -

- i. Prototype of each of the lattice / non lattice type Structure covered in Bid Specification shall be offered by the successful bidder for inspection within 60 days from the date of issue of the detailed order. Failure to offer the proto-type for inspection within the period specified could be construed as unsatisfactory performance under the contract and in such an eventuality, the performance security may be forfeited without giving any notice.
- ii. Notwithstanding anything covered in the drawings and other details furnished by the MPPTCL, the supplier may make minor modification (if any) in length and size of Structure member, quantity and size of nuts, bolts, washers etc, which could be considered essential for ensuring completeness and satisfactory operation of Structures.

9.0 INTERCHANGEABILITY OF STRUCTURES-

In Structures, any change in design of any structure / change in quantity is felt necessary the same will be intimated to the successful bidders/ firms one month prior to contractual delivery of the respective structure.

10.0 MATERIAL -

The Structures shall be of structural steel quality conforming to latest version of IS: 2062. Structural steel sections manufactured according to latest IS: 808 shall be taken into consideration for fabrication of Structures. Tested steel sections having its yield strength not less than 2550 kg/sq cm shall be used.

11.0 PROCUREMENT OF STEEL BY THE BIDDER -

The following provisions shall apply in connection with the procurement of steel by the bidder:

- (i) The steel used for the fabrication of Structures shall be mild-steel of tested quality as per latest version of IS: 2062 Gr.-A quality.
- (ii) The steel shall generally be procured from the main Steel Producers. However, in case of sections not rolled/ available from the main procedures, the same

could be procured from re-rollers as per quality conforming to relevant IS, provided:

- (a) Re-rolling of structural steel sections is done from billets/ingots of tested quality only.
- (b) Re-rolled sections are duly tested as per relevant IS. It may, however, be noted that additional cost, if any, on account of procurement of steel sections from re-rollers shall not be payable.
- (iii) The bidders should take into account the fabrication wastage while offering the prices. The MPPTCL shall not accept any liability in connection with the actual wastage of steel during fabrication or otherwise and no additional cost will be allowed on this account.
- (iv) Substitutions, if any, of steel sections of the Structure parts by higher size, due to their non-availability or otherwise shall be to the supplier's account. The MPPTCL shall not accept any liability on this account.

12.0 FABRICATION WORKMANSHIP -

- (i) Except where hereinafter modified, details of fabrication shall conform to latest version of IS:802.
- (ii) The fabrication shall be done strictly in accordance with the drawings made available by the MPPTCL.
- (iii) The Structures shall be accurately fabricated to bolt together easily at site without any undue strain on the bolts.
- (iv) The diameter of the hole shall be equal to the diameter of the bolt plus 1.5 mm.
- (v) Necessary drain holes shall be provided at all points of the Structures where pockets of depressions are likely to hold water.
- (vi) All similar parts shall be made strictly interchangeable. All steel sections before any work is done on them, shall be carefully leveled, straightened and made true to detailed drawings by methods which should ensure that gradual configuration of steel is not distorted. Further, while assembly the adjacent matching surfaces should be in close contact throughout. No rough edges shall be permitted in the entire Structures. Hammering is not permitted for straightening.
- (vii) Cutting may be done by shearing, cropping, flame cutting or sawing. The surface so cut shall be cleaned smooth, reasonably square and free from deformation and distortion.

13.0 DRILLING AND PUNCHING -

- (i) The holes in the member shall either be drilled or punched with a jig, the former process will be preferred.
- (ii) Punching may be adopted for providing holes in steel sections up to 12 mm thickness. For thicker sections, drilling shall be done.
- (iii) The holes shall be punched/drilled after bending and relative position of these holes shall be maintained with the use of proper templates/jigs and fixtures.

- (iv) The holes shall be perfectly circular and no tolerance in this respect is permissible. The holes shall be perpendicular to the Steel sections.
- (v) All burrs left by drills or punch shall be removed completely. When the Structure members are in position, the holes shall be truly opposite to each other. Drilling or ramming to enlarge defective holes shall not be permitted.
- (vi) The minimum spacing of bolt and edge distance shall be as under:
 - (a) For 16 mm diameter bolt, edge distance of 20 mm from hole centre to rolled or swanked edge and 23 mm from hole centre to sheared or flame cut edge.
 - (b) The gap between the edges of the connected members in butt joint shall not be more than 6 mm and less than 4 mm.
- (vii) The bolt gauge distance in flanges of angle sections shall generally be in accordance with "Hand Book for structural Engineers-Structural Steel Sections Revised."

14.0 GALVANIZING -

- (i) All structural steel shall be galvanized after fabrication. Galvanizing of Steel section conform to latest version of IS: 2629 & IS:4759 All galvanized members shall withstand tests as per IS:2633. For fasteners, the galvanizing shall conform to latest version of IS: 1367.
- (ii) The galvanizing shall be done after all fabrication work is completed, except that the nuts may be tapped or re-run after galvanizing. Threads of bolts and nuts shall have a net fit and shall be such that they can be turned with finger throughout the length of the threads of bolt and they shall be capable of developing full strength of the bolts. Spring washers shall be electro-galvanized as per latest version of IS: 1573.

15.0 GALVANISED BOLTS, NUTS AND WASHERS -

- (i) The bolts (5.6 quality) and nuts (5.0 quality) shall be of HRH mild steel and hot dip galvanized. Spring washers shall be supplied for insertion under all nuts. These washers shall be of steel, electro galvanized, positive lock type and of 3.5 mm thickness. Bolt heads and nuts shall be of hexagonal shape.
- (ii) The nuts shall be forged and tapped after galvanizing and then lubricated. The nuts shall be chamfered on one face only, the other face shall be machined.
- (iii) The bolts shall be manufactured by cold/hot forging process and the threads shall be rolled.
- (iv) The bolts and nuts shall be free from forging and threading defects such as cuts, splits, burrs, bulging, taper, eccentricity, loose fit etc. The bolts shall be threaded upto standard length only as per relevant Indian Standard and not to full length.
- (v) The bolts and nuts shall conform to IS:1967, IS:12427, IS:1363, IS:1367 with latest amendment.
- (vi) The spring washers suitable for diameter of the bolts shall be manufactured out of rectangular section with tolerances as per IS:3063 with latest amendments. The spring washer steel shall conform to IS:4072 with latest amendments. The

spring washers after coiling shall be suitably heat treated so as to result in the finished washer having hardness 43 to 50 HRC when tested in accordance with latest version of IS:1586. Surface of the washers shall be free of scales and burrs. The washers shall be coiled without any kinks (except for the shape with turned-up ends). The ends of the washer shall not abut when the washers are compressed. The ends shall be so served as to prevent tangling.

- (vii) The spring washer shall be electro galvanized with chromate passivation. The electro galvanizing of washers should conform to 'severe' grading service conditions incorporated in IS:1573 with latest amendments. The local thickness of zinc coating should be minimum 25 microns and average thickness 38 microns. It should be further suitably heat-treated to avoid any danger of hydrogen embitterment.
- (viii) Plain/pack washers shall be 4 mm thick and shall be suitable for diameter of respective bolts.

16.0 QUANTITY OF BOLTS, NUTS AND WASHERS -

- (i) Quantity and Size of Nuts and Bolts required alongwith each Structure has been detailed out in the **Annexure-I, II & III** of this bidding document.
- (ii) A set of one bolt and one nut required for assembly of Structure shall have one number spring washer and one number plain washer.
- (iii) Since the structures are of bolted type, every foundation bolt shall have three numbers nuts, one number anchor plate and one number plain washer as indicated in the drawings. The anchor plate shall have a hole at the centre suitable for diameter of the foundation bolt.

17.0 TOLERANCES -

- (i) The maximum allowable difference in the diameter of the hole on the two sides of the plate or angle shall not exceed 0.8 mm.
- (ii) The tolerance cumulative or between consecutive holes shall be within ± 0.5 mm.
- (iii) The tolerance on the overall length of member shall be within ± 1.6 mm.
- (iv) The tolerance on gauge distance shall be within ± 0.5 mm.
- (v) Rolling and weight tolerance of steel sections shall be as per latest version of IS: 1852 and IS: 808.

18.0 MARKING -

Every member of the Structure shall be distinctly given punch mark as per structural drawings. Type of Structure (e.g. AGT, 1GO3 etc.) and supplier's identification mark shall also be punched. The marking shall be done with marking dies of minimum 18 mm size and this mark shall be in "legible English letters".

19.0 PACKING AND MARKING -

- i. The material shall be boxed or bundled for transport preferably in the following manner:

- a. Large members like angles, channels etc., shall be packed in bundles securely wrapped four times around each end and over 900 mm with steel wire of 3.55 mm diameter with ends twisted tightly. As far as practicable, a bundle shall consist of all the large members of one Structure only.
 - b. Small loose pieces shall be nested and bolted together holes wrapped round at least four times with steel wire of 3.55 mm diameter and its ends twisted tightly or packed in wooden crates. Gross weight of each bundle shall not exceed 200 Kgs.
 - c. Bolts, nuts and washers required for Structures shall be packed in heavy gunny bags accurately tagged in accordance with the contents and a number of bags packed in a solid box of 22mm thick lumber with paneled ends to be accurately nailed and further reinforced with 22mm x 75mm buttons round the sides at the ends with 25 mm x 1.26 mm iron band stretched entirely around the buttons with ends overlapping at least 150 mm. Gross weight of each box shall not be exceed approximately 200 Kgs.
 - d. Packing list incorporating all relevant details e.g., quantity of Structures, number and size of steel sections, quantity of nuts, bolts, washers etc., shall be forwarded alongwith each consignment.
 - e. In the nut shell the packing arrangement should be such that all packages of one particular type of Structure are identifiable at site for the purpose of allocation for a particular work. In case more than one Structure of a particular type is delivered in area stores/work site, combined packing arrangement by way of clubbing members of similar type (for more than one Structure) in a combined package should not be done. Unified packing procedure for each Structure should be adopted.
- ii. Each bundle or packing shall be marked in "legible English letters" in the following manner.
 - a. Reference of purchase order.
 - b. The name of the consignee (as per dispatch instructions given by the MPPTCL).
 - c. Ultimate destination (if any) as required by the MPPTCL.
 - d. The relevant marks and number of Structure members or reference or bolts, nuts and small components for easy identification.
 - e. Supplier's identification:

The marking shall be stenciled and indelibly inked on the top members in the bundles, on wooden boxes and also on gunny bags containing smaller components.

20.0 GENERAL GUIDE-LINES FOR INSPECTION -

i. FOR FABRICATED STRUCTURE MEMBERS -

- a. Visual examination and quantity verification of offered lot.
- b. Sample selection from the offered lot at a ratio of 50 MT (or part thereof) 1 no. each for all tests.
- c. Dimension, fabrication and trueness verification of Structure members from shop drawing.
- d. Galvanizing test of each sample i.e., dip test, hammer test and mass of Zinc test.
- e. Random verification Zinc coating over galvanized surface by Alko meter.
- f. Tensile test and bend test of each sample.
- g. Chemical composition test of at least two samples per offered lot.
- h. Verification of manufacturer's test certificate for mild steel used in Structure members.

ii. FOR BOLTS, NUTS AND WASHERS -

- a. Visual examination and quantity verification of offered lot.
- b. Sample selection from the offered lot as per relevant IS for each items.
- c. Dimension, fabrication and trueness verification.
- d. Galvanizing test of each sample.
- e. Other acceptance tests for respective items as per relevant IS.

21.0 INSPECTION AND TEST CERTIFICATES -

- (i) All Structures to be supplied will be subject to inspection and approval by the MPPTCL 's representative before dispatch and / or on arrival at the destination. Inspection before dispatch shall not, however, relieve the supplier of his responsibility to supply the Structures strictly in accordance with the specification.
- (ii) The successful bidder shall abide by all the statutory provisions, acts such as the Indian Electricity Act, Indian Factory Act, Indian Boiler Act etc., and corresponding rules and regulations as may be applicable and as amended from time to time.
- (iii) The MPPTCL's representative shall be entitled at all reasonable time during manufacture to inspect, examine and test at the supplier premises the materials and workmanship of the material to be supplied.
- (iv) As soon as the Material is ready for testing, the supplier shall intimate the MPPTCL well in advance, so that action could be taken for getting the material inspected. The material shall not be dispatched unless waiver of inspection is obtained or inspected by the MPPTCL's authorized representative. When the material has passed the specified tests, the

MPPTCL's representative shall furnish a certificate to this effect in writing to the supplier. The Structures shall not be dispatched unless the test certificates are approved.

- (v) Test certificates shall be in accordance with latest version of the relevant Indian Standards.
- (vi) The supplier shall keep the MPPTCL informed in advance about the time of starting and of the progress of manufacture of Structures in various stages.
- (vii) The acceptance of any batch shall in no way relieve the supplier of any of his responsibilities for meeting all the requirements of the specification and shall not prevent subsequent rejection at any item if the same is later found defective.
- (viii) In case, any member of the Structure is not found as per the relevant drawing, it shall be liable for rejection even after receipt.
- (ix) Defects which may appear during fabrication shall be made good. Any member of the Structure, once rejected, shall be destroyed.

22.0 QUALITY ASSURANCE PLAN -

The Bidder must establish that he is following a proper quality assurance Programme for manufacture of Substation Structures. The Bidder shall invariably furnish following information alongwith his bid:

- (i) Statement giving list of important raw materials, names of sub-suppliers for the raw material, list of standards according to which the raw material is purchased and copies of test certificates thereof.
- (ii) Information and copies of test certificates as in (i) above in respect of bought out items.
- (iii) List of machines and manufacturing facilities available.
- (iv) Levels 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) List of testing equipment available with the Bidder for final testing of Structures specified and test plant limitation, if any, vis-à-vis type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

23.0 INFORMATION TO BE FURNISHED AFTER PLACEMENT OF ORDER -

The successful Bidder shall within 30 days of detailed order, submit following information to the MPPTCL:

- (i) List of raw material as well as bought out accessories and the names of sub-suppliers selected from the lists furnished along with Bid.
- (ii) Type test certificates of the raw material and bought out accessories.

- (iii) Quality Assurance Plan (QAP) with hold-up points for MPPTCL's inspection. The quality assurance plans and hold-up points shall be discussed between the MPPTCL representative and supplier before the QAP is finalized.

24.0 ROUTINE TEST CERTIFICATES -

The successful Bidder shall submit the routine test certificates of bought out items and for raw material at the time of routine testing of Substation Structures.

APPENDIX – A1**PRINCIPAL REQUIREMENT OF STRUCTURES**

S. No.	Particulars	Unit Weight (Approx.)(MT)
A- 400 KV Substation Switchyard Structures (Galvanized)		
1	Gantry Column (FGC-1)	7.433
2	Gantry Column (FBC-2)	2.123
3	Gantry Column (FBC-1)	2.855
4	Gantry Column (FGC-2)	7.475
5	Gantry Column (FTC)	1.725
6	Gantry Beam (FBB)	2.698
7	Gantry Beam (FGB-1M)	2.935
8	Gantry Beam (FGB-2)	2.805
9	Gantry Beam (FTB)	1.922
10	Centre Break Isolator Structure (FDS-6)	1.920
11	CT Structure	0.261
12	PI Structure	0.197
13	CVT Structure	0.100
14	LA Structure	0.136
B- 220 KV Substation Switchyard Structures (Galvanized)		
1	Gantry Column (AAGT)	5.216
2	Gantry Column (AGT)	2.932
3	Gantry Beam (AGB)	1.213
4	Main Bus Structure (ABM)	2.398
5	Auxiliary Bus Structure (ABA)	2.235
6	CT Structure (ACT)	0.268
7	LA Structure (ALA)	0.126
8	Post/Solid Core Structure (API)	0.204
9	Isolator Structure (AITCH)	2.027
10	PT/CVT Structure (APT)	0.268
C- 132 KV Substation Switchyard Structures (Galvanized)		
1	Gantry Column (3GO2)	1.974
2	Gantry Beam (3GO2)	1.092
3	Main Bus Structure (3BO4)	1.524
4	Isolator Structure (3DO2)	0.671
5	PT Structure (3VO4)	0.227
6	CT Structure (3CO5)	0.220
7	Coupling Capacitor Stru. (3KO2)	0.168
8	Post/Solid core Insulator Stru.(3PO2)	0.193
9	Auxiliary Bus Structure (3BO3)	0.905
10	L.A. Structure (3LO4)	0.138

S. No.	Particulars	Unit Weight (Approx.)(MT)
D- 33 KV Substation Switchyard Structures (Galvanized)		
1	Gantry column (1GO3)	0.502
2	Gantry Beam (1GO3)	0.317
3	Main Bus Structure (1BO4)	0.760
4	Auxiliary Bus Structure (1BO5)	0.712
5	Isolator Structure (1DO3)	0.267
6	CT/PT/LA/PI (1VO2)	0.087

The Bidders may please note that –

- a. Weights of Structures mentioned above are the weight of steel sections (excluding the weight of nuts, bolts, washers and Foundation Bolts required alongwith the Structures).
- b. Quantity of nuts, bolts, washers and Foundation Bolts required alongwith each Structure of various types shall be as mentioned in **Appendix-A2.**
- c. Weight of each type of above Structure is as per standard design adopted by the MPPTCL. The bidders are requested to offer their rates accordingly. The price of each structure should be the price including cost of fabricated galvanized steel sections, cost of galvanized nuts, bolts, foundation bolts, washers and other specified accessories as per **Appendix-A2.**

APPENDIX-A2**DETAILS OF NUTS, BOLTS, WASHERS AND
THEIR QUANTITY REQUIRED ALONGWITH EACH 400KV STRUCTURE**

Type of Structure	Sizes / Unit Weight of Nuts and Bolts																Found- ation Bolts Size/ dia(mm) and quantity (Nos)	
	Step Bolts 175 mm Long	16 mm dia							Plain Washers for 16mm dia bolt	20 mm dia								Plain Washers for 20mm dia bolt
		Length								Length								
		60 mm	55 mm	50 mm	45 mm	40 mm	35 mm	80 mm		75 mm	65 mm	60 mm	55 mm	50 mm	45 mm			
←-----QUANTITY (Nos)-----→																		
GANTRY COLUMN (FGC-1)	71	36	NIL	4	44	242	NIL	326	208	64	58	146	80	144	62	762	63 X 1950 16 Nos	
GANTRY COLUMN (FBC-2)	36	NIL	NIL	14	67	132	216	429	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	36 X1130 16 Nos	
GANTRY COLUMN (FBC-1)	37	NIL	NIL	166	180	70	100	516	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	45x1530 16 Nos	
GANTRY COLUMN (FGC-2)	72	172	20	242	80	264	NIL	778	NIL	272	NIL	NIL	NIL	172	NIL	444	63X1950 16 Nos	
GANTRY COLUMN (FTC)	36	NIL	NIL	NIL	48	90	200	338	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	32X1265 16 Nos	
GANTRY BEAM (FBB)	NIL	NIL	NIL	36	134	192	NIL	362	NIL	NIL	NIL	NIL	NIL	32	NIL	32	NIL	
GANTRY BEAM (FGB-1 M)	NIL	NIL	128	NIL	354	214	NIL	696	NIL	NIL	NIL	NIL	NIL	32	NIL	32	NIL	
GANTRY BEAM (FGB-2)	NIL	NIL	NIL	NIL	206	438	NIL	644	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	
GANTRY BEAM (FTB)	NIL	NIL	NIL	60	118	158	NIL	336	NIL	NIL	NIL	NIL	NIL	NIL	16	16	NIL	
CENTRE BREAK ISOLATOR STRUCTURE (Set of 6 Pedastal)	NIL	NIL	NIL	NIL	8	NIL	NIL	8	NIL	NIL	NIL	NIL	12	36	12	60	28 X 840 24 Nos	
CT STRUCTURE	NIL	NIL	NIL	NIL	24	8	NIL	32	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	20 X715 8 Nos	
PI STRUCTURE	NIL	NIL	NIL	NIL	44	16	NIL	60	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	25 X800 8 Nos	
CVT STRUCTURE	NIL	NIL	NIL	NIL	NIL	48	NIL	48	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	20 X715 8 Nos	
LA STRUCTURE	NIL	NIL	NIL	NIL	NIL	48	12	60	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	16 X715 8 Nos	

NOTE:

- (i) A set of one bolt and one nut required for assembly of structure shall have one number spring Washer.
- (ii) Each foundation bolt shall have three numbers nuts & 1 No. Anchor Plate & Plain Washer.
- (iii) The step bolt shall have two nuts & one number spring washer.
- (iv) Accessories, which are not indicated in above tables but are necessary for completeness and satisfactory operation of Structures shall be deemed to have been included in the scope of supply of this contract.

APPENDIX-A2**DETAILS OF NUTS, BOLTS, WASHERS AND
THEIR QUANTITY REQUIRED ALONGWITH EACH 220 KV STRUCTURE**

Type of Structure	Sizes of Nuts and Bolts																	Found ation Bolts Size (dia X length) mm and quanti ty (Nos)
	16 mm dia						Pack Washers for 16mm dia bolt			Plain Washers for 16mm dia bolt	20 mm dia			Plain Washers for 20mm dia bolt	24 mm dia		Plain Washers for 24mm dia bolt	
	Step bolts 175 mm long	Length					Thickness				Length				Length			
		60 mm	55 mm	50 mm	45 mm	40 mm	10 mm	8 mm	6 mm	70 mm	55 mm	45 mm	75 mm	70 mm				
←-----QUANTITY (Nos.)-----→																		
Gantry Column (AAGT)	56	50	120	217	98	180	2	18	97	665	NIL	NIL	NIL	NIL	144	NIL	144	30 X 1350 12 Nos
Gantry Column (AGT)	NIL	NIL	NIL	260	146	86	34	32	112	492	NIL	4	NIL	4	96	32	128	30 X 1350 8 Nos
Gantry Beam (AGB)	NIL	NIL	3	58	80	210	NIL	NIL	28	351	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Main Bus Structure (ABM)	NIL	NIL	36	52	58	490	NIL	NIL	30	636	NIL	96	NIL	96	NIL	NIL	NIL	24 X 1200 8 Nos
Auxiliary Bus Structure (ABA)	NIL	NIL	28	60	194	372	NIL	NIL	110	654	NIL	96	NIL	96	NIL	NIL	NIL	24 X 1200 8 Nos
CT Structure (ACT)	NIL	NIL	NIL	NIL	28	24	NIL	NIL	12	52	NIL	NIL	NIL	NIL	NIL	NIL	NIL	20 X 450 4 Nos
LA Structure (ALA)	NIL	NIL	NIL	NIL	12	16	NIL	NIL	NIL	28	NIL	NIL	NIL	NIL	NIL	NIL	NIL	20 X 450 4 Nos
Post/Solid core Insulator Structure (API)	NIL	NIL	NIL	NIL	44	16	NIL	NIL	NIL	60	NIL	NIL	NIL	NIL	NIL	NIL	NIL	20 X 900 4 Nos
Isolator Structure (AITCH)	NIL	NIL	144	96	88	100	NIL	NIL	96	428	NIL	NIL	NIL	NIL	NIL	NIL	NIL	20 X 900 24 Nos
PT/CVT Structure (APT)	NIL	NIL	NIL	NIL	28	24	NIL	NIL	12	52	NIL	NIL	NIL	NIL	NIL	NIL	NIL	20 X 450 4 Nos

NOTE:

(i) A set of one bolt and one nut required for assembly of structure shall have one number spring Washer.

(ii) Each foundation bolt shall have three numbers nuts, 1 No. Anchor Plate & Plain Washer.

(iii) The step bolt shall have two nuts & one number spring washer.

(iv) Accessories, which are not indicated in above tables but are necessary for completeness and satisfactory operation of Structures shall be deemed to have been included in the scope of supply of this contract.

APPENDIX-A2

DETAILS OF NUTS, BOLTS, WASHERS AND THEIR QUANTITY REQUIRED ALONGWITH EACH 132KV STRUCTURE								
Sr. No.	Type of Structure	Sizes of Nuts and Bolts						Foundation Bolts Size (dia X length) mm and quantity (Nos)
		16 mm dia					Plain Washers for 16mm dia bolt	
		Length						
		55 mm	50 mm	45 mm	40 mm	35 mm		
-----QUANTITY (Nos.)-----								
----->								
1	GANTRY COLUMN (3GO2)	NIL	50	15	350	102	505	20X1240 16 Nos.
2	GANTRY BEAM (3GO2)	56	NIL	NIL	142	40	220	NIL
3	MAIN BUS BAR STRUCTURE (3BO4)	NIL	NIL	NIL	150	325	475	25X1200 8 Nos.
4	AUXILARY BUS BAR STRUCTURE (3BO3)	NIL	NIL	NIL	190	150	340	20 X 540 32 Nos
5	ISOLATOR STRUCTURE (3D02)	NIL	NIL	NIL	56	NIL	56	20 X 940 16 Nos.
6	PT STRUCTURE (3VO4)	NIL	NIL	25	20	NIL	45	20 X 500 4 Nos.
7	CT STRUCTURE (3CO5)	NIL	NIL	NIL	NIL	NIL	0	25 X 600 4 Nos.
8	LA STRUCTURE (3LO4)	NIL	NIL	NIL	30	20	50	20 X 500 4 Nos.
9	COUPLING CAPACITOR STRUCTURE (3KO2)	NIL	NIL	NIL	26	NIL	26	20 X 540 4 Nos.
10	POST/SOLID CORE STRUCTURE (3PO2)	NIL	NIL	NIL	NIL	NIL	0	25 X 600 4 Nos.
NOTE:								
(i) A set of one bolt and one nut required for assembly of structure shall have one number spring washer.								
(ii) Each foundation bolt shall have three numbers nuts, one no. plane washer & Anchor plate.								
(iii) Accessories, which are not indicated in above tables but are necessary for completeness and satisfactory operation of Structures shall be deemed to have been included in the scope of supply of this contract.								

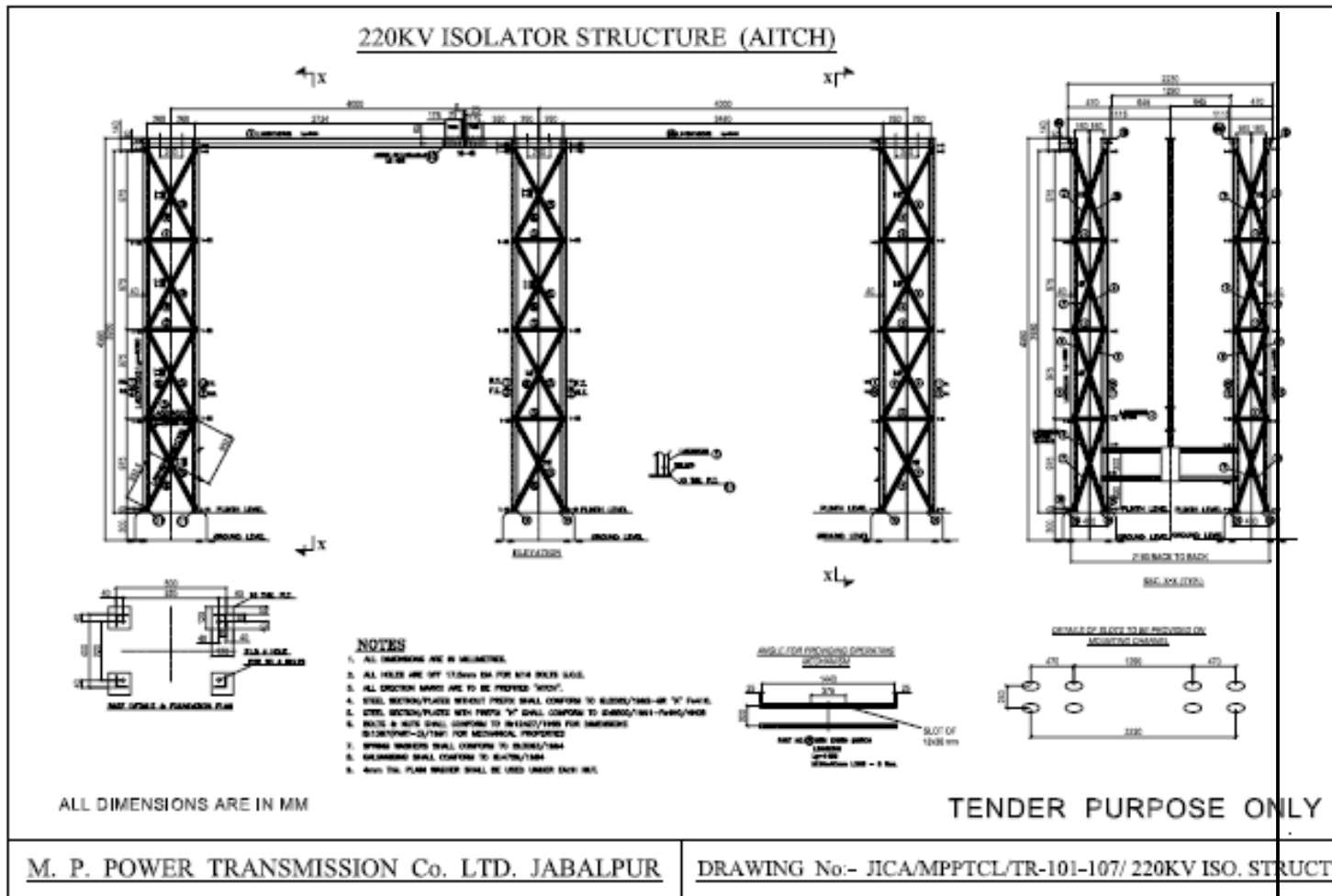
APPENDIX-A2

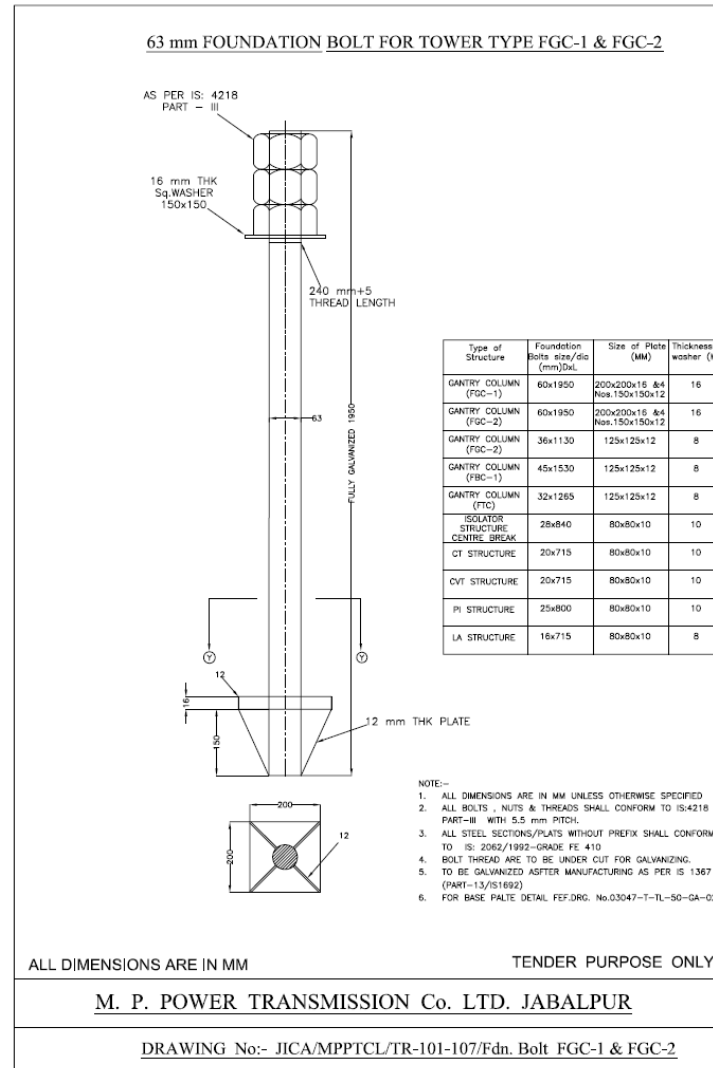
DETAILS OF NUTS, BOLTS, WASHERS AND THEIR QUANTITY REQUIRED ALONGWITH EACH 33KV STRUCTURE									
Sr. No	Type of Structure	Sizes / Unit Weight of Nuts and Bolts							Foundation Bolts Size (dia X length) mm and quantity (Nos)
		16 mm dia				Pack Washers for 16mm dia bolt		Plain Washers for 16mm dia bolt	
		Length				8 mm	6 mm		
		55 mm	50 mm	45 mm	40 mm				
		<-----QUANTITY (Nos.)----->							
1	ISOLATOR STRUCTURE (1D03)	NIL	NIL	NIL	42	NIL	NIL	42	25X1200 8 Nos.
2	CT/PT/LA/PI STRUCTURE (1VO2)	NIL	NIL	4	28	NIL	NIL	32	20X815 4 Nos.
NOTE:									
(i) A set of one bolt and one nut required for assembly of structure shall have one number spring washer.									
(ii) Each foundation bolt shall have three numbers nuts, one no. plane washer & Anchor plate.									
(iii) Accessories, which are not indicated in above tables but are necessary for completeness and satisfactory operation of Structures shall be deemed to have been included in the scope of supply of this contract.									

APPENDIX-B

DRAWINGS

S. no.	Drawing No.	Description
1	JICA/MPPTCL/TR-101 TO 107/220 KV Isolator Structure	220 KV Isolator Structure
2	JICA/MPPTCL/TR-101 TO 107/33 KV Isolator Structure	33 KV Isolator Structure
3	JICA/MPPTCL/TR-101 TO 107/Foundation Blot FGC-1 & FGC-2	Foundation Bolt
4	JICA/MPPTCL/TR-101 TO 107/Foundation Blot S/s Structure	Foundation Bolt





FOUNDATION BOLTS FOR SUB STATION STRUCTURES

Type of Structure	Foundation Bolts size/dia (mm)2xL	Size of Plate (MM)	Thickness of washer (MM)
Sanitary Column (FGC-1)	63x1950	200x200x16 & 4 Nos. 150x150x12	16
Sanitary Column (FGC-2)	63x1950	200x200x16 & 4 Nos. 150x150x12	16

Type of Structure	Foundation Bolts size/dia (mm)2xL	Size of Plate (MM)	Thickness of washer (MM)
SANITARY COLUMN (FGC-2)	36x1130	125x125x12	10
SANITARY COLUMN (FGC-1)	45x1530	125x125x12	10
SANITARY COLUMN (FTC)	32x1285	125x125x12	10
ISOLATOR STRUCTURE CENTRE BREAK	28x840	80x80x10	10
CT STRUCTURE	20x715	80x80x10	10
CVT STRUCTURE	25x715	80x80x10	10
PT STRUCTURE	25x600	80x80x10	10
LA STRUCTURE	18x715	80x80x10	8

NOTE:-

- ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
- ALL BOLTS, NUTS & THREADS SHALL CONFORM TO IS: 4311 PART-III WITH 5.5mm FITTICE.
- ALL STEEL SECTIONS/PLATE WITHOUT PREFIX SHALL CONFORM TO IS: 2062/1996 (GRADE: FE 410).
- BOLT THREAD ARE TO BE UNDER CUT FOR GALVANIZING TO BE GALVANIZED AFTER MANUFACTURING AS PER IS: 1367 (PART-III: 2008).
- FOUNDATION BOLT, NUT SHALL BE HOT DIP GALVANIZED.

ALL DIMENSIONS ARE IN MM TENDER PURPOSE ONLY

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DRAWING No:- JICA/MPPTCL/TR-101-107/Fdn. Bolt For S/S Struct. (2)

SCHEDULE – I (A)**DESCRIPTION OF MATERIAL FOR SCHEDULE OF RATES AND PRICES TO
BE FURNISHED IN VOLUME VI**

S. No.	Particulars	Unit Weight (Approx.)(MT)	Qty
A. 400KV Substation Switchyard Structures (Galvanized)			
1	Gantry Column (FGC-1)	7.433	As per Price Schedule
2	Gantry Column (FBC-2)	2.123	
3	Gantry Column (FBC-1)	2.855	
4	Gantry Column (FGC-2)	7.475	
5	Gantry Column (FTC)	1.725	
6	Gantry Beam (FBB)	2.698	
7	Gantry Beam (FGB-1M)	2.935	
8	Gantry Beam (FGB-2)	2.805	
9	Gantry Beam (FTB)	1.922	
10	Centre Break Isolator Structure (FDS-6)	1.920	
11	CT Structure	0.261	
12	PI Structure	0.197	
13	CVT Structure	0.100	
14	LA Structure	0.136	
B. 220 KV Substation Switchyard Structures (Galvanized)			
1	Gantry Column (AAGT)	5.216	As per Price Schedule
2	Gantry Column (AGT)	2.932	
3	Gantry Beam (AGB)	1.213	
4	Main Bus Structure (ABM)	2.398	
5	Auxiliary Bus Structure (ABA)	2.235	
6	CT Structure (ACT)	0.268	
7	LA Structure (ALA)	0.126	
8	Post/Solid Core Structure (API)	0.204	
9	Isolator Structure (AITCH)	2.027	
10	PT/CVT Structure (APT)	0.268	
C. 132 KV Substation Switchyard Structures (Galvanized)			
1	Gantry Column (3GO2)	1.974	As per Price Schedule
2	Gantry Beam (3GO2)	1.092	
3	Main Bus Structure (3BO4)	1.524	
4	Isolator Structure (3DO2)	0.671	
5	PT Structure (3VO4)	0.227	
6	CT Structure (3CO5)	0.220	
7	Coupling Capacitor Stru. (3KO2)	0.168	
8	Post/Solid core Insulator Stru.(3PO2)	0.193	
9	Auxiliary Bus Structure (3BO3)	0.905	
10	L.A. Structure (3LO4)	0.138	

S. No.	Particulars	Unit Weight (Approx.)(MT)	Qty
D.	33 KV Substation Switchyard Structures (Galvanized)		
1	Gantry column (1GO3)	0.502	As per Price Schedule
2	Gantry Beam (1GO3)	0.317	
3	Main Bus Structure (1BO4)	0.760	
4	Auxiliary Bus Structure (1BO5)	0.712	
5	Isolator Structure (1DO3)	0.267	
6	CT/PT/LA/PI (1VO2)	0.087	

Note :

- Weights of Structures mentioned above are the weight of steel sections (excluding the weight of nuts, bolts, washers and Foundation Bolts required alongwith the Structures).
- Quantity of nuts, bolts ,washers and Foundation Bolts required alongwith each Structure of various types shall be as mentioned in **Appendix – A2**.
- Weight of each type of above Structure is as per standard design adopted by the MPPTCL. The bidders are requested to offer their rates accordingly.
- The above description of material is given for the purpose of offering the prices and to mention description of material in Invoice for claiming payment.
- The quantity of above material has been mentioned in Volume VI

SECTION – II

2.5.1 [A] TECHNICAL SPECIFICATIONS FOR ACSR CONDUCTOR

1.0 SCOPE:

The scope of this bid covers design, manufacturing supply of equipments/ material as per Section-I, Volume-II. The “bidder” mentioned in the Section of Technical Bid means “Original Equipment Manufacturer (OEM)”. The purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipments/ material of manufacturer as per this bid requirement shall rest on the bidder.

2.0 STANDARDS:

Applicable standards for offered equipment/ material shall be as per Section-I, Volume-II.

3.0 CLIMATIC CONDITIONS:

Applicable climatic conditions shall be as per Section-I, Volume-II.

4.0 SYSTEM PARTICULARS:

Applicable system particulars shall be as per Section-I, Volume-II.

5.0 GENERAL TECHNICAL REQUIREMENTS : MATERIAL AND WORKMANSHIP (FOR ACSR Conductor):

5.01 Materials:

The conductors shall be manufactured from EC grade aluminium rods suitably hard-drawn on wire drawing machines. The aluminium rods used shall comply with IS:1841 and IS:5484 or any equivalent International Standard. The mechanical and electrical properties of aluminium wire shall comply with the requirements given in relevant standard.

5.02 Physical constants for Hard-drawn Aluminium:

5.02.1 Resistivity:

The resistivity of aluminium depends upon its purity and its physical condition. For the purpose of this specification the maximum value permitted is 0.28264 Ohm sq.mm/mt. at 20° C and this value has been used for calculation of the maximum permissible value of resistance.

NOTE: It is not intended to check the resistivity from the measured values of resistance.

5.02.2 Density:

At a temperature of 20°C the density of hard drawn aluminium has been taken as 2.703 g/cm.³

5.02.3 Constant-Mass Temperature Co-efficient of Resistance:

At a temperature of 20°C, the constant-mass temperature co-efficient of resistance of hard drawn aluminium measured between two potential points rigidly fixed to the wire, the metal being allowed to expand freely, has been taken as 0.004 per degree Celsius.

5.02.4 Co-efficient of Linear Expansion:

The co-efficient of linear expansion of hard-drawn aluminium at 0°C has been taken as 23.0×10^{-6} per °C. This value holds good for all practical purposes over the range of temperature from 0°C to highest safe operating temperature.

5.03 Galvanised steel wire shall be drawn from high carbon steel rods produced by either acidic or basic open hearth process, electric furnace process or basic oxygen process. The mechanical and electrical properties of wire shall comply with the requirements given in relevant standard. The chemical composition of high carbon steel wires is given below for guidance only.

Element	Percentage Composition
Carbon	0.5 to 0.85
Maganese	0.50 to 1.10
Phosphorous	Not more than 0.035
Sulphur	Not more than 0.045
Silicon	0.10 to 0.35

5.03.1 Physical constants for Galvanised steel wires:

5.03.1.1 Density :

At a temperature of 20°C, the density of galvanized steel wire is to be taken as 7.80 g/Cm³.

5.03.1.2 Coefficient of Linear Expansion :

In order to obtain uniformity in calculation a value of 11.5×10^{-6} °C may be taken as the value for the co-efficient of Linear Expansion of galvanized steel wires used for the cores of steel-reinforced aluminium conductors.

5.03.1.3 The zinc used for galvanizing shall be electrolytic high-grade Zinc not less than 99.95 percent purity. It shall conform to and satisfy all the requirements of IS: 209. Galvanising may be done either by hot process or electrolytic process. Minimum weight of Zinc coating shall be 260 g/m². Neutral grease may be applied between the layers of wire.

5.03.1.4 Freedom From Defects:

The wires shall be smooth and free from all imperfections such as spills, slag inclusion, die marks, scratches, fittings, blow-holes, projections, looseness, overlapping of strands, chipping of aluminium layers etc. and all such other defects which may hamper the mechanical and electrical properties of the conductor. Special care should be taken to keep away dirt, grit etc. during stranding.

6.0 Wire Sizes

6.01 Nominal Size:

The aluminium and galvanized steel wires for the stranded conductor covered by this standard shall have diameters specified in clause 3.03.01 & 3.03.02. The diameter of the steel wires shall be measured over the zinc coating.

6.02 Tolerances on Nominal Size :

Tolerance of + 1% is permitted on the nominal diameter of Aluminium Wires of Panther and Zebra Conductor and a tolerance of + 2 % is permitted on the nominal diameter of Galvanised Steel Core Wire.

7.0 Joints in Wires:

7.01 Aluminium Wires:

No joints shall be permitted in the aluminium wires in the outermost layer of the ACSR Conductor. Joints in the inner layers are permitted, in addition to those made in the base rod or wire before final drawing, but no two such joints shall be less than 15 mtr. apart in the complete stranded conductor such joints shall be made only by cold pressure butt-welding. It may please be noted that Joints are not permitted in the outermost layer of the conductor in order to ensure a smooth conductor finish and reduce radio interference levels and corona losses on extra high voltage lines.

7.02 Galvanised Steel Wires:

There shall be no joints except those the base rods or wires before final drawing, in steel wires forming the core of the steel-reinforced aluminium conductor. Joints are not permitted in the steel wires after final drawing also in order to avoid reduction in the breaking strength of the conductor that may occur as a result of failure of the joints.

8.0 Stranding :

8.01 The wires used in the construction of galvanized steel reinforced aluminium conductor, before stranding, shall satisfy all the relevant requirements of this specification.

8.02 The lay ratio of the different layers shall be within the limits given in the Table below:-

Type of conductor	Ratio of Alu. wire diameter to steel wire diameter	Lay Ratios of Steel core 6 wire layer		Lay Ratios for Aluminium wires (3 Alu. Wire Layer Conductors)					
				Outermost layer		Layer immediately beneath outer most layer		Innermost Layer	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Panther AL -30 Wire ST. - 7 Wire	1	13	28	10	14	10	16	-	-
Zebra AL -54 Wire ST. - 7 Wire	1	13	28	10	14	10	16	10	17
Moose AL -54 Wire ST. - 7 Wire	1	16	18	10	12	11	13	12	14

NOTE : For the purpose of calculation, the mean lay ratio shall be taken as the arithmetic mean of the relevant minimum and maximum values given in this table.

8.03 In all constructions, the successive layers shall have opposite directions of lay, the outermost layer being right-handed. The wires in each layer shall be evenly and closely stranded.

8.04 In conductors having multiple layers of aluminium wires, the lay ratio of any aluminium layer shall not be greater than the lay ratio of the aluminium layer immediately beneath it.

8.05 The finished Conductor shall have a smooth surface without any surface cut, abrasion, scuff marks and shall be free from dirt, grit, etc. even if the damage to conductor is acceptable from mechanical considerations. It will not be acceptable from electrical considerations, and full care should be taken not to supply damaged conductor. Projections of more than 2 mils shall not be acceptable. Any such damage shall be properly rectified or new conductor supplied.

8.06 Failure of any sample to meet the above requirements shall be sufficient cause for rejection of the lengths of conductor represented by the sample. Particular care shall, therefore, be taken during manufacture, handling, packing and transportation of the conductor, to see that the surface is not dented, cut or damaged in any way.

9.0 Standard Length :

9.01 The standard length of conductor shall be 1500 metres. A tolerance of +/-5% on the standard length offered by the supplier shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths.

9.02 Random lengths will be accepted provided no length is less than 70% of the standard length specified and the total quantity of such random lengths shall not be more than 5% of the total quantity ordered.

9.03 Supplier shall also indicate the maximum single length, above the standard length, they can manufacture in the guaranteed technical particulars. This is required for special stretches like river crossing etc. The Employer reserves the right to place orders for the above length to the 5% of the total ordered quantity on the same terms and conditions applicable for the standard lengths during the pendency of the contract.

10.0 Galvanising:

All the wires of Iron & steel strand shall be galvanized in accordance with IS-2629-1966. 'Recommended practice for hot dip galvanizing of Iron and Steel' or some other authoritative equivalent standard.

11.0 Tests :

11.01 The conductor offered shall be type tested as per the relevant standards. Further the acceptance, routine tests and tests during manufacture shall be carried out on the conductor.

11.02 Type tests shall mean those tests, which are to be carried out to prove the process of manufacture and general conformity of the material to this specification.

11.03 All the materials offered shall be fully type tested as per the relevant standards and the supplier shall furnish four sets of type test reports along with the offer. These tests must not have been conducted earlier than five years, prior to the date of opening of bid. For any change in the design/type already type tested and the design/type offered against this specification, the Employer reserves the right to demand repetition of tests without any extra cost.

11.04 Acceptance tests shall mean those tests, which are to be carried out on samples taken from each lot offered for pre-despatch inspection, for the purpose of acceptance of that lot.

11.05 Routine tests shall mean those tests which are to be carried out on each strand/spool/length of the conductor to check requirements which are likely to vary during production.

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

11.07 The norms and procedure of sampling for these tests will be as per the Quality Assurance Programme to be mutually agreed to by the Supplier and the Employer as per relevant clause of General Conditions of Contract.

11.08 The standards and norms to which these tests will be carried out are listed in para 3.01. Where a particular test is a specific requirement of this specification, the norms and procedures of the test shall be as mutually agreed to between the Supplier and the Employer in the Quality Assurance Programme.

11.09 For all type and acceptance tests, the acceptance values shall be the values guaranteed by the Supplier in the 'Guaranteed Technical Particulars' of his proposal or the acceptance value specified in this specification, whichever is more stringent for that particular test.

11.10 Type Tests :

The Conductor offered shall be fully type tested as per the relevant International/Indian Standard and the bidder shall furnish the report along with the offer. These tests must not have been conducted earlier than 5 years prior to the date of opening of bid. For any change in the design/type, already type tested and the design/type offered against this bid, the Employer reserves the right to demand repetition of some or all type tests without any extra cost.

The above said test reports submitted with the offer shall not be older than five years, prior to the date of opening of bid.

- a) UTS test on stranded conductor
- b) DC resistance test on stranded conductor
- c) Stress-strain test on composite conductor

11.11 Acceptance Tests :

- a) Visual and dimensional check
- b) Visual check for joints, scratches etc. and lengths of conductor
- c) Dimensional check on steel and aluminium strands
- d) Check for lay ratios of various layers
- e) Galvanising test on steel strands
- f) Torsion and Elongation test on steel wire
- g) Breaking load test on steel and aluminium strands
- h) Wrap test on steel and aluminium strands
- i) DC resistance test on aluminium strands
- j) UTS test on welded joint of aluminium strand

NOTE: All the above tests except test mentioned at (j) shall be carried out on aluminium and steel strands after stranding only.

11.12 Routine Test :

- a) Check to ensure that the joints are as per specification.
- b) Check that there are no cuts, fins etc. on the strands.
- c) Check that drums are as per specifications.
- d) All acceptance tests as mentioned in Clause 6.1.10 above shall be carried out on each coil.

11.13 Tests During Manufacture :

- a) Chemical analysis of zinc used for galvanizing
- b) Chemical analysis of aluminium for making aluminium strands
- c) Chemical analysis of steel used for making steel strands

11.14 Testing Expenses:

The entire cost of testing for the acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted unit price of conductor, except for the expenses of the inspection/Employer's representative.

11.15 Additional Tests:

The Employer reserves the right of having at his own expenses any other test(s) of reasonable nature carried out at Supplier's premises, at site, or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the material comply with the specification.

11.16 Sample Batch for Type Testing

- (a) The supplier shall offer at least three (3) drums for selection of samples required for conducting all the type tests, in case of change in design/type already tested and the design type offered against this specification, which the Employer reserves the right to demand carrying out type test without any extra cost.
- (b) The supplier is required to carry out all the acceptance tests successfully in the presence of Employer's representative before despatch of conductor.

11.17 Test Reports

- (a) Record of routine test reports shall be maintained by the Supplier at his works for periodic inspection by the Employer's representative.
- (b) Test Certificates of test during manufacture shall be maintained by the Supplier. These shall be produced for verification as and when desired by the Employer.

11.18 Test Facilities

The following additional test facilities shall be available at supplier's Works.

- (a) Calibration of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer etc.
- (b) Standard resistance for calibration of resistance bridges.
- (c) Finished conductor shall be checked for length verification and surface finish on separate rewinding machine at reduced speed (variable from 8 to 16 metres per minute). The rewinding facilities shall have appropriate clutch system and free of vibrations, jerks etc. with transverse layering facilities.

12.0 INSPECTION :

12.01 The Employer's representative shall at all times be entitled to have access to the works and all places of manufacture where conductor shall be manufactured and the representative shall have full facilities for unrestricted inspection of the Supplier's works, raw materials and process of manufacture for conducting necessary tests as detailed herein.

12.02 The Supplier shall keep the Employer informed in advance of the time of starting and of the progress of manufacture of conductor in its various stages so that arrangements can be made for inspection.

12.03 No material shall be despatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is waived off by the Employer in writing. In the later case also, the conductor shall be despatched only after satisfactory testing for all tests specified herein has been completed.

12.04 The acceptance of any quantity of material shall in no way relieve the Supplier of any of his responsibilities for meeting all requirements of the specification, and shall not prevent subsequent rejection if such material is later found to be defective.

12.05 At least 5% of the total number of drums subject to minimum of two in any lot put up for inspection, shall be selected at random to ascertain the length of conductor by following method:

“At the works of the manufacturer the conductor shall be transferred from one drum to another at the same time measuring its length with the help of graduated pulley and Cyclometer. The difference in the average length thus obtained and as declared by the supplier in the packing list shall be applied to all the drums if the conductor is found short during checking”.

13.0 QUALITY ASSURANCE PLAN :

13.01 The contractor shall furnish following information while making request for approval of conductor supplier:

- (i) Statement giving list of important raw materials names of sub supplies 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 Supplier's representative, copies of test certificates.
- (ii) Information and copies of test certificates as in (i) above in respect of bought out accessories.
- (iii) List of manufacturing facilities available.
- (iv) Level of automation achieved and list of areas where manual process exists.
- (v) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- (vi) Special features provided in the equipment to make it maintenance free.

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

13.02 The successful Supplier shall within 30 days of placement of order, submit following information to the Employer.

- (i) List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offer.
- (ii) Type test certificates of the raw material and bought out accessories.
- (iii) Quality assurance plan (QAP) with hold points for Employer's inspection. The quality assurance of plan and Employer's hold points shall be discussed between the Employer and Supplier, before QAP is finalized.

13.03 The successful Supplier shall submit the routine test certificates of bought out accessories and central excise duty passes for raw material viz. oil, copper, aluminium, conductor's insulating materials, core material at the time of routine testing of the Conductor.

14.0 DOCUMENTATION :

14.01 Six sets of type test reports, duly approved by the Employer shall be submitted by the supplier for distribution, before commencement of supply. Adequate copies of acceptance and routine test certificates, duly approved by the Employer shall accompany with despatched consignments.

14.02 The manufacturing of the material shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Employer. All manufacturing and fabrication work in connection with the material prior to the approval of the drawing shall be at Supplier's risk.

14.03 Approval of drawing/work by Employer shall not relieve the Supplier of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The material shall conform in all respect to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering. Employer shall have the power to reject any work or material, which in his judgment is not in full accordance therewith.

15.0 PACKING AND FORWARDING :

15.01 The conductor shall be supplied in non-returnable strong wooden drums provided with lagging of adequate strength, to protect the conductor against all damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The drums shall generally conform to IS: 1778 except otherwise specified hereinafter.

15.02 The drums shall be suitable for wheel mounting and for jetting off the conductor under a minimum controlled tension of the order of 5kN.

15.03 The standard drum drawings are enclosed however, supplier should submit the proposed drum drawings along with the bid. The same shall be in line with the requirements of standard drawings and as stated herein. The supplier shall submit four copies of fully dimensioned drawing of the drum he wishes to supply, for Employer's approval, before taking up manufacturing of conductor. After getting approval from the Employer, Supplier shall submit 30 more copies of the approved drawing to Employer for further distribution and field use at Employer's end.

15.04 All wooden components shall be manufactured out of seasoned soft wood free from such defects that may materially weaken the component part of the drums. Preservative treatment for anti-termite /anti-fungus (Aldrine/Aldruse) shall be applied to the entire drum with preservatives of a quality which is not chemically harmful to the conductor.

15.05 The flanges shall be of two/three ply construction with each ply at right angles to the other and nailed together. Further the outer face of the flange shall be reinforced with the circumferential battens, fixing in octagonal shape. The nails shall be driven from the inside face of flange, punched and then clenched on the outer face. The tolerance in thickness of each ply shall be +/- 3 mm only. There shall be at least 3 nails per plank of ply with maximum nail spacing of 75 mm. Where a slot is cut in the flange to receive the inner end of the conductor, the entrance shall be in line with the periphery of the barrel. Spindle hole shall be provided at the centers of the planks of the plies and spindle plates with 102 mm dia. Holes shall be fitted on either side of both the flanges.

15.06 The wooden battens used for making the barrel of the conductor shall be of segmental type. These shall be nailed to the barrel supports with at least two nails. The battens shall be closely butted and shall provide a round barrel with smooth external surface. The edges of the battens shall be rounded or chamfered to avoid damage to the conductor.

15.07 Barrel studs shall be used for construction of drums. The flanges shall be holed and the barrel supports slotted to receive them. The barrel studs shall be threaded over a length on either end, sufficient to accommodate washers, spindle plates and nuts for fixing flanges at the required spacing. Barrel studs should be tack welded with the nuts after tightening.

15.08 Normally, the nuts on the studs shall stand protrude of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be counter sunk. The ends of barrel shall generally be flushed with the top of the nuts.

15.09 The inner cheek of the flanges and drum barrel surface shall be painted with bitumen based paint.

15.10 Before reeling, cardboard or double corrugated or thick bituminised waterproof bamboo paper shall be secured to the drum barrel and inside of flanges or the drum by means of a suitable commercial adhesive material. The paper should be dried before use. Medium grade craft paper shall be used in between the layer of the conductor/earth wire. After reeling the conductor the exposed surface of the outer layer of conductor shall be wrapped with thin polythene sheet across the flanges to preserve the conductor from dirt, grit and damage during transportation and handling and also to prevent ingress of rain water during storage/transport.

15.11 Minimum space of 125 mm shall be provided between the inner surface of the external protective layer and outer layer of the conductor.

15.12 Each batten shall be securely nailed across grains as far as possible to the flange edges with at least 2 nails per end. The length of the nails shall not be less than twice the thickness of the battens. The nail shall not protrude above the general surface and shall not have exposed sharp edges or allow the battens to be released due to corrosion.

15.13 Outside the protective layer, there shall be minimum of two binder consisting of hoop iron/galvanized steel wire. Each protective layer shall have two recess to accommodate the binders.

15.14 The conductor ends shall be properly sealed and secured with the help of U-nails on one side of the flanges. The end securing shall be done by taking out at least 500 mm of steel core on either ends by U-nails. The composite conductor shall be binded by use of galvanized steel wire/aluminum wire at three locations at least 75 mm apart or more covered with PVC adhesive tape so as to avoid loosening of conductor layers in transit and handling.

15.15 Only one length of conductor shall be wound on each drum.

16.0 MARKING :

Each drum shall have the following information stenciled on it in indelible ink along with other essential data:

- i. Contract
- ii. Name and address of consignee
- iii. Manufacturer's name and address
- iv. Drum number
- v. Size of conductor
- vi. Length of conductor in metres
- vii. Gross weight of drum with conductor
- viii. Weight of empty drum with protective lagging
- ix. Arrow marking for unwinding

17.0 END SEALING:

Both the ends of each length of conductor should be provided with non-destructive type metal crimped or epoxy capped seals with punching embossing/engraving of manufacturer's monogram and drum number.

2.5.1 [B] TECHNICAL SPECIFICATIONS FOR SCREENING CONDUCTOR (HIGH TENSILE GALVANISED STEEL EARTH WIRE)

1.0 SCOPE:

The scope of this bid covers design, manufacturing supply of equipments/ material as per Section-I, Volume-II. The “bidder” mentioned in the Section of Technical Bid means “Original Equipment Manufacturer (OEM)”. The purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipments/ material of manufacturer as per this bid requirement shall rest on the bidder.

2.0 STANDARDS:

Applicable standards for offered equipment/ material shall be as per Section-I, Volume-II.

3.0 CLIMATIC CONDITIONS:

Applicable climatic conditions shall be as per Section-I, Volume-II.

4.0 SYSTEM PARTICULARS:

Applicable system particulars shall be as per Section-I, Volume-II.

5.0 GENERAL TECHNICAL PARTICULARS : MATERIAL AND WORKMANSHIP FOR EARTH WIRE:

- 5.01.** The steel wire (strands) used in manufacture of galvanized steel earth wire shall be drawn from steel wire rod produced by either acid or basic open hearth process or by the electric furnace process or basic oxygen process. The steel wire shall not have sulphur and phosphorous contents exceeding 0.045% each. The carbon content shall not exceed 0.55%. The steel produced by bassemmer process shall not be used for drawing of steel wire strands. The finished earth wire shall have minimum brittleness as it will be subjected to continuous vibration while in use on line.
- 5.02.** The steel wire shall be hot dip galvanized and shall have clause ‘A’ (heavy) zinc coating of minimum 260 gram per sq. meter of the uncoated wire surface. The zinc coating shall be smooth and continuous of uniform thickness, free from imperfections not consistent with good commercial practice and shall meet the test requirement. The zinc used in galvanizing of earth wire shall be as per IS: 209-1966.
- 5.03.** All the steel wires shall be circular, smooth, uniform and free from imperfections, such as spills and splits, die marks scratches, abrasions, cuts and kinks etc. drawing and after stranding.

- 5.04. The steel wires, after galvanizing shall be bright in appearance, smooth and free from all defects like flux, ash, cross inclusions, bare and black spots, pimples, lumpiness in runs, rust, stains, bulky white deposits and blisters.
- 5.05. To avoid susceptibility towards wet storage stains (white rust) the stranded earth wire shall be provided with a protective coating of boiled linseed oil.
- 5.06. The finished earth wire shall have a smooth surface without any surface cuts, abrasions, scuff marks and shall be free from dirt, grit etc.
- 5.07. Failure of any sample to meet the above requirements shall be sufficient cause for rejection of the lot of earth wire represented by the sample, particular care shall therefore be taken during manufacture, handling, packing and transportation of the earth wire so that it is not dented, cut or damaged in any way.

6.0 SIZE AND PROPERTIES:

- 6.01. The earth wire size, physical properties, tolerance in diameter of individual strands and length of lay of the strand shall be as given above.
- 6.02. The wires shall be so stranded together that when an evenly distributed pulls is applied at the end of completed strands, each wire will take an equal share of the pull.
- 6.03. The earth wire shall be supplied in the standard lengths which shall not be less than 3 Km. and such lengths will be specifically indicated in the tender. Not less than 95% of the total quantity of the earth wire shall be supplied in standard lengths. The quantity of earth wire in length shorter than standard one shall not exceeds 5% of the total quantity to be supplied. Further, no single earth wire length in respect of such 5% (maximum) supply in random lengths shall be shorter than 50% of the standard length.
- 6.04. The length of the stranded wire shall be supplied without joints in the individual wires comprising it, excluding welds made in base rod before it is drawn.
- 6.05. Each coil be warranted to contain no welds, joints or splice other than in the base rod before it is drawn.

7.0 GALVANISING AND OILING:

- 7.01. All the wires of the strand shall be galvanized in accordance with IS-2629-1966. Recommended practice for Hot dip galvanizing of Iron and Steel of some other authoritative equivalent standard.
- 7.02. The galvanized earthwire after stranding operation shall have dipped in boiled linseed oil before winding it on drums.

8.0 TEST FOR EARTH WIRE :

- 8.01.** Earth wire shall be subjected, before despatch from the works to tests as specified in the IS:2141, IS:1521, IS:1755 & IS:4826 or any other authoritative equivalent standard.
- 8.02.** All the drums of galvanized steel stranded earth wire of the same grade, diameter and construction, manufactured under similar condition shall be grouped to constitute one lot.
- 8.03.** Samples from each lot shall be tested for ascertaining the conformity to the requirements of the earth wire specified herein. The drums selected shall be tested for length of the lay and diameter of individual strands etc. The lot shall be declared conforming to the requirement of these characteristics if all the samples are found satisfactory. One test specimen from each wire of the strand shall now be drawn from every selected drum and subjected to chemical analysis, tensile tests, ductility test, elongation test and coating test. One test specimen, of the completed strand from each drum shall be subjected to tensile strength. The lot shall be declared conforming to the requirements of these characteristics, if the entire test specimen satisfies the relevant requirement.

9.0 INSPECTION :

- 9.01.** The purchaser's representative shall at all times be entitled to have access to the works and all places of manufacture where earth wire shall be manufactured and the representative shall have full facilities for unrestricted inspection of the Supplier's works, raw materials and process of manufacture for conducting necessary tests as detailed herein.
- 9.02.** The Supplier shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of earth wire in its various stages so that arrangements can be made for inspection.
- 9.03.** No material shall be despatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the purchaser in writing waives off the inspection. In the later case also, the earth wire shall be despatched only after satisfactory testing for all tests specified herein has been completed.
- 9.04.** The acceptance of any quantity of material shall in no way relieve the Supplier of any of his responsibilities for meeting all requirements of the specification, and shall not prevent subsequent rejection if such material is later found to be defective.
- 9.05.** At least 5% of the total number of drums subject to minimum of two in any lot put up for inspection, shall be selected at random to ascertain the length of earth wire by following method:

“At the works of the manufacturer of the earth wire, the earth wire shall be transferred from one drum to another at the same time measuring its length with the help of graduated pulley and Cyclometer. The difference in the average length thus obtained and as declared by the supplier in the packing list shall be applied to all the drums if the conductor/earth wire is found short during checking”

10.0 DOCUMENTATION:

- 10.01.** Six sets of 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 with despatched consignments.
- 10.02.** The manufacturing of the material 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 material prior to the approval of the drawing shall be at Supplier's risk.
- 10.03.** Approval of drawing/work by Purchaser shall not relieve the Supplier of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respect to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering. Purchaser shall have the power to reject any work or material, which in his judgment is not in full accordance therewith.

11.0 PACKING AND FORWARDING:

- 11.1.** The earth wire shall be supplied in strong wooden drums provided with lagging of adequate strength, to protect the conductor/earth wire against all damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The drums shall generally conform to IS: 1778 except otherwise specified hereinafter.
- 11.2.** The drums shall be suitable for wheel mounting and for jetting off the conductor/earth wire under a minimum controlled tension of the order of 5kN.
- 11.3.** After placement of the letter of Award, the supplier shall submit four copies of fully dimensioned drawing of the drum he wishes to supply, for Purchaser's approval, before taking up manufacturing of earth wire. After getting approval from the Purchaser, Supplier shall submit 30 more copies of the approved drawing to Purchaser for further distribution and field use at Purchaser's end.
- 11.4.** All wooden components shall be manufactured out of seasoned soft wood free from such defects that may materially weaken the component part of the drums. Preservative treatment for anti-termite /anti-fungus (Aldrine/Aldruse) shall be applied to the entire drum with preservatives of a quality which is not harmful to the earth wire.
- 11.5.** The flanges shall be of two/three ply construction with each ply at right angles to the other and nailed together. Further the outer face of the flange shall be reinforced with the circumferential battens, fixing in octagonal shape. The nails shall be driven from the inside face of flange, punched and then clenched on the outer face. The tolerance in thickness of each ply shall be +/- 3 mm only. There shall be at least 3 nails per plank of ply with maximum nail spacing of 75 mm. Where a slot is cut in the flange to receive the inner end of the conductor/earth wire, the entrance shall be in line with the periphery of the barrel. Spindle hole shall be provided at the centers of the planks of the plies and spindle plates with 102 mm dia. Holes shall be fitted on either side of both the flanges.

- 11.6.** The wooden battens used for making the barrel of the earth wire shall be of segmental type. These shall be nailed to the barrel supports with at least two nails. The battens shall be closely butted and shall provide a round barrel with smooth external surface. The edges of the battens shall be rounded or chamfered to avoid damage to the earth wire.
- 11.7.** Barrel studs shall be used for construction of drums. The flanges shall be holed and the barrel supports slotted to receive them. The barrel studs shall be threaded over a length on either end, sufficient to accommodate washers, spindle plates and nuts for fixing flanges at the required spacing. Barrel studs should be tack welded with the nuts after tightening.
- 11.8.** Normally, the nuts on the studs shall stand protrude of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be counter sunk. The ends of barrel shall generally be flushed with the top of the nuts.
- 11.9.** The inner cheek of the flanges and drum barrel surface shall be painted with bitumen-based paint.
- 11.10.** Before reeling, cardboard or double corrugated or thick bituminised waterproof bamboo paper shall be secured to the drum barrel and inside of flanges or the drum by means of a suitable commercial adhesive material. The paper should be dried before use. Medium grade craft paper shall be used in between the layer of the conductor/earth wire. After reeling the conductor/earth wire the exposed surface of the outer layer of conductor/earth wire shall be wrapped with thin polythene sheet across the flanges to preserve the conductor/earth wire from dirt, grit and damage during transportation and handling and also to prevent ingress of rain water during storage/transport.
- 11.11.** Minimum space of 125 mm shall be provided between the inner surface of the external protective layer and outer layer of the conductor/earth wire.
- 11.12.** Each batten shall be securely nailed across grains as far as possible to the flange edges with at least 2 nails per end. The length of the nails shall not be less than twice the thickness of the battens. The nail shall not protrude above the general surface and shall not have exposed sharp edges or allow the battens to be released due to corrosion.
- 11.13.** Outside the protective layer, there shall be minimum of two binders consisting of hoop iron/galvanized steel wire. Each protective layer shall have two recesses to accommodate the binders.
- 11.14.** The earth wire ends shall be properly sealed and secured with the help of U-nails on one side of the flanges. The end securing shall be done by taking out at least 500 mm of steel wire on either end by U-nails. The earth wire shall be binded by use of galvanized steel wire/aluminum wire at three locations at least 75 mm apart or more covered with PVC adhesive tape so as to avoid loosening of earth wire layers in transit and handling.
- 11.15.** Only one length of earth wire shall be wound on each drum.

12.0 MARKING :

Each drum shall have the following information stenciled on it in indelible ink along with other essential data:

- (i) Order Number and date.
- (ii) Name and address of consignee
- (iii) Manufacturer's name and address
- (iv) Drum number
- (v) Size of earth wire (7/3.66mm)
- (vi) Length of earth wire in meters
- (vii) Gross weight of drum with earth wire
- (viii) Weight of empty drum with protective lagging
- (ix) Arrow marking for unwinding

13.0 END SEALING :

Both the ends of each length of earth wire should be provided with non-destructive type metal crimped or epoxy capped seals with punching embossing/engraving of manufacturer's monogram and drum number.

2.5.1 [C] TECHNICAL SPECIFICATIONS FOR 70 KN, 90 KN, 120 KN & 160 KN EMS PORCELAIN DISC INSULATORS

1.0 SCOPE:

The scope of this bid covers design, manufacturing supply of equipments/ material as per Section-I, Volume-II. The “bidder” mentioned in the Section of Technical Bid means “Original Equipment Manufacturer (OEM)”. The purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipments/ material of manufacturer as per this bid requirement shall rest on the bidder.

2.0 STANDARDS:

Applicable standards for offered equipment/ material shall be as per Section-I, Volume-II.

3.0 CLIMATIC CONDITIONS:

Applicable climatic conditions shall be as per Section-I, Volume-II.

4.0 SYSTEM PARTICULARS:

Applicable system particulars shall be as per Section-I, Volume-II.

5.0 GENERAL TECHNICAL REQUIREMENTS

5.1 PORCELAIN

The porcelain used in the manufacture of the shells shall be ivory white, nonporous of high dielectric, mechanical and thermal strength, free from internal stresses, blisters, laminations, voids, foreign matter, imperfections or other defects which might render it in any way unsuitable for insulator shells. Porcelain shall remain unaffected by climatic conditions, ozone, acid, alkalizes, zinc or dust. The manufacturing shall be by the wet process and impervious character obtained by thorough verification.

Porcelain Glaze

Surfaces to come in contact with cement shall be made rough by sand glazing. All other exposed surfaces shall be glazed with ceramic materials having the same temperature coefficient of expansion as that of the insulator shell. The thickness of the glaze shall be uniform throughout and the colour of the glaze shall be brown. The glaze shall have a visible luster, smooth on surface and be subject to satisfactory performance under extreme tropical climatic weather conditions and prevent ageing of the porcelain. The glaze shall remain under compression on the porcelain body throughout the working temperature range.

5.2 METAL PARTS

5.2.1 Cap and Ball Pins

Ball pins shall be made with drop forged steel and caps with malleable cast iron. They shall be in one single piece and duly hot dip galvanized. They shall not contain parts or pieces joined together, welded, shrink fitted or by any other process from more than one piece of material. The pins shall be of high tensile steel, drop forged and heat-treated. The caps shall be cast with good quality black hearth malleable cast iron and annealed. Galvanising shall be by the hot dip process with a heavy coating of zinc of very high purity. The Supplier shall specify the grade, composition and mechanical properties of steel used for caps and pins.

5.2.2 Security Clips

The security clips shall be made of phosphor bronze or of stainless steel. 2.5% extra security clip shall be provided.

5.3 FILLER MATERIAL

Cement to be used as a filler material shall be quick setting, fast curing Portland cement. It shall not cause fracture by expansion or loosening by contraction. Cement shall not react chemically with metal parts in contact with it and its thickness shall be as small and as uniform as possible.

The insulator design shall be such that the insulating medium shall not directly engage with hard metal. The surfaces of porcelain and hard metal should be coated with resilient paint to offset the effect of difference in thermal expansions of these materials.

5.4 MATERIAL DESIGN AND WORKMANSHIP

5.4.1 GENERAL

(i) All raw materials to be used in the manufacture of these insulators shall be subject to strict raw material quality control and to stage testing/quality control during manufacturing stage to ensure the quality of the final end product. Manufacturing shall conform to the best engineering practices adopted in the field of extra high voltage transmission. Bidders shall therefore offer insulators as are guaranteed by them for satisfactory performance on 400KV/220KV/132KV Transmission lines.

(ii) The design, manufacturing, process and material control at various stages be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish, elimination of sharp edges and corners to limit corona and radio interference voltages.

5.4.2 INSULATOR SHELL

The design of the insulator shells shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. Shells with cracks shall be eliminated by temperature cycle test followed by mallet test. Shells shall be dried under controlled conditions of humidity and temperature.

5.4.3 METAL PARTS

- (i) The pin and cap shall be designed such that it will not transmit the mechanical stresses to the shell by compression and develop uniform mechanical strength in the insulator. The cap shall be circular with the inner and outer surfaces concentric and of such design that it will not yield or distort under loaded conditions. The head portion of the pin ball shall be suitably designed so that when the insulator is under tension the stresses are uniformly distributed over the pinhole portion of the shell. The pin ball shall move freely in the cap socket either during assembly of a string or during erection of a string or when a string is placed in position.
- (ii) Metal caps shall be free from cracks, seams, shrinks, air holes, blow holes and rough edges. All metal surfaces shall be perfectly smooth with no projecting parts or irregularities, which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly. Pins shall not show any microscopically visible cracks, inclusions and voids.

5.4.4 GALVANISING

All ferrous parts shall be hot dip galvanized in accordance with the latest edition of IS:2629. The zinc to be used for galvanizing shall conform to grade Zn 99.5 as per IS:209. The Zinc coating shall be uniform, smoothly adherent, reasonably bright, continuous and free from impurities such as flux, ash, rust stains, bulky white deposits and blisters. Before ball fittings are galvanized, all die flashing on the shank and on the bearing surface of the ball shall be carefully removed without reducing the designed dimensional requirements.

5.4.5 SECURITY CLIPS (LOCKING DEVICES)

The security clips to be used as a locking device for ball and socket coupling shall be 'R' shaped hump type to provide for positive locking of the coupling as per IS:2486 (Part IV). The legs of the security clips shall allow for spreading after installation to prevent complete withdrawal from the socket. The locking device shall be resilient, corrosion resistant and of sufficient mechanical strength. There shall be no possibility of the locking device to be displaced or be capable of rotation when placed in position and under no circumstances shall it allow separation of insulator units and fittings. 'W' type security clips are also acceptable. The hole for the security clip could be countersunk and the clip shall be of such design that the eye of the clip may be engaged by a hot line clip puller to provide for disengagement under energized conditions. The force required for pulling the clip into its unlocked position shall not be less than 50 N (5 kgs) or more than, 500 N (50 kgs).

5.5 BALL AND SOCKET DESIGNATION

The dimensions of the balls and sockets for 70 KN & 90 KN discs shall be of 16 mm and for 120KN/160KN discs shall be of 20 mm designation in accordance with the standard dimensions stated in IS:2486 (Part II).

5.6 DIMENSIONAL TOLERANCE OF DISC INSULATOR

It shall be ensured that the dimensions of the disc insulators are within the limits specified below:

a. Diameter of Disc (mm)

Rating	Standard	Maximum	Minimum
160 KN Disc	280	293	267
120 KN Disc	255	266	244
90 KN Disc	255	266	244
70 KN Disc	255	266	244

b. Ball to Ball Spacing between Discs (mm)

Rating	Standard	Maximum	Maximum
160 KN Disc	170	175	165
120 KN Disc	145	149	141
90 KN Disc	145	149	141
70 KN Disc	145	149	141

5.7 INTERCHANGEABILITY

The insulators inclusive of the ball and socket fittings shall be of standard design suitable for use with hardware fittings of any make conforming to relevant Indian Standards.

5.8 CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) PERFORMANCE

All surfaces shall be even, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The metal parts and porcelain shall not produce any noise generating corona under all operating conditions.

5.9 SUITABILITY FOR LIVE LINE MAINTENANCE

5.9.1 The insulators shall be compatible for use with hot line or live line maintenance techniques so that usual hot line operations can be carried out with ease, speed and safety.

5.9.2 Suppliers shall indicate the methods generally adopted in routine hot and cold line maintenance of EHV lines for similar insulators supplied by them. Suppliers shall also indicate the recommended periodicity of such maintenance.

5.10 FREEDOM FROM DEFECTS

Insulators shall have none of the following defects:

- i) Ball pin shake
- ii) Cementing defects near the pin like small blow holes, small hair cracks, lumps, etc.
- iii) Sand fall ferro particle defects on the surface of the insulator.
- iv) Shell eccentricity

5.11 INSULATOR STRINGS

5.11.1 TYPE AND RATING

The insulator strings shall be formed with standard discs described in this specification for use on 3 phase, 400kV/220kV/132kV, 50Hz effectively earthed systems in a moderately polluted atmosphere. Suspension insulator strings for use with suspension towers are to be fitted with discs of 70 kN & 120KN EMS rating while tension insulator strings for use with Anchor/Tension towers are to be fitted with discs of 90 kN & 160 kN EMS rating.

5.11.2 STRING SIZE

The size of the disc insulator, the number to be used in different types of strings and their electro-mechanical strength shall be as follows:

S.No.	Type of String	Size of disc insulator (mm)	No. of standard discs	Electro mechanical strength of insulator string (kN)
a)	Single Suspension for 400KV	255 x145	23	120
b)	Double Suspension for 400KV	255 x145	2x23	2x120
c)	Single Tension for 400/220KV	280x170	24/14	160
d)	Double Tension for 400/220KV	280x170	2x24/2x14	2x160
e)	Single Suspension for 220/132KV	255x145	13/9	70
f)	Double Suspension for 220KV/132KV	255x145	2x13/2x9	2x70
g)	Single Tension for 132KV	255x145	10	90
h)	Double Tension for 132KV	255x145	2x10	2x90

5.12 STRING CHARACTERISTICS

5.12.1 The characteristics of the complete string shall be as follows :

S. No	Particulars	Single / Double Suspension			Single / Double Tension		
		400KV	220KV	132KV	400KV	220KV	132KV
i.	Switching surge withstand voltage (dry & wet) KV peak	1050	900	350	1050	900	350
ii	Lightening Impulse withstand voltage (dry) KV peak	1600	1200	800	1700	1200	800
iii	Power frequency withstand voltage (wet) KV r.m.s	680	460	280	690	490	300
iv	Mechanical failing Load - kgf	11500/ 23000	7000/ 14000	7000/ 14000	16500/ 33000	16500/ 33000	9000/ 18000
v	No deformation load-kgf	7705/ 15410	4690/ 9380	4690/ 9380	11055/ 22110	11055/ 22110	6030/ 12060
vi.	Corona Extinction Voltage KV rms	320	-	-	320	-	-
vii.	Max. RIV for complete string at 266KV (rms) line to ground voltage (micro volt)	500	-	-	500	-	-
viii.	Max. voltage across any disc	9%	-	-	9%	-	-

5.12.2 Insulator units after assembly shall be concentric and coaxial within limits as permitted by Indian standards.

5.12.3 The string design shall be such that when units are coupled together there shall be contact between the shell of one unit and metal of the next adjacent unit.

5.12.4 It may please be noted that in the BOQ hardwares required for insulator string is integral part of string. Bidder shall quote the price of insulator string with suitable hardware.

5.12.5 The bidder may please also use Long rod porcelain insulator string or long rod polymer insulators in place of Disc insulator string. The Long rod Porcelain insulators or Long rod polymer insulator shall have technical specification equivalent or better than the technical specification of Disc insulator string. It may please be noted that in a particular work, the bidder will have to use only one type of insulators and combination of different types of insulators in one particular work will not be allowed.

6.0 TESTS

The following tests shall be carried out on the insulator string and also on unit disc insulators.

6.1 TYPE TESTS

This shall mean those tests which are to be carried out to prove the design, process of manufacture and general conformity of the material and product with the intents of this specification. These tests shall be conducted on a representative number of samples prior to commencement of commercial production. The successful supplier shall indicate his schedule for carrying out these tests.

6.2 ACCEPTANCE TESTS

This shall mean those tests which are to be carried out on samples taken from each lot offered for pre-despatch inspection for the purpose of acceptance of the lot.

6.3 ROUTINE TESTS

This shall mean those tests, which are to be carried out on each insulator to check the requirements which are likely to vary during production.

6.4 STAGE TESTS DURING MANUFACTURE

Stage tests during manufacture shall mean those tests which are to be carried out during the process of manufacture to ensure quality control such that the end product is of the designed quality conforming to the intent of this specification.

6.5 TEST VALUES

For all type and acceptance tests, the acceptance values shall be the value guaranteed by the Supplier in the guaranteed technical particulars or the acceptance value specified in this specification or the relevant standard whichever is more stringent for that particular test.

6.6 TEST PROCEDURES AND SAMPLING NORMS

The norms and procedure of sampling for the above tests shall be as per the relevant Indian Standard or other Internationally accepted standards. This will be discussed and mutually agreed to between the successful Supplier and Purchaser before placement of order. The standards and norms according to which these tests are to be carried out are listed against each test. Where a particular test is a specific requirement of this specification, the norms and procedure for the same shall be as specified in Appendix-I attached hereto or as mutually agreed to between the successful Supplier and the Purchaser in the Quality Assurance Programme. The supplier shall offer at least three times the quantity of materials required for conducting all the type tests for sample selection. Before sample selection, the supplier shall be required to conduct all the acceptance tests successfully in presence of Purchaser's representative.

6.7 DETAILS OF TYPE TESTS

6.7.1 The material offered shall be fully type tested as per this specification and the Supplier shall furnish four sets of type test reports alongwith the offer. These tests must not have been conducted earlier than five years.

6.7.2 Following type tests shall be conducted on string insulators/unit disc insulators

a)	Visible discharge test	IS:731
b)	Impulse voltage withstand test	IS:731
c)	Wet power frequency voltage withstand test	IS:731
d)	Verification of dimension test	IS:731
e)	Temperature cycle test	IS:731
f)	Electro-Mechanical failing load test	IS:731
g)	Puncture test	IS:731
h)	Porosity test	IS:731
i)	Galvanising test	IS:731
j)	24 hours mechanical failing load test	IS:731
k)	Metallurgical test	IS:2108 & IS:2004

6.8 DETAILS OF ACCEPTANCE AND ROUTINE TESTS

6.8.1 All Acceptance and Routine tests as stipulated herein shall be carried out by the Supplier in the presence of Purchaser's representative. Immediately after finalisation of the programme of acceptance/routine testing, the Supplier shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the test.

6.8.2 For String Insulator Units following Acceptance & Routine tests shall be conducted:

(A) Acceptance tests:

a)	Verification of dimensions	IS:731
b)	Temperature cycle test	IS:731

c)	Galvanising test	IS:731
d)	Mechanical performance test	IEC:575
e)	Test on locking device for ball and socket coupling	IEC:372/IS-2486(part-IV)
f)	Eccentricity test	As per Specification
g)	Electro-mechanical strength test	IS-731
h)	Puncture test	
i)	Porosity test	

(B) Routine tests:

a)	Visual Inspection	IS-731
b)	Mechanical routine test	
c)	Electrical routine test	IEC:383

6.9 Tests during Manufacture (STAGE TESTS)

On all components as applicable

a)	Chemical analysis of Zinc used for galvanizing	As per this Specification
b)	Chemical analysis, mechanical and metallographic test and magnetic particle inspection for malleable castings	
c)	Chemical analysis, hardness test and magnetic particle inspection for forgings	
d)	Crack detection test for metal parts	

6.10 ADDITIONAL TESTS

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

6.11 COORDINATION FOR TESTING:

For 400KV/220KV/132KV insulator strings, the Supplier is required to produce type test reports to the satisfaction of the Purchaser. However, in case the Purchaser desires, the Supplier shall conduct all the type tests on the complete string with relevant hardware fittings. Responsibility of arranging required hardwares for the purpose of type testing will remain with the insulator Supplier.

7.0 INSPECTION

7.1 i) Purchaser and its representatives shall at all times be entitled to have access to the works and to all places of manufactures where insulators are

manufactured and the successful Supplier shall afford all facilities to them for unrestricted inspection of the works, inspection of material, inspection of manufacturing process of insulators and for conducting necessary tests as specified herein.

- ii) The successful Supplier shall keep the Purchaser informed in advance of the time of starting and progress of manufacture of insulators 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 and tested.
- iv) The acceptance of any quantity of insulators shall in no way relieve the successful Supplier of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection, if such disc insulators are later found to be defective.

7.2 IDENTIFICATION MARKING

7.2.1 Each disc insulator shall be legibly and indelibly marked with the trade mark of the manufacturer, the month and year of manufacture, the guaranteed combined mechanical and electrical strength in kilo-newtons abbreviated by 'KN' to facilitate easy identification and proper use.

7.2.2 The marking shall be on porcelain shell of insulators. The marking shall be printed and not impressed/embossed and same shall be applied before firing.

7.2.3 One 10mm thick ring of good quality paint shall be marked on the cap of each insulator of particular strength for easy identification of the type of insulator. The paint shall not have any deteriorating effect on the insulator performance. Following codes shall be used as identification mark:-

- For 70kN disc insulator – Green
- For 90kN disc insulator – Blue
- For 120kN disc insulator- Yellow
- For 160kN disc insulator – Red

8.0 QUALITY ASSURANCE PLAN

8.1 The Supplier hereunder shall invariably furnish following information alongwith his offer, failing which the offer shall be liable for rejection. Information shall be separately given for individual type of material offered.

- i) Statement giving list of important raw materials, names of sub-suppliers for the raw material, list of standards according to which the raw material are tested, list of tests, normally carried out on raw material in presence of Supplier'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 in quality control and details of such test and inspections.
 - vi) Special features provided in the insulators to make it maintenance free.
 - vii) List of testing equipment available with the Supplier for final testing of insulators specified and test plant limitation, if any, vis-a-vis the type, special, acceptance and routine tests specified in the relevant standards.
- 8.2 The successful Supplier shall within 30 days of placement of order submit the following information to the Purchaser.
- i) List of raw material as well as bought out accessories and the name of material 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 Purchaser's inspection. The QAP and Purchaser's hold points shall be discussed between the Purchaser and the Supplier before the QAP is finalized.
- 8.3 The successful Supplier shall submit the routine test certificates of bought out items and raw material at the time of routine testing of the insulator.

9.0 DOCUMENTATION

- 9.1 The Supplier shall furnish full description and illustrated catalogues of insulators offered, alongwith the bid. The supplier shall also furnish alongwith the bid the outline drawing of each insulator unit including cross-sectional view of the shell. The drawing shall include the following information :
- i) Shell diameter and unit spacing with manufacturing tolerance.
 - ii) Creepage distance.
 - iii) Unit mechanical and electrical characteristics as also for the complete string-suspension and tension.
 - iv) Size and weight of ball and socket part.
 - v) Weight of unit insulator disc.
 - vi) Materials for the disc, cap and pin.
 - vii) Identification mark.
 - viii) Manufacturer's catalogue number.

- ix) Brief installation instructions.
- x) Relevant technical details of significance.

9.2 TEST REPORTS

- i) Four copies of type test reports shall be furnished to the Purchaser within one month of conducting the tests. One copy will be returned duly certified by the Purchaser to the Supplier within three weeks thereafter and on receipt of the same Supplier shall commence with the commercial production of the insulators.
- ii) Four copies of acceptance 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 requested for by the Purchaser.

10.0 PACKING & FORWARDING

- i) All disc insulators shall be packed in strong seasoned wooden crates. The gross weight of the crates alongwith disc insulators shall not normally exceed 100 kg. to avoid handling problem.
- ii) The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.
- iii) Suitable cushioning, protective padding, or dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.
- iv) All packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and avoid the possibility of goods being lost or wrongly dispatched on account of faulty packing and faulty or illegible markings. Each wooden case/crate shall have all the markings stenciled on it in indelible ink.

11.0 SPECIFICATION DRAWINGS

The specification drawing in respect of the disc insulators indicated above is attached with this specification. The specification drawing is attached herewith for information and guidance of the Supplier only. The drawings to be furnished by the Supplier shall be as per his own design and manufacture and shall be distinct and separate from these specification drawings.

The drawing shall include but not limited to the following information :-

- a) Shell diameter and ball to ball spacing with manufacturing tolerances.
- b) Minimum creepage distance with positive tolerance.

- c) Protected creepage distance
- d) Eccentricity of the disc
 - i) Axial run out
 - ii) Radial run out
- e) Unit mechanical and electrical characteristics
- f) Size and weight of ball & socket parts
- g) Weight of unit insulator disc
- h) Materials
- i) Identification mark
- j) Manufacturer's catalogue number.

After placement of award, the supplier shall submit full dimensioned manufacturing drawing of insulator cap, pin & insulator shell in six copies to the purchaser for reference & record.

Appendix-I

TEST DETAILS

1. Voltage Distribution Test:

The voltage across each insulator unit shall be measured by sphere gap method. The result obtained shall be converted into percentage and proportionate correction be applied so as to give a total of 100% distribution. The voltage across any disc shall not exceed 9% for suspension insulator strings and for double tension insulator strings. The total of the voltage distribution of all discs so computed shall be within 95% and 105%. If not, the test shall be repeated. The proportions correction shall be made on the values so as to give a total of 100% distribution.

2. Mechanical Strength Test:

The complete insulator string alongwith its hardware fittings excluding arcing horn, corona control ring/grading ring and suspension assembly/dead end assembly shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. After removal of the load, the string components shall not show any visual deformation and it shall be possible to disassemble them by hand. Hand tools may be used to remove cotter pins and loosen the nuts initially. The string shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

3. Vibration Test:

The suspension string shall be tested in suspension mode, and tension string in tension mode itself in laboratory span of minimum 30 metres. In the case of suspension

string a load equal to 600 kg shall be applied along the axis of the suspension string by means of turn buckle. The insulator string alongwith hardware fittings and two sub-conductors (each tensioned at 4500 kg) shall be secured with clamps. The system shall be suitable to maintain constant tension on each sub-conductors throughout the duration of test. Vibration Dampers shall not be used on the test span. Both the sub-conductors shall be vertically vibrated simultaneously at one of the resonance frequencies of the insulator string (more than 10 Hz) by means of vibration inducing equipment. The amplitude of vibration at the antinode point nearest to the string shall be measured and the same shall not be less than $+ 120/f$, f being the frequency of vibration. The insulator string shall be vibrated for five million cycles then rotated by 90 deg. and again vibrated for 5 million cycles without any failure. After the test, the disc insulators shall be examined for looseness of pins and cap or any crack in the cement. The hardware fittings shall be examined for fatigue failure and mechanical strength test. There shall be no deterioration of properties of hardware components and disc insulators after the vibration test.

The disc insulators shall be subjected to the following tests as per relevant standards:

		Percentage of discs to be tested
	Temperature cycle test followed by mechanical performance test	60
	Puncture test (for porcelain insulator only)	40

If the results of the second test show a porcelain shell rupture, the production does not comply with this specification.

4. Chemical Analysis of Zinc used for Galvanising:

Samples taken from the zinc ingot shall be chemically analysed as per IS:209. The purity of zinc shall not less than 99.95%.

5. Tests for Forgings:

The chemical analysis, hardness tests and magnetic particle inspection for forgings, will be as per the internationally recognized procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Supplier and Purchaser in Quality Assurance Programme.

6. Test on Castings:

The chemical analysis, mechanical and metallographic tests and magnetic particle inspection for castings will be as per the internationally recognized procedures for these tests. The samplings will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Supplier and Purchaser in Quality Assurance Programme.

7. Eccentricity Test:

The insulator shall be vertically mounted on a fixture using dummy pin and socket. A vertical scale with horizontal slider shall be used for the axial run out. The pointer shall be positioned in contact with the bottom of the outermost petticoat of the disc. The disc insulators shall be rotated with reference to the fixture and the slider shall be allowed to move up and down on the scale but always maintaining contact with the bottom of the outer most petticoat. After one full rotation of the disc, the maximum and minimum position the slider has reached on the scale can be found out. Difference between the above two readings shall satisfy the guaranteed value for axial run out. Similarly using a horizontal scale with vertical slider the radial run out shall be measured. The slider shall be positioned on the scale to establish contact with the circumference of the disc insulator and disc insulator rotated on its fixture always maintaining the contact. After one full rotation the maximum and minimum position of the slider reached on the scale are found out. The difference between the above readings shall satisfy the guaranteed value for radial run out.

8. Crack Detection Test:

Crack detection test shall be carried out on each ball and pin before assembly of disc unit. The manufacturer shall maintain complete record of having conducted such tests on each and every piece of ball pin. The supplier shall furnish full details of the equipment available with him for crack test and also indicate the test procedure in detail.

SYSTEM PARTICULARS

S.No.	PARTICULARS	Electrical System Data		
		A.C. 3phase	A.C. 3phase	A.C. 3phase
1	System			
2	Line voltage (kV rms)	220	132	400
3	Max.voltage (kV rms)	245	145	420
4	Frequency	50Hz.	50Hz.	50 Hz
5	Neutral grounding system	effectively earthed	effectively earthed	effectively earthed
6	Lightning impulse with-stand voltage(dry & wet)(kVp)	1050	550	1425
7	Power frequency withstand voltage (wet) (kVp)	395	230	630
8	Switching surge withstand voltage (wet) (kVp)	650	325	1050
9	Short circuit level (kA)	40	40	40
10.	Minimum corona extinction voltage at 50 Hz AC system dry condition (Kv rms)	-	-	320

11.	Radio interference voltage at one MHz for phase to earth voltage of 266KV dry conditions(Microvolt)	-	-	500
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APPENDIX – A1

PRINCIPLE PARAMETERS AND OTHER REQUIREMENT FOR ACSR CONDUCTOR

Principal Parameters of Stranded Conductor:

S.No	Details of Stranded Conductor	ACSR Moose	ACSR Zebra	ACSR Panther
a)	No. of Strands	Aluminium-54 Steel –7	Aluminium-54 Steel –7	Aluminium-30 Steel-7
i.	Steel Centre	1	1	1
ii.	1 st Steel Layer	6	6	6
iii.	1 st Aluminium Layer	12	12	12
iv.	2 nd Aluminium Layer	18	18	18
v.	3 rd Aluminium Layer	24	24	-
b)	Sectional Area of Aluminium (mm ²)	528.5	428.9	212.10
c)	Total Sectional Area (mm ²)	597	484.50	261.60
d)	Overall diameter(mm)	31.77	28.62	21.00
e)	Approximate weight (Kg/Km)	2004	1621	976
f)	Calculated D.C. Resistance at 20°C (Ohm/Km)	0.0552	0.06915	0.139
g)	Minimum UTS (kN)	161.2	130.32	89.67
h)	Modulus of Elasticity (Kg/cm ²)	0.686 x 10 ⁶	0.686 x 10 ⁶	0.787 x 10 ⁶

The details of aluminium strand are as follows:

S. No.	Details of Aluminium Strands	ACSR Moose	ACSR Zebra	ACSR Panther
i)	Minimum breaking load of strand Before stranding (kN)	1.57	1.29	1.17
j)	Minimum breaking load of strand after stranding (kN)	1.49	1.23	1.11

k)	Maximum D.C. resistance of strand at 20°C (Ohm/Km)	2.921	3.651	4.107
l)	Nominal Strand Dia	3.53	3.18	3.00
m)	Max. Strand Dia	3.55	3.21	3.03
n)	Min. Strand Dia	3.51	3.18	3.00
o)	Mass (Kg/Km) of Strand at Nominal Dia	21.47	21.47	19.11

The details of steel strand are as follows:

S. No	Details of Steel Strands	ACSR Moose	ACSR Zebra	ACSR Panther
p)	Minimum breaking load of strand Before stranding (kN)	12.86	10.43	9.29
q)	Minimum breaking load of strand after stranding (kN)	12.22	9.91	8.83
r)	Nominal Strand Dia	3.53	3.18	3.00
s)	Maximum Strand Dia	3.60	3.24	3.06
t)	Minimum Strand Dia	3.46	3.18	3.00
u)	Mass (Kg/Km) of Strand at Nom. Dia	76.34	61.95	55.18
v)	Zinc coating testing	3 dips of 1 min. each	3 dips of 1 min. each	3 dips of 1 min. each
w)	Wt. of Zinc Coating (gms./m ²)	260	260	260

APPENDIX – A2**PRINCIPLE PARAMETERS AND OTHER REQUIREMENT FOR SCREENING CONDUCTOR (HIGH TENSILE GALVANISED STEEL EARTH WIRE)****PRINCIPAL PARAMETERS OF EARTH WIRE:**

The standard technical particulars of 7/3.66mm galvanized steel earth wire shall be as follows:-

- a. The details of Steel strand:

Sr. No.	Details of steel strands	Earth Wire
a)	Material	Steel
b)	Stranding	7
c)	Weight per Km	583 Kgs
d)	Dia. of wire	3.66 mm
e)	Tolerance	2%
f)	Minimum elongation in 100 mm length	5 mm
g)	Minimum breaking strength per strand	1000 Kg
h)	Minimum tensile strength	95 Kg./mm ²
i)	D.C. resistance at 20°C	17.15 Ohms/Km

- b. The details of Stranded Earth Wire :

Sr. No.	Details of Stranded Earth Wire	Earth Wire
i.	Maximum Length of Lay	198
ii.	Minimum Length of Lay	165
iii.	Minimum breaking load	6972 Kgs
iv.	Overall diameter	10.98mm
v	Modulus of elasticity	1.933 x 10 ⁶ Kg./cm ²
vi	Co-efficient of linear expansion	11.50 x 10 ⁻⁶ per °C
vii	Weight of zinc coating on wire	260 gms./m ² (Min.)
viii	No. of one minute dip and half minute dip respectively	3 one minute and 1 half minute
ix	Calculated d.c. Resistance at 20°C	2.5 Ohms per Km

APPENDIX – A3

PRINCIPLE PARAMETERS AND OTHER REQUIREMENT FOR 70 KN, 90 KN, 120 KN & 160 KN EMS PORCELAIN DISC INSULATORS

1. DETAILS OF DISC INSULATORS

- 1.1 The insulator strings shall consist of standard discs for a three phase 50 Hz, effectively earthed 400KV/220KV/132KV transmission system in a moderately polluted atmosphere. The discs shall be cap and pin, ball and socket type.
- 1.2 The specified values and disc dimensions, impulse and power frequency voltages, electromechanical strength [EMS] of individual insulator units are as under. The values given are minimum which apply to all cases. Specified withstand and flashover voltages are referred to standard atmospheric condition.

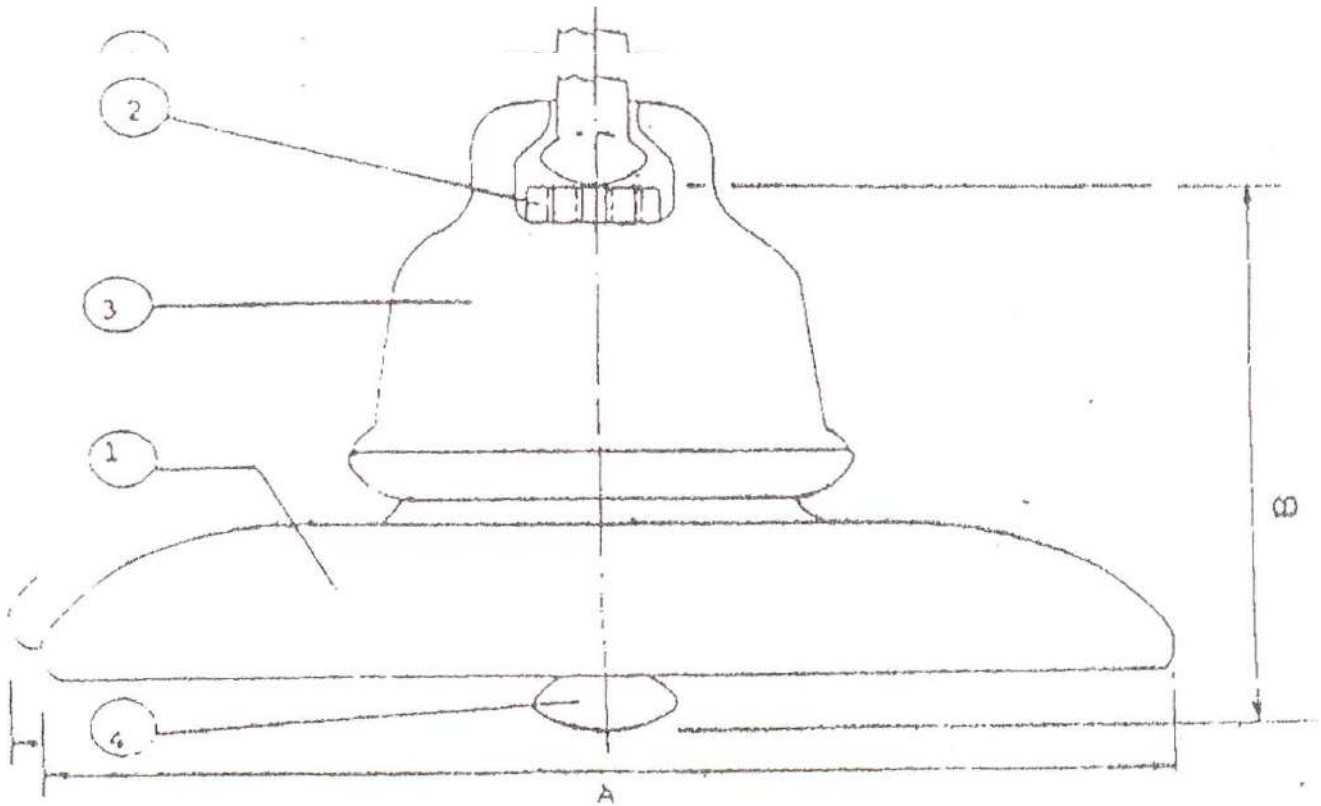
2. CHARACTERISTICS OF DISC INSULATORS

The disc insulators should have the following particulars and characteristics:

S.No	Particulars	Disc Insulators			
		70KN EMS	90kN EMS	120kN EMS	160kN EMS
i	Diameter of the disc (mm)	255	255	255	280
ii	Spacing of the disc (mm)	145	145	145	170
iii	Size and designation of pin-ball shank	16 mm	16 mm	20mm	20 mm
iv	Creepage distance (mm) (minimum)	320	320	320	330
v	Power frequency one minute dry withstand voltage kV (rms)	70	75	75	75
vi	Power frequency one minute wet withstand voltage kV (rms)	40	45	45	45
vii	Power frequency puncture withstand voltage kV (rms)	120	125	125	125
viii	Minimum dry impulse withstand voltage 1.2x50 micro second wave, positive and negative Kv Peak)	110	110	110	120
ix	Maximum Radio interference voltage with 10 kV RMS to ground. (microvolts)	50	50	50	50
x	Minimum corona extinction voltage kV (rms)	9	9	18	18

APPENDIX - B
DRAWINGS

S. No.	Drawing No.	Description
1	JICA/MPPTCL/TR-101 TO 107/	Drawing for 70KN, 90KN and 160KN Disc Insulator
2	JICA/MPPTCL/TR-101 TO 107/	Drawing for 120KN Disc Insulator



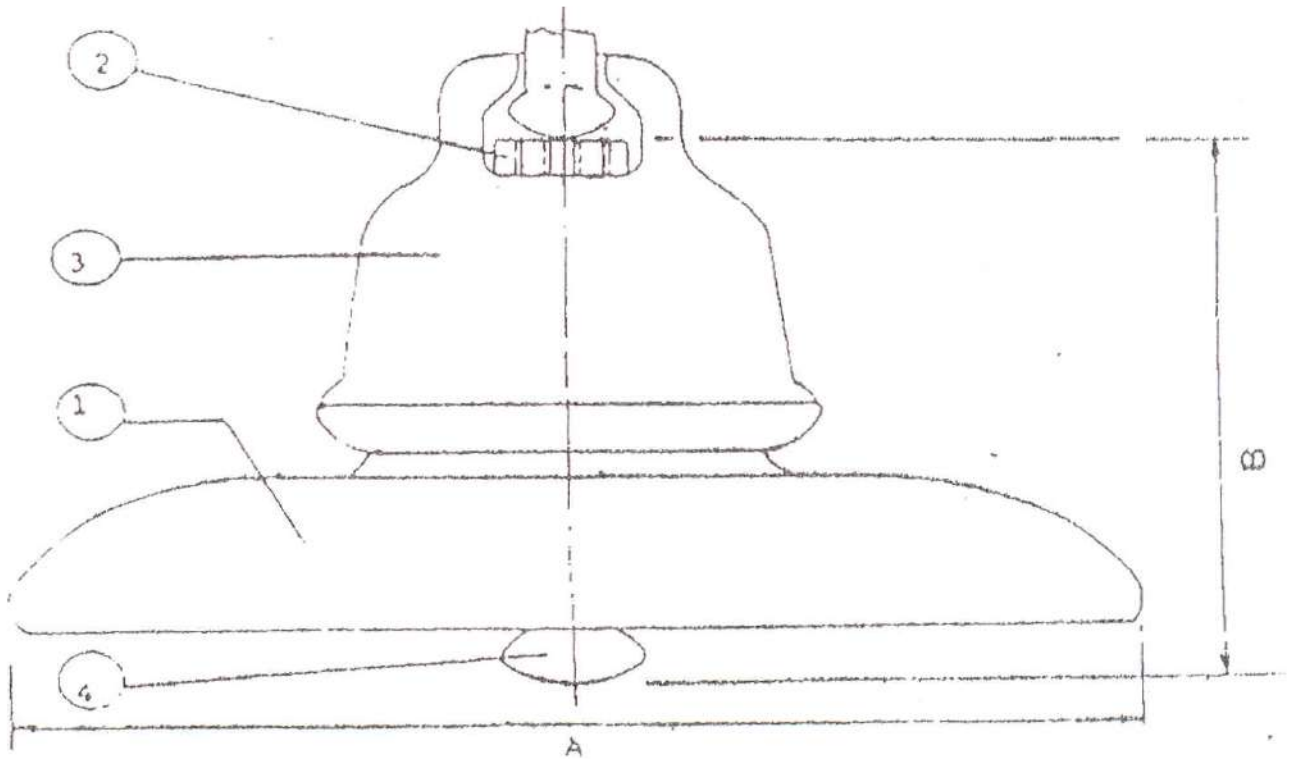
ITEM DESCRIPTION	MATERIAL
1. SHELL	PORCELAIN
2. SECURITY CLIP	PHOSPHOR BRONZE/STAINLESS STEEL
3. CAP	MCI
4. BALL PIN	FORGED STEEL

PARTICULARS:-

S.NO.	EMS OF DISC INSULATOR	DIAMETER (A)	SPACING (B)	MINIMUM CREEPAGE DISTANCE	SIZE OF BALL SOCKET
1.	70 KN	200	145	320	16
2.	90 KN	200	145	320	16
3.	160 KN	280	170	330	20

**NOTE. (1) TOLERANCE AS INDICATED IN THIS SPECIFICATION
(2) ALL DIMENSIONS IN MM**

160 KN DISC INSULATOR OF BALL & SOCKET TYPE FOR TENDER PURPOSE ONLY
--



ITEM DESCRIPTION	MATERIAL
1. SHELL	PORCELAIN
2. SECURITY CLIP	PHOSPHOR BRONZE/STAINLESS STEEL
3. CAP	MCI
4. BALL PIN	FORGED STEEL

PARTICULARS:-

S.NO.	EMS OF DISC INSULATOR	DIAMETER (A)	SPACING (B)	MINIMUM CREEPAGE DISTANCE	SIZE OF BALL SOCKET
1.	120 KN	255	145	320	20

**NOTE. (1) TOLERANCE AS INDICATED IN THIS SPECIFICATION
(2) ALL DIMENSIONS IN MM**

120 KN DISC INSULATOR OF BALL & SOCKET TYPE FOR TENDER PURPOSE ONLY
--

SCHEDULE – I (A)**DESCRIPTION OF EQUIPMENT FOR SCHEDULE FOR RATES AND PRICES
TO BE FURNISHED IN VOLUME-VI**

S.No.	Material Particulars	Quantity
1	ACSR Conductors	As per Price Schedule
	Supply of 54/7/3.53 mm ACSR Moose Conductor	
	Supply of 54/7/3.18mm ACSR Zebra Conductor	
	Supply of 30/7/3.00mm ACSR Panther Conductor	
2	Supply of Screening Conductor (7/3.66 mm Earthwire)	
3	Disc Insulators	
	Supply of 70 KN EMS Porcelain Disc Insulator	
	Supply of 90KN EMS Porcelain Disc Insulator	
	Supply of 120 KN EMS Porcelain Disc Insulator	
	Supply of 160 KN EMS Porcelain Disc Insulator	

NOTE: 1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.

2. The quantity of above equipments has been mentioned in Volume VI

SECTION – II

2.5.2 TECHNICAL SPECIFICATION FOR MS FLATS & MS ROUND

1.0 SCOPE -

This scope of this specification covers design, manufacturing supply of MS Flat and MS Round for EHV substations as per Section-I, Volume-II. The bidder mentioned in the Section of Technical specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment / material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS -

Applicable standards for offered equipment / material shall be as per Section-I, Volume – II.

3.0 CLIMATIC CONDITIONS –

Applicable climatic conditions shall be as per Section-I, Volume – II.

4.0 SYSTEM PARTICULARS -

Applicable system particulars shall be as per Section-I, Volume – II.

5.0 SIZE OF MS FLATS & MS ROUND –

The following sizes of MS Flats & MS Round are covered in this specification:-

S. No.	Material Particulars
A	MS Flats
1	75X8 mm
2	50X6 mm
3	65x8 mm
B	MS Round
1	40 mm

6.0 MATERIAL -

The MS Flats & MS Round should be conforming to latest version of IS: 2062. Tested MS Flats & MS Round having its yield strength not less than 2550 kg/sq cm shall be used. If re-rolled materials are supplied, then it must be ensured that Re-rolling of MS Flats & MS Round is done from billets/ingots of tested quality only and re-rolled sections are duly tested as per relevant IS.

7.0 WEIGHMENT-

The Weighment shall be witnessed by the consignee at the time of taking delivery. The Weighment recorded in the Material Receipt Certificate (MRC) issued by the consignees shall be final. The bidder / manufacturer is exclusively responsible for any loss in transit.

8.0 VARIATION IN QUANTITY-

Variation in ordered quantity of any size and overall ordered quantity shall be to the extent of $\pm 2\%$ only. Any claim of quantity supplied in excess of these limit shall not be admitted.

9.0 LENGTH-

The MS Flats & MS Round shall be supplied in following lengths:

- i. M.S.Flats : 5.5 Mtrs. to 15 Mtrs.
- ii. M.S.rounds : 7 Mtrs. to 15 Mtrs.

Any tolerance on negative side shall not be accepted.

10.0 PACKING & MARKING-

Each bundle or packing shall be marked in "legible English letters" in the following manner.

- i. Reference of purchase order
- ii. The name of the consignee
- iii. Manufacturer's identification.

The marking shall be stenciled and indelibly inked on the each member in the bundles.

11.0 GENERAL GUIDE-LINES FOR INSPECTION-

FOR MS FLATS & MS ROUND

- i. Visual examination and quantity verification of offered lot.
- ii. One no. sample shall be selected from the offered lot of every 50 MT or part thereof for each Size.
- iii. Dimensional verification of MS Flats & MS Round.
- iv. Tensile test and Bend test of each sample.
- v. Chemical composition test of one sample of every 50 MT or part thereof.
- vi. Verification of manufacturer's test certificate for billets/ingots used in rolling of MS Flats & MS Round.

12.0 INSPECTION AND TEST CERTIFICATES -

- (i) MS Flats & MS Round to be supplied will be subject to inspection and approval by the MPPTCL 's representative before dispatch and / or on arrival at the destination. Inspection before dispatch shall not, however, relieve the supplier of his responsibility to supply the MS Flats & MS Round strictly in accordance with the specification.
- (ii) The successful bidder / manufacturer shall abide by all the statutory provisions, acts such as the Indian Electricity Act, Indian Factory Act,

Indian Boiler Act etc., and corresponding rules and regulations as may be applicable and as amended from time to time.

- (iii) The MPPTCL's representative shall be entitled at all reasonable time during manufacture to inspect, examine and test at the bidder's premises the materials and workmanship of the material to be supplied.
- (iv) As soon as the material is ready for testing, the supplier shall intimate the MPPTCL well in advance, so that action could be taken for getting the material inspected. The material shall not be dispatched unless waiver of inspection is obtained or inspected by the MPPTCL's authorized representative. When the material has passed the specified tests, the MPPTCL's representative shall furnish a certificate to this effect in writing to the supplier. The MS Flats & MS Round shall not be dispatched unless the test certificates are approved.
- (v) Test certificates shall be in accordance with latest version of the relevant Indian Standards.
- (vi) The acceptance of any batch shall in no way relieve the supplier of any of his responsibilities for meeting all the requirements of the specification and shall not prevent subsequent rejection at any item if the same is later found defective.
- (vii) In case, MS Flats & MS Round is not found as per the relevant specification, it shall be liable for rejection even after receipt.
- (viii) Defects which may appear during manufacture shall be made good.
- (ix) Testing charges shall be born by the bidder.

13.0 ROUTINE TEST CERTIFICATES -

The successful Bidder/ Manufacturer shall submit the routine test certificates of raw material at the time of routine testing of MS Flats & MS Round.

14.0 PREFERRED EXPERIENCED MANUFACTURER:

Based on our past experience for this item we will accept equipment / material manufactured by M/s. SAIL, M/s. RINL, M/s. Unique Structures, M/s. Pushpak Steel and M/s. Karam Steel as for as this item is concerned.

15.0 IMPORTANT NOTE FOR BIDDERS-

In this bid, the Bidders will have to furnish confirmation in regard to compliance of our entire technical requirements. The bid should clearly describe various technical particulars of the MS Flats & MS Round as per details given in this specification. Based on above information all details required in Schedules should be furnished so that we may be able to examine whether the Bid submitted is technically acceptable or not.

APPENDIX - A

**DISCRIPTION OF MATERIAL INCLUDED IN THE SCHEDULE-I OF PRICES
FOR EACH PACKAGE.**

S. No.	Material Particulars
A	MS Flats
1	75X8 mm
2	50X6 mm
3	65x8 mm
B	MS Round
1	40 mm

Note:- The above description of the material is given for the purpose of offering the prices and to mention description of material in invoices for claiming payment.

SCHEDULE – I (A)**DESCRIPTION OF MATERIAL FOR SCHEDULE OF RATES AND PRICES
TO BE FURNISHED IN VOLUME -VI**

S.No.	Particulars	Qty
1	MS Flats	As per Price Schedule
a.	75X8 mm	
b.	50X6 mm	
c.	65x8 mm	
2.	MS Round	
a.	40 mm	

Note :

1. The above description of material is given for the purpose of offering the prices and to mention description of material in Invoice for claiming payment.
2. The quantity of above material has been mentioned in Volume VI.

SECTION – II

2.5.3 TECHNICAL SPECIFICATIONS FOR POWER AND COPPER CONTROL CABLES

1.0 SCOPE:

This scope of this specification covers design, manufacturing supply of Power and Copper Control Cables as per Section-I, Volume-II. The bidder mentioned in the Section of Technical specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment / material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS :

Applicable standards for offered equipment / material shall be as per Section-I, Volume-II.

3.0 CLIMATIC CONDITIONS :

Applicable climatic conditions shall be as per Section-I, Volume-II.

4.0 SYSTEM PARTICULARS :

Applicable system particulars shall be as per Section-I, Volume-II.

5.0 GENERAL TECHNICAL REQUIREMENTS & CONSTRUCTIONAL DETAILS :

The cables shall be suitable for laying on racks, in ducts, trenches, conduits and underground buried installation with chances of flooding by water. Cables shall be designed to withstand mechanical, electrical and thermal stresses developed under steady-state and transient operating conditions as specified elsewhere in this specification.

5.1 CONTROL CABLES:

Control cables shall be of 1.1 KV grade, multicore (as specified in Clause 1.3 above), PVC insulated, PVC inner sheathed, Armoured, PVC outer sheathed with Solid copper conductor for cables of 2.5 sq.mm and 4 sq. mm sizes and Stranded copper conductor for cables of 10 sq.mm size conforming to latest version of IS:1554 or equivalent International Standards.

5.1.1 CONDUCTOR:

The conductor shall be made from high conductivity copper rods complying with latest version of IS:613 or equivalent International Standards. The conductor shall consist of annealed copper wires complying with IS:8130 with latest amendments or equivalent International Standards.

5.2 INSULATION:

The conductor shall be provided with PVC insulation applied by extrusion in accordance with latest version of IS:5831 or equivalent International Standards. The average thickness of insulation shall be in accordance with the IS:1554 (Part-I) with latest amendments or equivalent International Standards.

The insulation shall be so applied that it fits closely on the conductor and shall be possible to remove it without damages to the conductor.

5.3 CODE IDENTIFICATION:

Colouring of insulation shall identify cores of the cables of upto 5 cores. Following colour schemes shall be adopted:

S. No.	Number of Cores	Colour Scheme
1	1 Core	Red, Black, Yellow or Blue
2	2 Cores	Red and Black
3	3 Cores	Red, Yellow and Blue
4	4 Cores	Red, Yellow, Black and Blue
5	5 Cores	Red, Yellow, Black, Blue and Grey
6	6 Cores and above	Two adjacent cores (counting and direction core) in each layer, Blue and Yellow, remaining cores Grey or in accordance with the scheme given in IS: 1554 Clause 10.3

The cables having more than 5 cores, as an alternate to the provision of (6) above, the core identification may be done by numbers as indicated in latest version of IS :1554 (PART-I) Clause 10.3.

5.4 LAYING UP OF CORES:

In multi-core cables, the cores shall be laid up together with a suitable lay, the outer most layer shall have right-hand lay and successive layer shall be laid with opposite lay, where necessary, the interstices shall be filled with non hygroscopic materials.

5.5 INNER SHEATH:

The laid up cores shall be provided with inner sheath applied by extrusion. It shall be ensured that the shape be as circular as possible. The inner sheath shall be so applied that it fits closely on the laid up cores and it shall be possible to remove it without damage to the insulation. The thickness of inner sheath shall be conforming to latest version of IS:1554 (Part-I) or equivalent International Standards.

5.6 FILLER AND INNER SHEATH:

The filler and inner sheath shall be of the following:

- (i) Unvulcanised rubber, or
- (ii) Thermoplastic materials

Unvulcanised rubber or thermoplastic material used shall not be harder than PVC used for insulation and outer sheath. The material shall be chosen to be compatible with temperature ratings of the cable and shall have no deteriorious effect on any other component of the cable.

5.7 ARMOURING:

Armouring shall be of the following:

- (i) Galvanized round steel wires, or
- (ii) Galvanized steel strip.

The galvanized steel wires/ strips shall comply with the requirements of latest version of IS:3975 or equivalent International Standards. The armouring shall be of galvanized steel, as follows:

S. No.	Calculated nominal size of Cable under armour	Type of armour and size Steel strip/Round wire
1	Upto 13 mm.	1.4 mm. dia GS wire
2	Above 13 upto 25 mm.	0.8 mm. thick GS strip/1.6 mm. dia GS wire
3	Above 25 upto 40 mm.	0.8 mm. thick GS strip/2.0 mm. dia GS wire
4	Above 40 upto 55 mm.	1.4 mm. thick GS strip/2.5 mm. dia GS wire
5	Above 55 upto 70 mm.	1.4 mm. thick GS strip/3.15 mm. dia GS wire
6	Above 70 mm.	1.4 mm. thick GS strip/4.0 mm. dia GS wire

The gap between armour wire/strip shall not exceed one armour wire/strip space and there shall be no cross over/over-riding of armour wire/strip. The minimum area of coverage of armour shall be 90%. The breaking load of armour joint shall not be less than 95% of that of wire/strip. Zinc rich paint shall be applied on armour joint surface.

5.8 OUTER SHEATH:

The outer sheath shall be applied by extrusion. It shall be applied:

- (i) Over the inner sheath in case of unarmoured multicore cables.
- (ii) Over the armouring in case of armoured multicore cables.

The outer sheath shall be applied by extrusion. It shall be applied over the armouring in case of armoured multicore cables. The outer sheath shall be so applied that it fits closely over armouring. It shall be possible to remove it without damage to the insulation/inner sheath. The colour of the outer sheath shall be black.

The thickness of outer sheath insulation shall conform to latest version of IS:1554 Part-I or equivalent International Standards.

6.0 ALUMINIUM POWER CABLES:

Power cables shall be of 1.1 KV grade, multicore (as specified above), PVC insulated, PVC inner sheathed, armoured, PVC outer sheathed with stranded Aluminium conductor and Heavy duty Galvanized Single Flat Steel armoured conforming to IS 1554 or equivalent International Standards.

6.1 CONDUCTOR:

Aluminium conductor used in power cables shall comply with latest version of IS:8130 or equivalent International Standards.

7.0 IDENTIFICATION:

In addition to Manufacturer's identification on cable as per Clause-17.1 of IS:1554 (Part-I) with latest amendments, following marking shall also be embossed over outer sheath at every three meters:

- (i) Cable size and voltage grade.

- (ii) Word "PROPERTY OF MP POWER TRANSMISSION COMPANY" and Name of manufacturer.

Besides above Marking for length of Cable at every one meter shall also be done on outer sheath of cable.

The embossing shall be increase, automatic in line throughout the length of the Cable and shall be legible and indelible.

8.0 PACKING AND MARKING:

Cables shall be supplied in non-returnable wooden drums or steel drums of heavy construction. The surface of the drum and outer most cable layer shall be covered with waterproof layer. Both the ends of the cables shall be properly sealed with heat shrinkable PVC or rubber caps, secured by 'U' nails so as to eliminate ingress of water during transportation storage and erection. Wooden preservative antitermite shall be applied to the entire drums. Wooden drums should comply with latest version of IS:10418 or equivalent International Standards. The following information should be stenciled on the drum:

- (i) Reference to relevant Indian or International Standard.
- (ii) Manufacturer's name, brand name or trade mark.
- (iii) Type of cable and voltage grade.
- (iv) Number of cores.
- (v) Nominal cross-sectional area of the conductor.
- (vi) Cable code.
- (vii) Colour of cores.
- (viii) Length of cable on the drum.
- (ix) Number of lengths on drum (if more than one).
- (x) Direction of rotation of drum by means of an arrow.
- (xi) Approximate gross weight.
- (xii) Running end of cable.
- (xiii) Country of manufacturer and Year of manufacture.

9.0 STANDARD DRUM LENGTH:

The control cable should be jointless in each drum. The standard drum length for Copper Control cables shall be as follows;

For 220 and 132 KV Substation work	500 Mtrs
Power cable	500 Mtrs

10.0 TOLERANCE:

- (i) Tolerance on the overall diameter of the Cable shall be ± 2 mm over the declared value in the technical data sheets of Guaranteed Technical Particulars.
- (ii) The length per drum shall be subjected to maximum tolerance of $\pm 5\%$ of the standard drum length. The purchaser shall have option to reject cable drums with shorter length.

- (iii) Over all tolerance in total quantity for each type and size of cables shall be $\pm 2\%$

11.0 TESTS:

All types and sizes of cables being supplied shall be subjected to Type tests, Additional test, Routine tests and Acceptance tests as specified below at the expense of Supplier and according to relevant standards.

11.1 TYPE TESTS AND ADDITIONAL TESTS:

It is essential to furnish all the type test reports for each type and size of cable as stipulated in latest version of IS:1554 (Part-I) and following Additional tests alongwith the tender:

- (i) Loss of mass test
- (ii) Heat shock test
- (iii) Thermal stability test
- (iv) Accelerated water absorption test
- (v) Dielectric strength retention test

Above Type/Additional Tests shall be conducted in Government / Reputed Testing Laboratories and shall not be older than 5 Years.

For any change in the design/type, already type tested/tested for additional test and the design/type offered against this tender, the purchaser reserves the right to demand repetition of some or all type tests and additional tests without any extra cost on the first or any one lot of any rating included in the package.

11.2 ACCEPTANCE TEST:

Acceptance tests shall be carried out on each type and size of cables on cable drums selected at random as per following plan:

S. No.	Numbers of drums offered for inspection	Number of drums to be taken as samples
1	Upto 50	2
2	Upto 51 to 100	5
3	From 101 to 300	13
4	From 301 to 500	20
5	Above 501	32

The following shall constitute acceptance tests:-

- (i) Annealing test (for copper)
- (ii) Conductor Resistance test
- (iii) Test for thickness of insulation and sheath.
- (iv) Tensile strength and elongation test at break of insulation and sheath.
- (v) High voltage test (Water immersion test) – a.c. test only
- (vi) High Voltage test at room temperature and
- (vii) Insulation Resistance test

For carrying out acceptance tests, samples from the selected cable drums shall be taken from any portion of the cable length of the drum and not necessarily from its ends, for example the cable sample may be randomly taken from 125 mtr, 250 mtr, 375 mtr length etc. It may also be noted that after delivery of material at destination site/ store by the successful bidder, purchaser shall carry out inspection in similar fashion as indicated above and the material shall be accepted only after satisfactory inspection at site/ store.

11.3 ROUTINE TESTS

Routine tests shall be carried out for each drum of cables of all types and sizes. Following shall constitute routine tests :

- (i) Conductor Resistance test
- (ii) High Voltage Test at room temperature

12.0 INSPECTION:

- (i) The purchaser shall have access at all times to the works and all other places of manufacture, where the Cables are being manufactured and the successful Tenderer shall provide all facilities for unrestricted inspection of works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed in the tender document.
- (ii) The successful Tenderer shall keep the purchaser informed in advance of the time of starting and of the progress of manufacture of Cables in its various stages, so that arrangement could be made for inspection.
- (iii) No material shall be dispatched from the point of manufacture unless the material has been satisfactorily inspected and tested or pre-despatch inspection has been waived.
- (iv) For the purpose of inspection, it will be duty of the supplier to provide, to the inspecting officer, the detailed order, approved drawings, comments, if any, on the drawings and all amendments(if any) made in any term/ condition/specification/ GTP of the order and all relevant IS, IEC, standards. Failure to provide documents demanded by the inspector shall render the inspection as "Fake Inspection Call" and relevant penalty may be imposed on the supplier on this account.
- (v) The acceptance of any quantity of the material shall in no way relieve the successful tenderer of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such Material are later found to be defective.

13.0 INSPECTION PROGRAMME

13.1 Successful Tenderer shall chalk out a detailed inspection and testing programme for various manufacturing activities. The Purchaser also reserves the right to carryout any tests by a third party at its sole discretion. All Costs of inspection/tests shall be borne by you.

13.2 STAGE INSPECTION:

Successful Tenderer shall intimate the detailed manufacturing programme within 30 days from the date of placement of order. The MPPTCL will have a right to depute its inspecting officers during the manufacture of the cable at various stages of manufacturing for Stage Inspections. Purchaser shall normally depute its representative to carry out stage inspections at following stages of manufacturing of cables : -

- i. before drawing of conductor
- ii. before application of insulation on conductor
- iii. before application of inner sheath over laid up cores

Intimation for stage inspections as above for various lots shall be given by you one week in advance to organize deputation of inspecting officer. During stage inspections, the inspecting officer shall verify the sources of raw material, its quality etc. During this stage, following documents shall be verified by our inspector as a proof towards use of raw material for manufacture of Cables ordered by us.

- i. Invoice of the supplier
- ii. Factory test certificate
- iii. Packing list
- iv. Bill of lading, if applicable
- v. Bill of entry certificate by customs, if applicable

The Purchaser also reserves the right to carry out stage inspections at other stages also, for which advance intimation shall be given and all necessary cooperation shall be rendered by the manufacturer. Only after approval of the purchaser, the supplier shall proceed ahead for manufacturing of the cable. During stage inspection, adherence to the approved Quality Assurance Plan will also be checked.

A complete record of stage inspection shall be kept by you and this record shall be made available for inspection by the representative of the MPPTCL.

14.0 QUALITY ASSURANCE PLAN:

14.1 The Tenderer must establish that they are following a proper quality assurance programme for manufacture of Cables. The Tenderer shall invariably furnish following information alongwith his tender. Information shall be separately given for each type of cable:

- (i) Statement giving list of important raw materials, names of sub-suppliers for the raw material, list of standards according to which the raw material is purchased and copies of test certificates thereof.
- (ii) Information and copies of test certificates as in (i) above in respect of bought out items.
- (iii) List of manufacturing facilities available.
- (iv) Levels 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) List of testing equipment available with the Tenderer for final testing of cable specified and test plant limitation, if any, vis-à-vis type, special, acceptance and routine tests specified in the relevant

standards. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

14.2 The successful Tenderer 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 Tender.
- (ii) Type test certificates of the raw materials and bought out accessories.
- (iii) Quality Assurance Plan (QAP) with hold-up points for purchaser's inspection. The quality assurance plans and hold-up points shall be discussed between the Purchaser and supplier before the QAP is finalized.

14.3 The successful Tenderer shall submit the routine test certificates of bought out items and for raw material at the time of routine testing of cable.

APPENDIX – A

SIZE OF POWER & COPPER CONTROL CABLE

1.1 KV UNARMoured COPPER CONTROL CABLES:

19 Core 2.5 Sq mm

12 Core 2.5 Sq mm

8 Core 2.5 Sq mm

4 Core 2.5 Sq mm

2 Core 2.5 Sq mm

1.1 KV ARMoured COPPER CONTROL CABLES:

19 Core 2.5 Sq mm

12 Core 2.5 Sq mm

4 Core 2.5 Sq mm

4 Core 4 Sq mm

4 Core 10 Sq mm

2 Core 2.5 Sq. mm

ARMoured ALUMINIUM POWER CABLE:

3.5 Core 300 Sq mm

SCHEDULE – I (A)**DESCRIPTION OF MATERIAL FOR SCHEDULE OF RATES
AND PRICES TO BE FURNISHED IN
VOLUME -VI**

S.No.	Particulars	Qty
1.	1.1KV UNARMoured COPPER CONTROL CABLES	
a.	19 Core 2.5 Sq mm	As per Price Schedule
b.	12 Core 2.5 Sq mm	
c.	8 Core 2.5 Sq mm	
d.	4 Core 2.5 Sq mm	
e.	2 Core 2.5 Sq mm	
2.	1.1 KV ARMoured COPPER CONTROL CABLES:	
a.	19 Core 2.5 Sq mm	As per Price Schedule
b.	12 Core 2.5 Sq mm	
c.	4 Core 2.5 Sq mm	
d.	4 Core 4 Sq mm	
e.	4 Core 10 Sq mm	
f.	2 Core 2.5 Sq. mm	
3.	ARMoured ALUMINIUM POWER CABLE:	
a.	3.5 Core 300 Sq mm	As per Price Schedule

Note :

1. The above description of material is given for the purpose of offering the prices and to mention description of material in Invoice for claiming payment.
2. The quantity of above material has been mentioned in Volume VI.

SECTION – II

2.5.4 TECHNICAL SPECIFICATION FOR CLAMPS & CONNECTORS

1.0 SCOPE -

This scope of this specification covers design, manufacturing supply of Clamps & Connectors/ Spacers manufactured through Gravity Die Casting process/ Pressure Die Casting for EHV substations as per Section-I, Volume-II. The bidder mentioned in the Section of Technical specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment / material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS -

Applicable standards for offered equipment / material shall be as per Section-I, Volume-II.

3.0 CLIMATIC CONDITIONS –

Applicable climatic conditions shall be as per Section-I, Volume-II.

4.0 SYSTEM PARTICULARS -

Applicable system particulars shall be as per Section-I, Volume-II.

5.0 GENERAL TECHNICAL REQUIREMENTS FOR CLAMPS & CONNECTORS:

5.1 This section covers the design of current carrying type Clamps and Connectors for use in the 400 KV, 200 KV and 132 KV Switchyard . The connectors required would include those required for connections from terminals of equipments to conductors. Certain quantity of non-current carrying type clamps are also included. The scope of supply would include Clamps and Connectors/Spacers complete with associated bolts, nuts, Belleville /spring washers and flat washers as specified.

5.2 ***For each of the item, a drawing has been enclosed and all the items of Clamps & Connectors/Spacers should be offered strictly on the basis of above drawings.***

5.2.1 All the current carrying parts shall be so designed and manufactured to have minimum contact resistance. The maximum tension per conductor is expected to be 2000 Kgs.

5.2.2 The clamps shall so be designed that insulators shall not be subject to any abnormal stresses due to thermal changes in conductor.

5.2.3 All the clamps shall enable the connection to be as short as possible. Wherever possible the clamps shall be two separate halves.

- 5.2.4 Spacer shall prevent clashing of the “T” clamps and minimize effects of short circuit forces between bundle conductors on structures. They shall be capable of withstanding electro-magnetic and electrostatic forces during short circuit without deformation or damage to the conductor or spacer.
- 5.2.5 Spacers shall permit the relative axial and torsional movement of sub-conductors and maintain their correct separation without lubrication or maintenance.
- 5.2.6 All nuts, bolts & washers shall be made of hot dip galvanized Mild Steel conforming to relevant IS only.
- 5.2.7 The Material in all respect shall incorporate highest quality of modern engineering design and workmanship. The specification is merely for the guidance of the Bidder as has been clearly stated earlier and it is not the intention to specify the details of design and workmanship. The Clamps/ Spacers shall be designed and manufactured in accordance with the Bidder’s standard practices, when such practices do not conflict with this specification.
- 5.2.8 There shall not be any sharp edges which may lead to accumulation of charge & electrical breakdown. All corners/ edges shall be rounded.
- 5.2.9 The Material offered shall be complete with all components and accessories which are necessary or useful for their satisfactory performance and efficient maintenance. Such parts shall be deemed to be within the scope of this specification whether specifically included or not.
- 5.2.10 The design should be such that adequate clamping pressure is obtained with the tightening of the nuts and the pressure should be maintained throughout the service of the connector. In order to provide for creep of Aluminium under pressure, it is essential that only Belleville washers are used. This should be specifically confirmed and should also indicate tightening torque required.
- 5.2.11 All connectors and clamps shall be suitable to carry safely the maximum allowable current in the associated conductor and to withstand the maximum loads occurring under adverse circumstances and operating conditions. The maximum fault current is 40 KA rms for a period of 3 seconds. The temperature of the clamps and fittings shall never exceed that of the associated conductor.
- 5.2.12 The **short circuit current shall be of the order of 40 KA rms for 3 seconds**. The Clamps & Connectors/ Spacers should be suitable to withstand the short circuit forces corresponding to this current.
- 5.2.13 The design of Clamps should be such that proper space for movement of normal quality single head spanner during tightening is available. This is an important requirement and should be confirmed by the Bidder.
- 5.2.14 **Materials:**
- The Clamps & Connectors/ Spacers shall be made of materials listed below: -
- i. For connecting ACSR conductor Aluminium alloy casting conforming to designation A6 of IS:617.(Redesignation 4600)

- ii. Bolts, Nuts, plain washers and spring washers for above items shall be made of hot dip galvanized Mild Steel conforming to relevant IS only.
- iii. The Bidder shall ensure that the Alloy used assures good stability and sound casting by proper fluidity. Proper mechanical and physical strength characteristics should be obtained corresponding to the standard requirements of the Alloy specified.

5.2.15 For Clamps and Connectors used in 400 KV and associated 220 KV switchyard should be made by Gravity Die-Casting Process and thereafter given appropriate treatment. For Clamps and Connectors used in 220 KV, 132 KV & 33 KV Switchyard should be made by Gravity or Pressure Die-Casting Process and thereafter given appropriate treatment. Clamps bodies made by Sand casting shall not be accepted in any case. For 220 KV and 132 KV Switchyard 'Wedge type connector' are also acceptable.

5.2.16 Castings :

All casting shall be free from blow holes, surface blisters and shall be rounded off.

5.2.17 Constructional Details :

- i. All sharp edges and corners shall be blurred and rounded off.
- ii. Minimum thickness of any part of the Clamps and Connectors/ Spacers shall not be less than 12 mm.
- iii. Bolts and nuts shall have hexagonal heads and threads as per Indian Standard.
- iv. Flexible connectors, braids or laminated straps shall be made from tinned copper strips or aluminium laminates depending upon the clamp.
- v. Size of terminal/conductor for which the Clamps/ Spacers are suitable shall be embossed on each component of the clamp.
- vi. Casting should be such that adequate free space for placement and movement of double ended spanners for tightening of nuts is available. Further, for adequate strength, clear distance of minimum 6 mm shall be available between the edges of the holes meant for Nuts/Bolts and any corner of the Clamps & Connectors/ Spacers.

5.2.18 Bolts, Nuts & Washers :

These shall be as per Indian Standard and shall have tensile strength and elongation as per grade 5.6P. The Bidder should ensure proper tightening either by use of Belleville or by the use of torque wrenches.

5.2.19 Interchangeability :

All components of like design shall be inter-changeable.

6.0 Tests :

All types of Material being supplied shall be subjected to Type tests, Routine tests and Acceptance tests as specified below at the expense of Bidder and according to relevant standards. The following tests shall be carried out on the Clamps & Connectors/ Spacers :

6.1 Type Tests :

This shall mean those tests which are to be carried out to prove the design, process of manufacture and general conformity of the material and product with the intents of this specification. The equipment / materials offered shall be type tested as per the relevant International/Indian Standard and as required under the technical specification.

All the clamps covered in the bid identification should be Type Tested as detailed below :-

- a. All type tests are required to be conducted in respect of following items as per relevant IS/ Technical Specification:-
 - i. T Clamp for Twin Moose Run & Single Moose Tap
 - ii. Pad Clamp for Twin Moose ACSR
 - iii. T Clamp for Twin Zebra Run & Single Zebra Tap
 - iv. PG Clamp for Zebra ACSR
 - v. Pad Clamp for Twin Zebra ACSR
- b. For remaining items, all the type tests excepting short time current test are required to be conducted.

The Type test reports for all the clamps as detailed above are required to be furnished with the Bid. If the type tests on these Clamps are older than 5 years or are yet to be carried out, the successful Bidder will be required to furnish the requisite test report for successful conduction of type tests within 60 days from the date of detailed order.

6.2 Acceptance Tests :

This shall mean those tests which are to be carried out on samples taken from each lot offered for pre-despatch inspection for the purpose of acceptance of the lot.

6.3 Routine Tests :

This shall mean those tests, which are to be carried out on each Clamp & Connector/ Spacers to check the requirements which are likely to vary during production.

6.4 Stage Tests During Manufacture :

Stage tests during manufacture shall mean those tests which are to be carried out during the process of manufacture to ensure quality control such that the end product is of the designed quality conforming to the intent of this specification.

6.5 Test Values :

For all type and acceptance tests, the acceptance values shall be the values guaranteed by the Bidder in the guaranteed technical particulars or the acceptance value specified in this specification or equivalent International Standards whichever is more stringent for that particular test.

6.6 Test Procedures and Sampling Norms :

The norms and procedure of sampling for the above tests for Clamps & connectors/ Spacers shall be as per the relevant Indian Standard or equivalent International Standards.

7.0 Clamps & Connectors:

7.1 Type Tests :

It is essential to furnish following type test reports in respect of Clamps covered in clause 2.1 above as stipulated in latest version of IS: 5561:

- i. Tensile Test
- ii. Resistance Test
- iii. Temperature rise Test
- iv. Short time current Test
- v. Dimensional Check
- vi. Galvanizing Test, if applicable

7.2 Acceptance and Routine Tests :

For Clamps & Connectors following Acceptance & Routine tests shall be conducted:

(A) Acceptance test :

- i. Visual check
- ii. Tensile Test
- iii. Resistance Test
- iv. Dimensional Check
- v. Galvanizing Test, if applicable

(B) Routine Test :

- i. Visual inspection
- ii. Dimensional Check

7.3 SPACERS:

7.3.1 Type test:

It is essential to furnish following type test report for Spacers (also covered in clause 2.1) as stipulated in latest version of IS: 10162 :

- i. Visual examination
- ii. Verification of dimensions
- iii. Clamp slip test
- iv. Resilience test
- v. Clamp bolt torque test
- vi. Assembly torque test
- vii. Tensile load test
- viii. Compression and pull off test
- ix. Magnetic power loss test and
- x. Galvanizing Test, if applicable

7.3.2 Acceptance and Routine Tests :

For Spacers following Acceptance & Routine tests shall be conducted:

(A) Acceptance test:

- i. Visual examination
- ii. Verification of dimensions
- iii. Clamp slip test
- iv. Clamp bolt torque test
- v. Assembly torque test
- vi. Tensile load test
- vii. Compression and pull off test
- viii. Galvanizing Test, if applicable

(B) Routine test :

- i. Visual examination and
- ii. Verification of dimensions

8.0 MARKING:

Each Clamps & Connectors / Spacers shall be marked with the trade mark of the manufacturer and year of manufacturing. Marks shall be forged or stamped with a steel die before galvanizing. The mark shall be distinct, durable and conspicuous.

9.0 PACKING AND FORWARDING:

- (i) All Material and associated fittings e.g., nuts, bolts and washers etc shall be packed in suitable sized strong and weather resistant wooden cases/crates. The gross weight of the packing shall not normally exceed 50 Kg. to avoid handling problems.
- (ii) The packing shall be of sufficient strength to withstand rough handling during transit, storage and subsequent handling in the field.

- (iii) Suitable cushioning, protective padding or spacer shall be provided to prevent damage or deformation during transit and handling.
- (iv) All identical items shall be dispatched to destination duly assembled and packed. Bolts, nuts, washers and pins etc. shall be packed duly installed and assembled with the respective parts and suitable measures shall be taken to prevent their transit loss/damage.
- (v) All packing cases shall be marked legibly and correctly so as to ensure their safe arrival at their destination and to avoid the possibility of goods being lost or wrongly dispatched on account of faulty or illegible markings. Each wooden case / crate shall have all the markings stenciled on it in indelible ink.
- (vi) The list showing quantity of components, product drawing and assembly / maintenance instructions for the users should be sent with each consignment.

10.0 DRAWINGS:

We have standardized our technical requirements for Clamps & Connectors/ Spacers. Accordingly drawing for each item is attached with the Bidding Document. Bidder will have to offer material exactly as per these drawings. Any change in design/dimension will lead to rejection of bid.

The Bidder shall submit following information / drawings for each item, with the Bid:

- (i) Fully dimensioned drawings giving as assembly and details of each type of items with bill of material and weight.
- (ii) Technical details with descriptive literature/catalogue and photograph for each items.
- (iii) The nature of the material used for various parts shall be clearly specified in the drawings.
- (iv) Weight of individual components and total assembled weight.

The successful bidder is required to furnish fully dimensional drawings of offered material within 15 days from the date of issue of the order for its approval.

11.0 INSPECTION :

- (i) Purchaser and its representatives shall at all times be entitled to have access to the works and to all places of manufacturing where Clamps & Connectors/ Spacers are manufactured and the Bidder shall afford all facilities to them for unrestricted inspection of the works, inspection of raw material, inspection of manufacturing process of Clamps & Connectors/ Spacers and for conducting necessary tests as detailed in the Bidding document.

- (ii) The successful Bidder may keep the Purchaser informed in advance of the time of starting and progress of manufacture of Clamps & Connectors/ Spacers in its various stages so that arrangements could be made for stage inspection.
- (iii) No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested or inspection waiver is granted.
- (iv) The acceptance of any quantity of Clamps & Connectors/ Spacers shall in no way relieve the Bidder of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection, if such materials are later found to be defective.
- (v) Immediately after finalization of the programme of acceptance / routine testing, the successful Bidder shall give advance intimation in writing intimating the date and the place at which the materials shall be ready for inspection and testing. All acceptance tests shall be carried out in presence of Purchaser's representative. They will also provide such assistance as may be required for or as may be reasonably demanded by Purchaser's representative to carry out such tests efficiently. The material shall not be dispatched unless the same is inspected and approved or the waiver of inspection is granted.
- (vi) When the specified tests are conducted successfully in presence of Purchaser's representative, the successful Bidder shall submit the test certificate in duplicate duly witnessed by representative to Purchaser's for approval. The material shall not be dispatched until these certificates are approved.
- (vii) Successful Bidder's request for pre-despatch inspection waiver should invariably accompany with the test certificate in duplicate as per the relevant IS and guaranteed technical particulars of the order, for Purchaser's approval.

12.0 QUALITY ASSURANCE PLAN:

12.1 The Bidder must establish that they are following a proper quality assurance programme for manufacture of Materials. The Bidder shall invariably furnish following information alongwith his Bid;

- i. Statement giving list of important raw materials, names of vendors for the raw material, list of standards according to which the raw material is purchased and copies of test certificates thereof.
- ii. Information and copies of test certificates as in (i) above in respect of bought out items.
- iii. List of manufacturing facilities available.
- iv. Levels 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. List of testing equipment available with the Bidder for final testing of material specified and test plant limitation, if any, vis-à-vis type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

12.2 The successful Bidder 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 Bid.
- ii. Type test certificates of the raw material and bought out accessories.
- iii. Quality Assurance Plan (QAP) with hold-up points for purchaser's inspection. The quality assurance plans and hold-up points shall be discussed between the Purchaser and supplier before the QAP is finalized.

12.3 The successful Bidder shall submit the routine test certificates of bought out items and raw material at the time of routine testing.

13.0 STAGE INSPECTION:

Successful Bidder shall strictly adhere to the approved detailed manufacturing and quality assurance Programme. The MPPTCL have right to depute its officer during the manufacture of the Clamps & Connectors/ Spacers at various stages of Manufacturing for Stage Inspection. Purchaser shall normally depute its representative to carryout Stage Inspection at the time of Gravity Die Casting of Clamps & Connectors/ Spacers.

Intimation for stage inspections as above for various lots shall be given by you one week in advance to organize deputation of inspecting officer. During stage inspections, the inspecting officer shall verify the sources of raw material, its quality etc. During this stage, following documents shall be verified by our inspector as a proof towards use of raw material for manufacture of Clamps & Connectors/ Spacers ordered by us.

- i Invoice of the supplier
- ii Factory test certificate
- iii Packing list
- iv Bill of lading, if applicable
- v Bill of entry certificate by customs, if applicable

The Purchaser also reserves the right to carry out stage inspections at other stages also, for which advance intimation shall be given and all necessary cooperation shall be rendered by the manufacturer. Only after approval of the purchaser, the supplier shall proceed ahead for manufacturing of the Clamps. During stage inspection, adherence to the approved Quality Assurance Plan will also be checked. In case the

inspecting officer does not visit the works for stage inspection, the supplier may proceed ahead as per their standard manufacturing process.

A complete record of stage inspection shall be kept by you and this record shall be made available for inspection by the representative of the MPPTCL.

APPENDIX - A

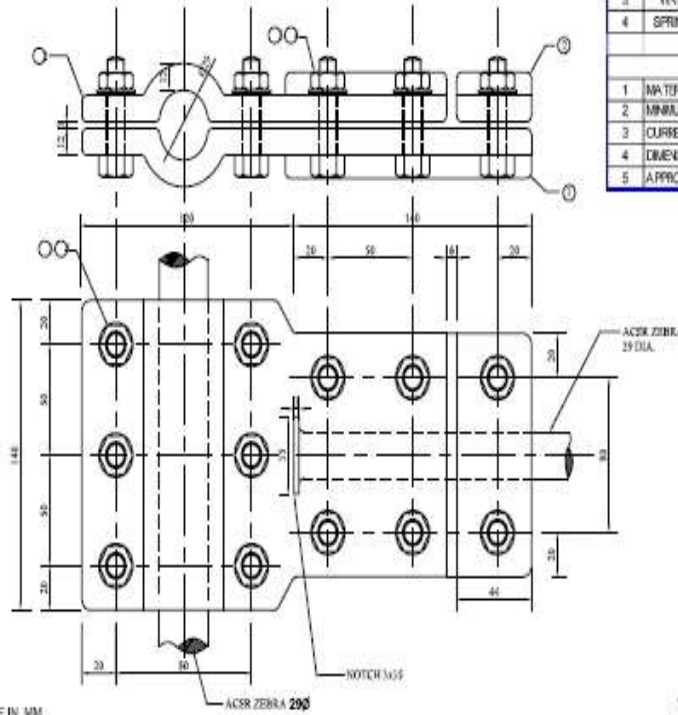
**DISCRIPTION OF MATERIAL INCLUDED IN THE SCHEDULE-I
OF PRICES FOR EACH PACKAGE.**

'T' clamps for
Twin Zebra ACSR run and single Zebra ACSR tap
Zebra ACSR run and Zebra ACSR tap
Twin Moose ACSR run and Moose ACSR tap
Moose ACSR run and Moose ACSR tap
4" IPS Tubular Bus Conductor run and Twin Moose ACSR tap
Parallel Groove (PG) Clamps for ;
Moose ACSR and Moose ACSR
Zebra ACSR and Zebra ACSR
Zebra ACSR and Panther ACSR
Moose ACSR and Zebra ACSR
Post Insulator (PI) Clamps for ;
Single Zebra ACSR
Twin Zebra ACSR
Rigid Type Spacers for ;
Quadruple ACSR Moose
Twin Moose ACSR (spacing 300 mm)
Bus Post clamp for ;
4" IPS tubular bus conductor, sliding type
4" IPS tubular bus conductor, expansion type.

APPENDIX - B**List of Drawings**

'T' clamps for
Twin Zebra ACSR run and single Zebra ACSR tap
Zebra ACSR run and Zebra ACSR tap
Twin Moose ACSR run and Moose ACSR tap
Moose ACSR run and Moose ACSR tap
4" IPS Tubular Bus Conductor run and Twin Moose ACSR tap
Parallel Groove (PG) Clamps for ;
Moose ACSR and Moose ACSR
Zebra ACSR and Zebra ACSR
Zebra ACSR and Panther ACSR
Moose ACSR and Zebra ACSR
Post Insulator (PI) Clamps for ;
Single Zebra ACSR
Twin Zebra ACSR
Rigid Type Spacers for ;
Quadruple ACSR Moose
Twin Moose ACSR (spacing 300 mm)
Bus Post clamp for ;
4" IPS tubular bus conductor, sliding type
4" IPS tubular bus conductor, expansion type.

TEE CLAMP FOR ZEBRA ACSR TO ZEBRA ACSR CONDUCTOR



SNO.	DESCRIPTION	MATERIAL	QTY.
1	CLAMP	AL ALLOY GR - A6	1
2	KEEPER	AL ALLOY GR - A6	2
3	EOLT NUT & WASHER M-10	HOT DIP GALVANISED	12 SETS
4	SPRING WASHER	MILD STEEL	12

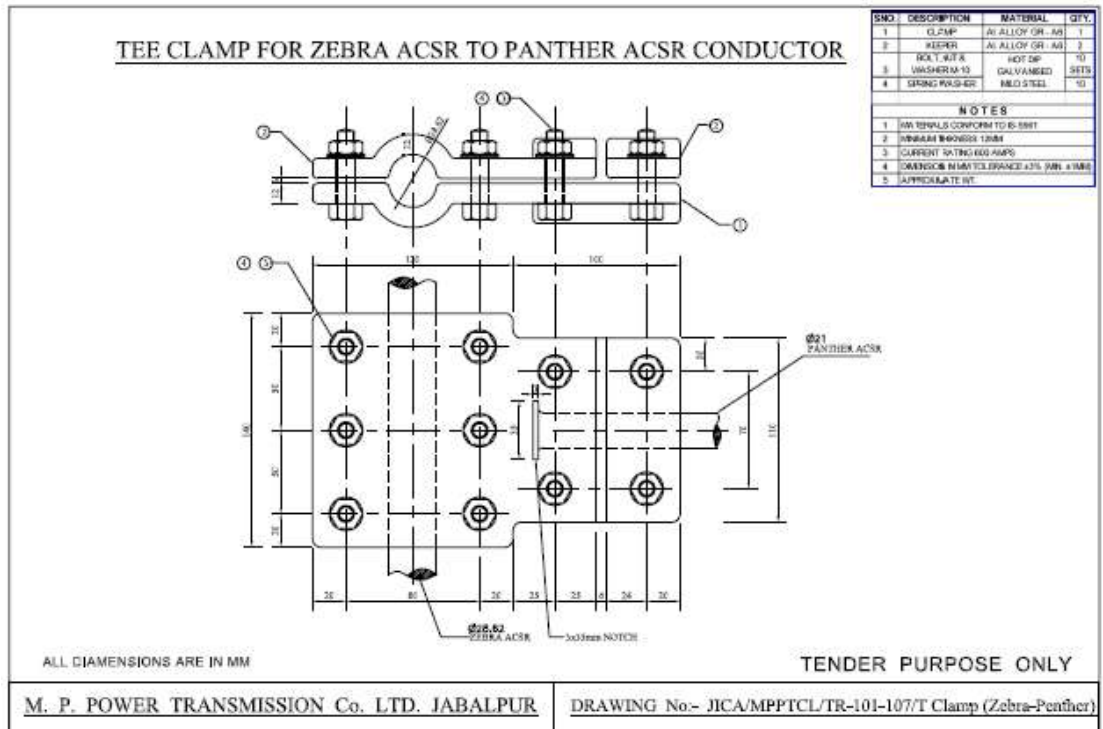
NOTES	
1	MATERIALS CONFORM TO IS-5561
2	MINIMUM THICKNESS 12MM
3	CURRENT RATING 1000 AMPS
4	DIMENSION IN MM TOLERANCE $\pm 3\%$ (MIN. ± 1 MM)
5	APPROXIMATE WT. 2.62KG.

ALL DIMENSIONS ARE IN MM

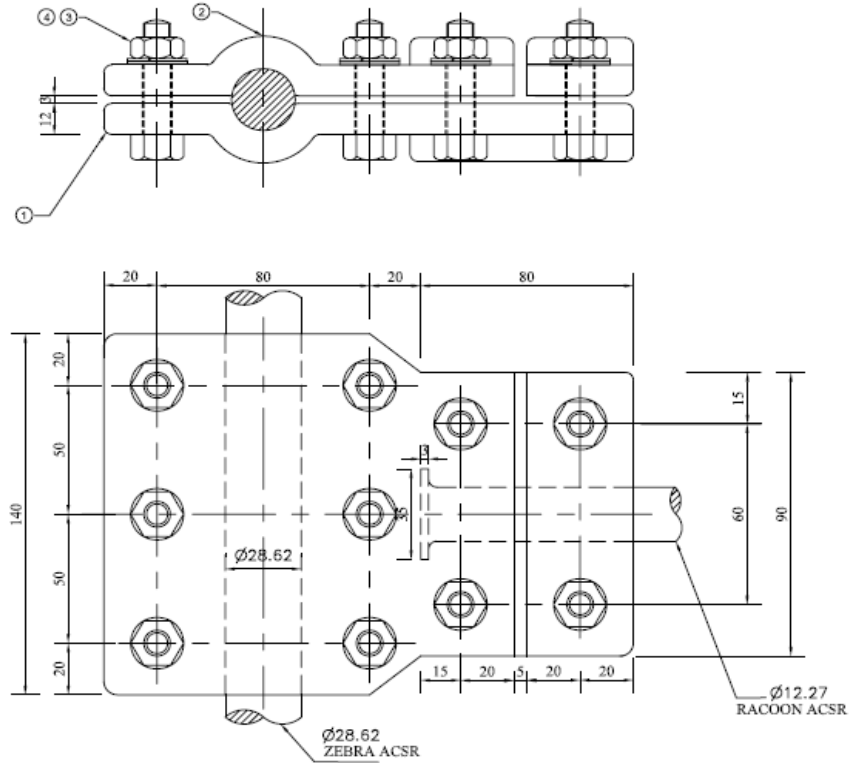
TENDER PURPOSE ONLY

M. P. POWER TRANSMISSION Co. Ltd. JABALPUR

DRAWING No.- JICA/MPPTCL/TR-101-107/T Clamp (Zebra-Zebra)



TEE CLAMP FOR ZEBRA ACSR TO RACOON ACSR CONDUCTOR



SNO.	DESCRIPTION	MATERIAL	QTY.
1	CLAMP	AL. ALLOY GR - A6	1
2	KEEPER	AL. ALLOY GR - A6	2
3	BOLT,NUT & WASHER M-10	HOT DIP GALVANISED	10 SETS
4	SPRING WASHER	MILD STEEL	10
NOTES			
1	MATERIALS CONFORM TO IS-5581		
2	MINIMUM THICKNESS 12MM		
3	CURRENT RATING 300 AMPS		
4	TOLERANCE $\pm 3\%$		

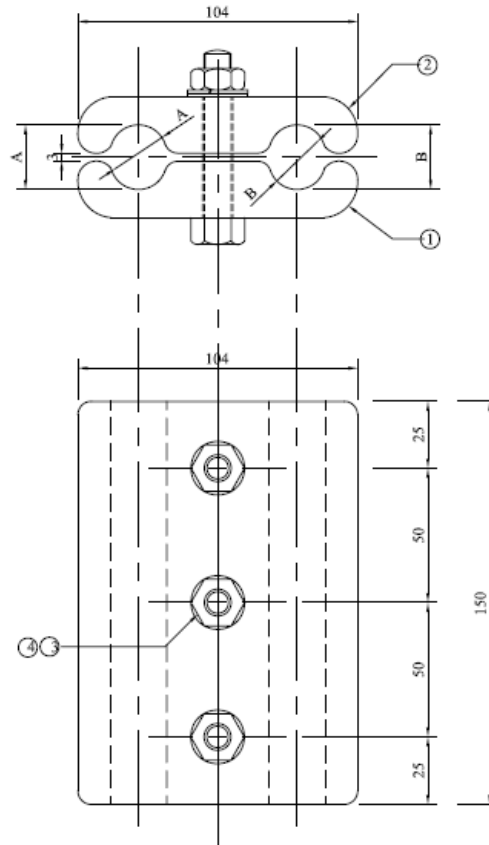
ALL DIMENSIONS ARE IN MM

TENDER PURPOSE ONLY

M. P. POWER TRANSMISSION Co. LTD. JABALPUR

DRAWING No:- JICA/MPPTCL/TR-101-107/T Clamp (Zebra-Racoon)

**PG CLAMP FOR ZEBRA TO PANTHER
& PG CLAMP FOR ZEBRA TO ZEBRA**



SNO.	DESCRIPTION	MATERIAL	QTY.
1	CLAMP	AL. ALLOY GR - A6	1
2	KEEPER	AL. ALLOY GR - A6	1
3	BOLT, NUT & FLAT WASHER M-10	HOT DIP GALVANISED	3 SETS
4	SPRING WASHER	MILD STEEL	3

NOTES

1	MATERIALS CONFORM TO IS-5561
2	MINIMUM THICKNESS 12MM
3	CURRENT RATING 800/1000 A.MPS
4	DIMENSION IN MM, TOLERANCE $\pm 3\%$ (MIN. ± 1 MM)

SNO.	DESCRIPTION	CONDUCTOR		DIMENSION		CURRENT RATING
		A	B	A	B	
1	PG CLAMP FOR ZEBRA, ACBR TO PANTHER ACBR	ZEBRA	PANTHER	20	21	800 Amp
2	PG CLAMP FOR ZEBRA, ACBR TO ZEBRA ACBR	ZEBRA	ZEBRA	20	20	1000 Amp

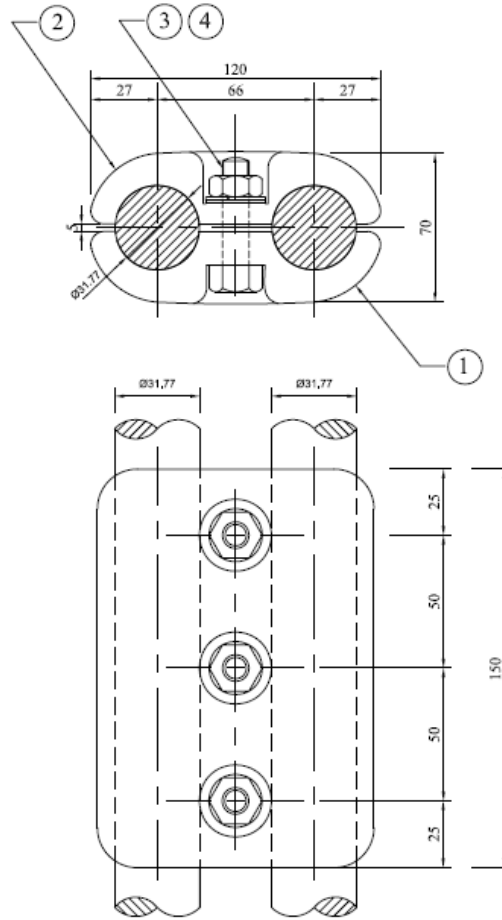
ALL DIMENSIONS ARE IN MM

TENDER PURPOSE ONLY

M. P. POWER TRANSMISSION Co. LTD. JABALPUR

DRAWING No:- JICA/MPPTCL/TR-101-107/P G CLAMP

PG CLAMP FOR MOOSE ACSR TO MOOSE ACSR



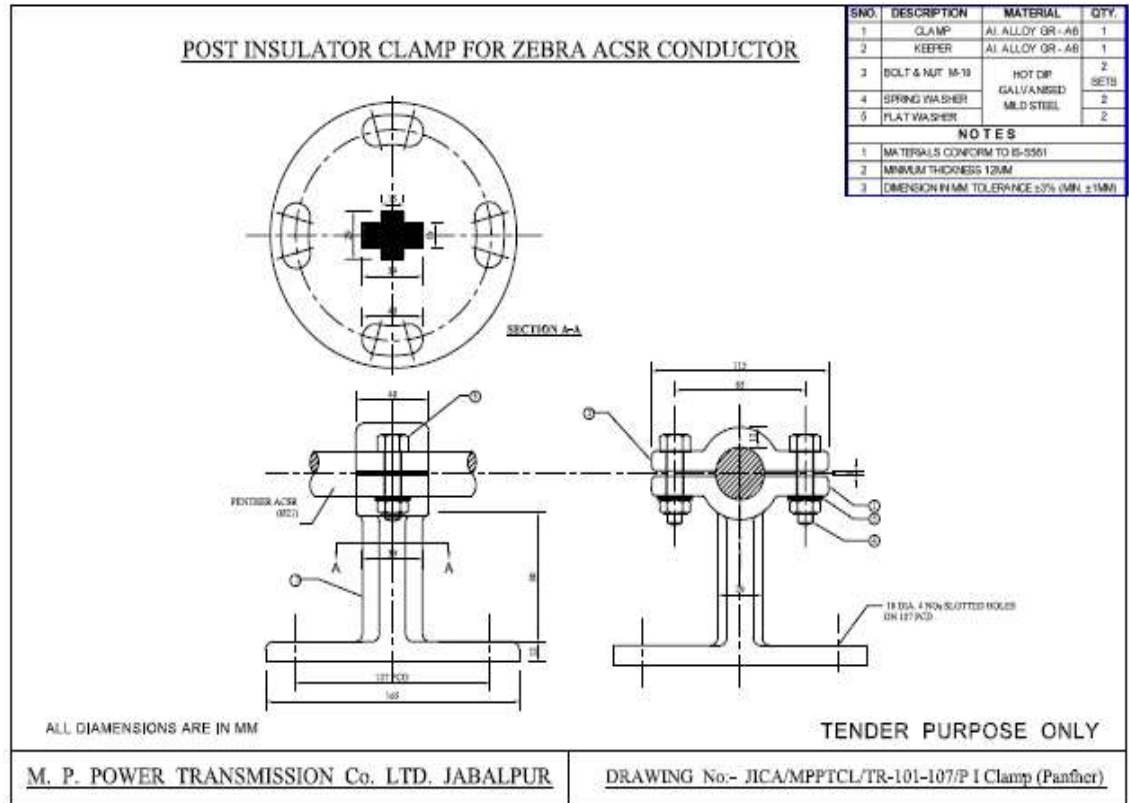
SNO.	DESCRIPTION	MATERIAL	QTY.
1	CLAMP	AL. ALLOY GR - A8	1
2	KEEPER	AL. ALLOY GR - A8	1
3	BOLT,NUT & FLAT WASHER M-12	HOT DIP GALVANISED	3 SETS
4	SPRING WASHER	MILD STEEL	3
NOTES			
1	MATERIALS CONFORM TO IS-5661		
2	MINIMUM THICKNESS 12MM		
3	CURRENT RATING 1000 AMPS		
4	DIMENSION IN MM. TOLERANCE ±3% (MIN. ±1MM)		

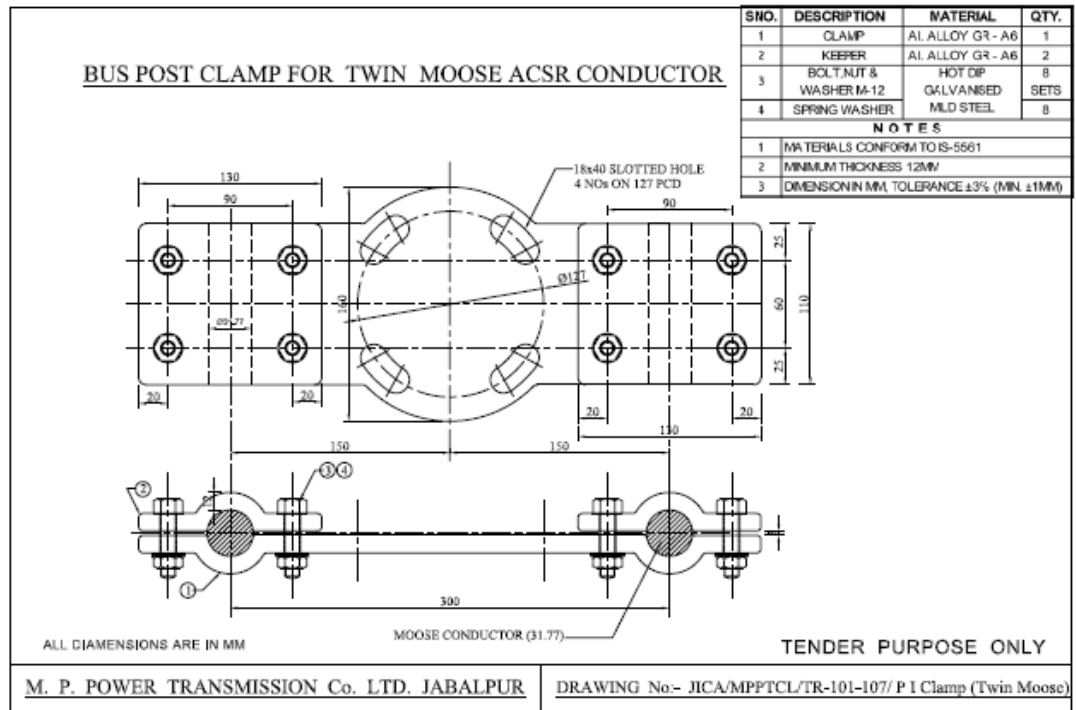
ALL DIMENSIONS ARE IN MM

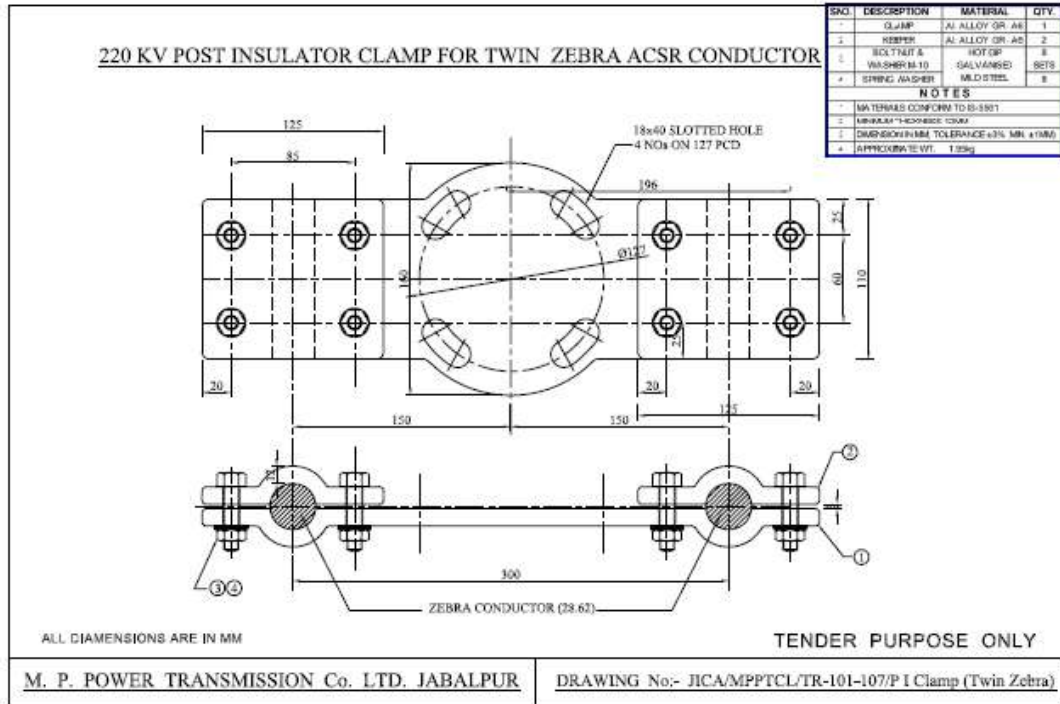
TENDER PURPOSE ONLY

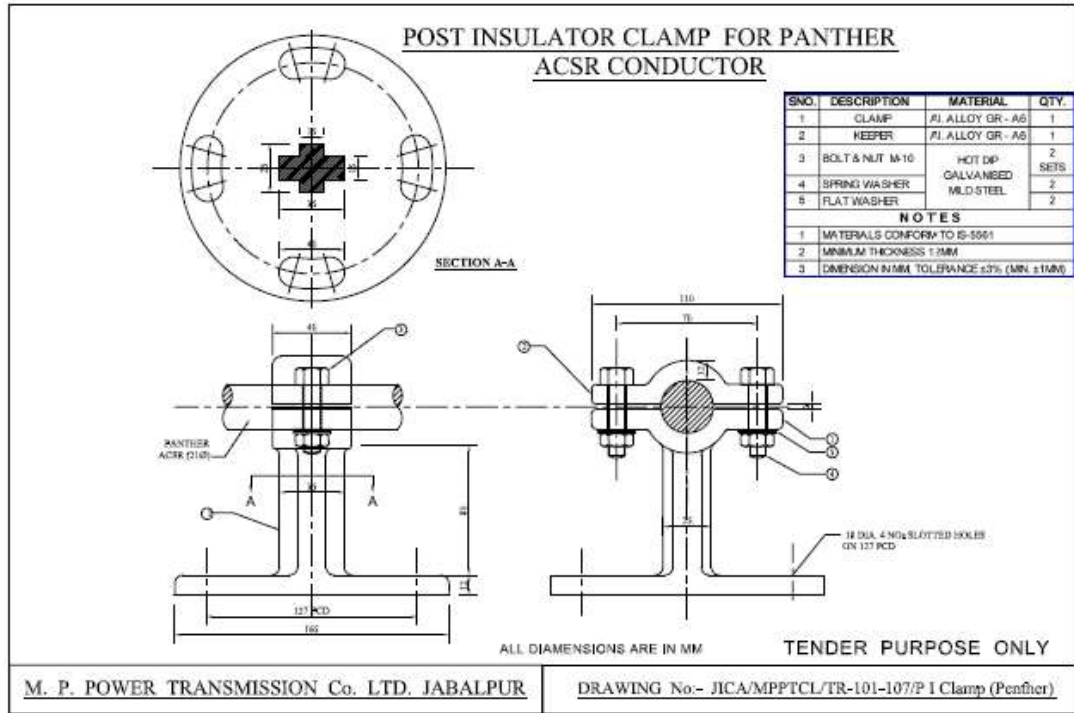
M. P. POWER TRANSMISSION Co. LTD. JABALPUR

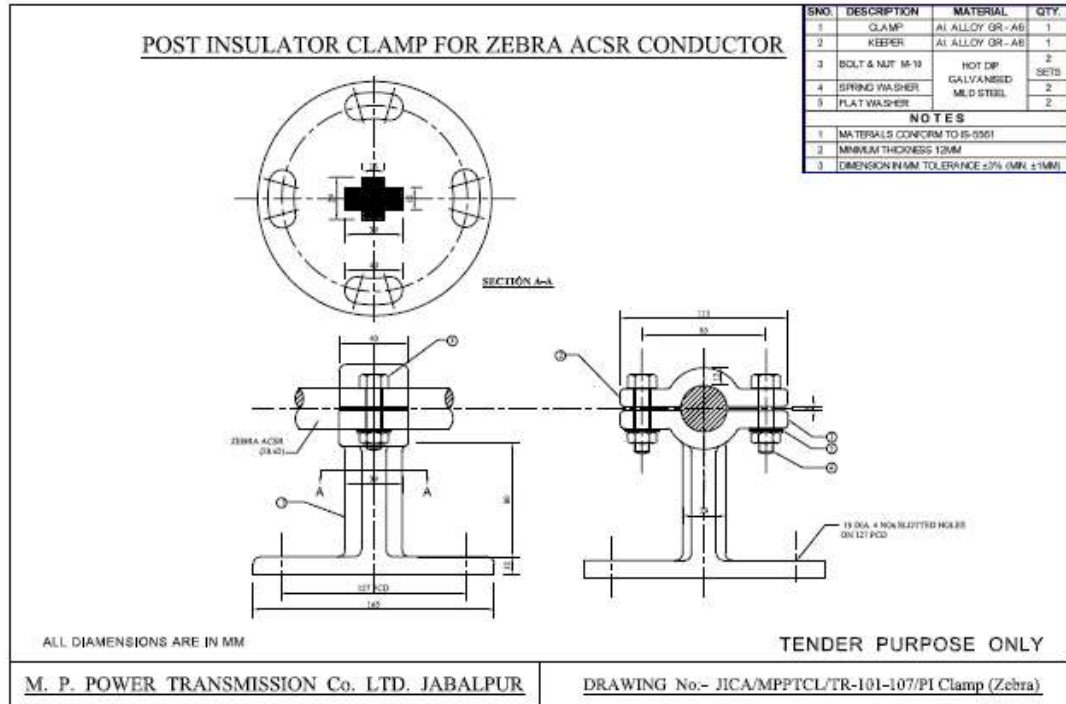
DRAWING No:- JICA/MPPTCL/TR-101-107/P G CLAMP (Moose)

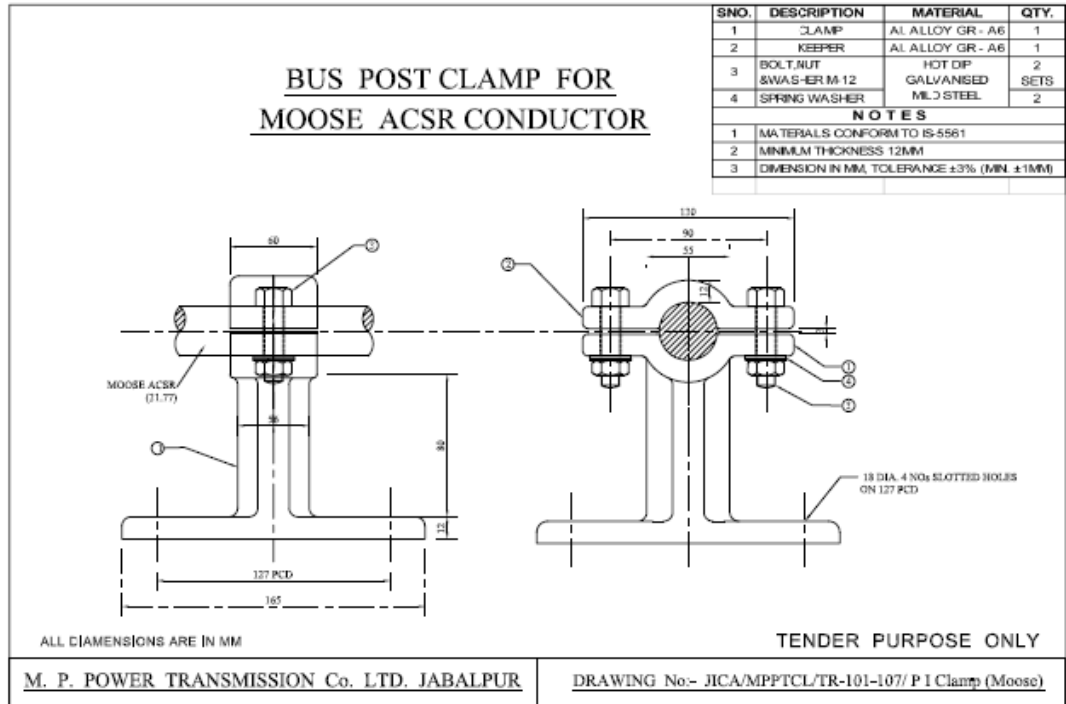


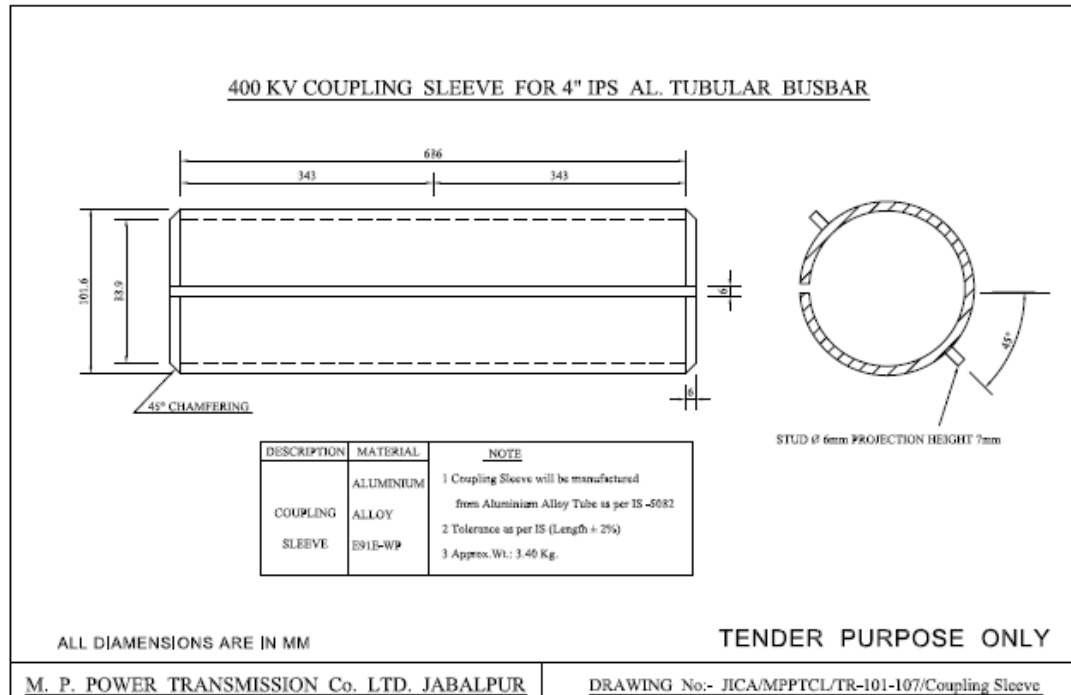


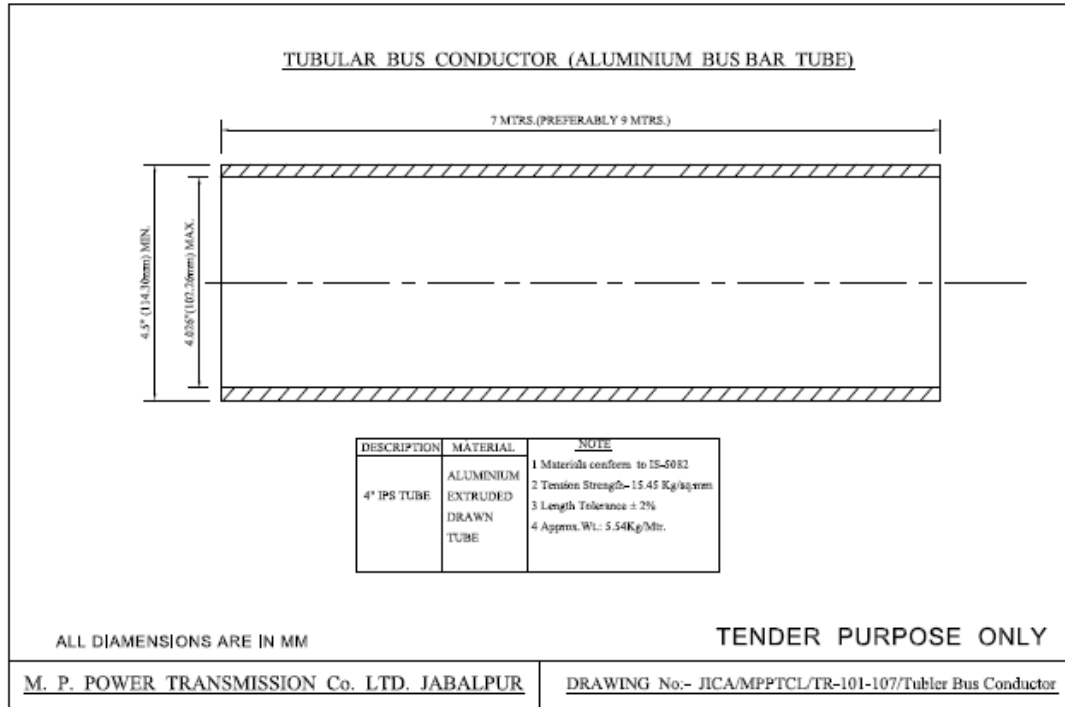












SCHEDULE – I (A)**DESCRIPTION OF MATERIAL FOR SCHEDULE OF RATES AND PRICES TO
BE FURNISHED IN VOLUME –VI**

S.No.	Particulars	Qty.
1	‘T’ clamps and set of spares as per Annexure-D Section-I Vol. II, Part-I for	As per Price Schedule
	Twin Zebra ACSR run and single Zebra ACSR tap	
	Zebra ACSR run and Zebra ACSR tap	
	Twin Moose ACSR run and Moose ACSR tap	
	Moose ACSR run and Moose ACSR tap	
	4” IPS Tubular Bus Conductor run and Twin Moose ACSR tap	
2	Parallel Groove (PG) Clamps and set of spares as per Annexure-D Section-I Vol. II, Part-I for ;	
	Moose ACSR and Moose ACSR	
	Zebra ACSR and Zebra ACSR	
	Zebra ACSR and Panther ACSR	
	Moose ACSR and Zebra ACSR	
3	Post Insulator (PI) Clamps and set of spares as per Annexure-D Section-I Vol. II, Part-I for ;	
	Single Zebra ACSR	
	Twin Zebra ACSR	
4	Rigid Type Spacers for ;	
	Quadruple ACSR Moose	
	Twin Moose ACSR (spacing 300 mm)	
5	Bus Post clamp for ;	
	4” IPS tubular bus conductor, sliding type	
	4” IPS tubular bus conductor, expansion type.	

Note :

1. The above description of material is given for the purpose of offering the prices and to mention description of material in Invoice for claiming payment.
2. The quantity of above material has been mentioned in Volume VI.

SECTION – II

**2.5.5 Technical Specification for Tubular Bus Conductor
(4” and 2” IPSTube) & Coupling Sleeves.**

1.0 SCOPE -

This scope of this specification covers design, manufacturing supply of tubular busbar conductor and coupling sleeves for EHV substations as per Section-I, Volume-II. The bidder mentioned in the Section of Technical specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment / material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS -

Applicable standards for offered equipment / material shall be as per Section-I, Volume-II.

3.0 CLIMATIC CONDITIONS –

Applicable climatic conditions shall be as per Section-I, Volume-II.

4.0 SYSTEM PARTICULARS -

Applicable system particulars shall be as per Section-I, Volume-II.

5.0 MATERIAL :

Hard drawn Aluminium tube with minimum 57% IACS conductivity at 20 Deg. C for Aluminium tubular bus conductors.

5.1 PROPERTIES :

The tube sizes offered shall be as per standard Internationals Pipe Sizes (IPS) and Extra Heavy Pipe Sizes.

For the inside diameter (ID) of the tube, there shall be no plus tolerance and for the outside diameter (OD) there shall be no minus tolerance.

5.2 STRENGTH :

5.2.1 Yield strength based on tensile stress of 1335 Kg/cm² for aluminium tubular bus conductors for all sizes.

5.2.2 Breaking strength based on tensile stress of 1545 Kg/ cm² for aluminium tubular bus conductors.

5.2.3 The tubular bus conductors shall have adequate strength to withstand mechanical forces due to short circuit currents.

6.0 TEMPERATURE RISE :

The tubular bus conductor temperature when carrying full load current as indicated in technical specification enclosed, shall not exceed 75 Deg. C for the site ambient temperatures.

6.1 FREEDOM FROM CORROSION :

If any particular corrosive atmosphere is mentioned in technical specifications enclosed, Bidder shall advise the necessary treatment for the tubular bus conductor to make it free from corrosion. Treatment may be multilayer zinc-copper-silver plating or any standard type of electro-plating.

6.2 TECHNICAL PARTICULARS OF TUBULAR BUS CONDUCTOR:

S.No.	Particulars	4" IPS Tube	2" IPS Tube
1	Application:	Switchyard Bay Conductor	
2	Size	4" IPS	2" IPS
3	Standard pipe size:	OD=114.30mm (4.5")	OD=60.32mm (2.375")
		ID=102.26mm (4.026")	ID=52.50mm (2.067")
4	Minimum length of each pipe	7.0 Mtrs. (preferably 9 meters)	7.0 Mtrs. (preferably 9 meters)
5	RATING		
i.	Voltage rating	400KV	220KV
ii.	No. of phases	3	3
iii.	Current rating	2000 Amps	1000 Amps
iv.	Frequency	50 Hz.	50 Hz.
v.	Short ckt. current	40 KA. rms	40 KA. rms
vi.	Duration of fault	3 Sec	3 Sec
6	DESIGN RATE		
i	Wind velocity	(a) Max 2.7 Meter/Sec	(a) Max 2.7 Meter/Sec
		(b) Minimum 0.61 Meter/Sec.	(b) Minimum 0.61 Meter/Sec.
ii	Visual corona discharge	320 KV rms	320 KV rms
7	CONFIGURATION		
i	Phase spacing	7 Mtrs.	7 Mtrs.
ii	Arrangement	Horizontal	Horizontal
iii	Span	13 Mtrs / 12 Mtrs.	13 Mtrs / 12 Mtrs.
8	Guaranteed current carrying capacity for above conditions (minimum)	2000 Amps.	1000 Amps.
9	Conductor used in the 400 KV Switchyard		
i	Material	Aluminium conductor.	
ii	Sub conductor / phase	Twin	
iii	Sub conductor spacing	450 mm	
iv	Sub conductor configuration	Horizontal	

v	Sub conductor details		
a	Conductor	ACSR "Moose"	ACSR "Zebra/ Panther"
b	Stranding	54/7/3.66 mm,	-
c	Overall Dia.	31.77 mm,	-
vi	Ultimate strength	16700 Kg.	13500 Kg
vii	Maximum working tension	2000 Kgs for line side.	1000 Kgs for line side.
10	Shield wire details		
i	Material	Galvanized	Galvanized
ii	Dia	3.66 mm	2.77 mm
iii	Strands	7	5

6.3 COUPLING SLEEVES:

For the purpose of jointing of the Aluminium bus tubes Coupling Sleeves shall will be used. These sleeves shall be standard IPS Aluminium alloy pipe having dimensions as indicated in the enclosed drawings.

6.4 TESTS :

6.4.1 The following tests shall be carried out on the Tubular Bus Conductors:

- (i) Tensile test.
- (ii) Resistance test.
- (iii) Temperature rise test for rated current.
- (iv) One second short circuit current test.
- (v) Critical disruptive voltage test.

5.0 INTERCHANGEABILITY:

All components of like design shall be inter-changeable.

6.0 MARKING:

Each Tubular Bus Conductor and Coupling Sleeves shall be marked with the trade mark of the manufacturer and year of manufacturing. Marks shall be forged or stamped. The mark shall be distinct, durable and conspicuous.

7.0 PACKING AND FORWARDING:

- (i) The packing shall be of sufficient strength to withstand rough handling during transit, storage and subsequent handling in the field.
- (ii) Suitable cushioning, protective padding or spacer shall be provided to prevent damage or deformation during transit and handling.
- (iii) All packing cases shall be marked legibly and correctly so as to ensure their safe arrival at their destination and to avoid the possibility of goods being lost or wrongly dispatched on account of faulty or illegible

markings. Each wooden case / crate shall have all the markings stenciled on it in indelible ink.

- (iv) The list showing quantity of components, product drawing and assembly / maintenance instructions for the users should be sent with each consignment.

8.0 DRAWINGS:

8.1 We have standardized our technical requirements for Tubular bus conductor & Coupling Sleeves for Tubular Bus Conductors accordingly drawing for each item is enclosed with the document. Bidder will have to offer materials exactly as per enclosed drawings.

The Bidder shall submit following information / drawings for each item, with the Bid:

- (i) Fully dimensioned drawings giving as assembly and details of each type of items with bill of material and weight.
- (ii) Technical details with descriptive literature and photograph for each items.
- (iii) The nature of the material used for various parts shall be clearly specified in the drawings.

8.2 Successful Bidder shall furnish detailed dimensioned drawings within 15 days from the date of issued of order for purchaser's approval.

9.0 INSPECTION :

- (i) Purchaser and its representatives shall at all times be entitled to have access to the works and to all places of manufacturing where Tubular Bus Conductor & Coupling Sleeves are manufactured and the Bidder shall afford all facilities to them for unrestricted inspection of the works, inspection of raw material, inspection of manufacturing process of Tubular Bus Conductor & Coupling Sleeves and for conducting necessary tests as detailed in the Bidding document.
- (ii) The successful Bidder may keep the Purchaser informed in advance of the time of starting and progress of manufacture of Tubular Bus Conductor & Coupling Sleeves in its various stages so that arrangements could be made for stage inspection.
- (iii) No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested or inspection waiver is granted.
- (iv) The acceptance of any quantity of Tubular Bus Conductor & Coupling Sleeves shall in no way relieve the Bidder of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection, if such materials are later found to be defective.

- (v) Immediately after finalization of the programme of acceptance/ routine testing, the successful Bidder shall give advance intimation in writing intimating the date and the place at which the materials shall be ready for inspection and testing. All acceptance tests shall be carried out in presence of Purchaser's representative. They will also provide such assistance as may be required for or as may be reasonably demanded by Purchaser's representative to carry out such tests efficiently. The material shall not be dispatched unless the same is inspected and approved or the waiver of inspection is granted.
- (vi) When the specified tests are conducted successfully in presence of Purchaser's representative, the successful Bidder shall submit the test certificate in duplicate duly witnessed by representative for Purchaser's approval. The material shall not be dispatched until these certificates are approved.
- (vii) Successful Bidder's request for pre-despatch inspection waiver should invariably accompany with the test certificate in duplicate as per the relevant IS and guaranteed technical particulars of the order, for Purchaser's approval.

10.0 QUALITY ASSURANCE PLAN:

10.1 The Bidder must establish that they are following a proper quality assurance programme for manufacture of Tubular Bus Conductor and Coupling Sleeves. The Bidder shall invariably furnish following information along with his Bid:

- i. Statement giving list of important raw materials, names of vendors for the raw material, list of standards according to which the raw material is purchased and copies of test certificates thereof.
- ii. Information and copies of test certificates as in (i) above in respect of bought out items.
- iii. List of manufacturing facilities available.
- iv. Levels 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.

List of testing equipment available with the Bidder for final testing of material specified and test plant limitation, if any, vis-à-vis type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

10.2 The successful Bidder 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 Bid.
- ii. Type test certificates of the raw material and bought out accessories.
- iii. Quality Assurance Plan (QAP) with hold-up points for purchaser's inspection. The quality assurance plans and hold-up points shall be discussed between the Purchaser and supplier before the QAP is finalized.

10.3 The successful Bidder shall submit the routine test certificates of bought out items and raw material at the time of routine testing.

11.0 STAGE INSPECTION:

Successful Bidder shall strictly adhere to the approved detailed manufacturing and quality assurance Programme. The MPPTCL have right to depute its officer during the manufacture of the Tubular Bus Conductor & Coupling Sleeves at various stages of Manufacturing for Stage Inspection. Purchaser shall normally depute its representative to carryout Stage Inspection at the time of manufacturing of the Tubular Bus Conductor & Coupling Sleeves.

Intimation for stage inspections as above for various lots shall be given by you one week in advance to organize deputation of inspecting officer. During stage inspections, the inspecting officer shall verify the sources of raw material, its quality etc. During this stage, following documents shall be verified by our inspector as a proof towards use of raw material for manufacture of Tubular Bus Conductor & Coupling Sleeves ordered by us.

- i Invoice of the supplier
- ii Factory test certificate
- iii Packing list
- iv Bill of lading, if applicable
- v Bill of entry certificate by customs, if applicable

The Purchaser also reserves the right to carry out stage inspections at other stages also, for which advance intimation shall be given and all necessary cooperation shall be rendered by the manufacturer. Only after approval of the purchaser, the supplier shall proceed ahead for manufacturing of the Tubular Bus Conductor & Coupling Sleeves. During stage inspection, adherence to the approved Quality Assurance Plan will also be checked. In case the inspecting officer does not visit the works for stage inspection, the supplier may proceed ahead as per their standard manufacturing process.

A complete record of stage inspection shall be kept by you and this record shall be made available for inspection by the representative of the MPPTCL.

SCHEDULE – I (A)

**DESCRIPTION OF MATERIAL FOR SCHEDULE OF RATES AND PRICES TO
BE FURNISHED IN VOLUME – VI**

S.No.	Particular	
1	IPS Tube with coupling sleeves	As per Price Schedule
2	2 inch	
3	4 inch	

Note :

1. The above description of material is given for the purpose of offering the prices and to mention description of material in Invoice for claiming payment.
2. The quantity of above material has been mentioned in Volume VI.

SECTION – II

2.5.6 TECHNICAL SPECIFICATION FOR SAG COMPENSATING SPRINGS.

1.0 SCOPE -

This scope of this specification covers design, manufacturing supply of Sag Compensating Springs for EHV substations as per Section-I, Volume-II. The bidder mentioned in the Section of Technical specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment / material of manufacturer as per this specification requirement shall rest on the bidder.

1.1 STANDARDS -

Applicable standards for offered equipment / material shall be as per Section-I.

1.2 CLIMATIC CONDITIONS –

Applicable climatic conditions shall be as per Section-I.

1.3 SYSTEM PARTICULARS -

Applicable system particulars shall be as per Section-I.

2. DESCRIPTION AND STANDARD TECHNICAL PARTICULARS OF SAG COMPENSATING SPRINGS.

2.1 The Sag Compensating Springs are used to compensate the differential sag of quadruple “MOOSE” main string bus bars due to temperature variations over a range from 0⁰ C to 80⁰ C so that it is within the contact zone of 300 mm of pantograph isolators used. The main frame of the spring shall be designed for heavy-duty operation for which it is intended. The main frame assembly comprises of end plates, guide rod, bolts, nuts, eyes or clevises for anchoring and sheet metal housing.

2.2 The spring shall be helical and made of high quality spring steel rods formed by centre-less grinding. The spring shall be pre-compressed, so that under all conditions the spring will work under compression. The ends of the spring shall be flat, closed and rounded.

2.3 The spring steel shall have low average stresses to ensure long and maintenance free life.

2.4 The tension rods and guide rod shall be made of stainless steel. There shall be three numbers guide rods arranged in triangular configuration, so that stresses developed due to the load coming on the spring is equally distributed on all the bolts. These rods are provided to ensure that the springs remain “Buckle Proof” in all the combination to ensure that no bolt loosens or gives way under working conditions.

2.5. The springs shall be manufactured by hot coiling method and “Shot peened “ to induce compressive stresses in the spring to over come fatigue. It shall be

- guaranteed that under complete compression of the spring the permissible stress will not be exceeded.
- 2.6. The springs shall be based in an approved manner to relieve hydrogen embrittlement.
 - 2.7. The springs being intended for outdoor use shall be coated with chlorinated rubberized paint over a lead oxide base.
 - 2.8. The coiling shall normally be right wound and the total number of coils shall be determined by the design considerations to give the specified performance.
 - 2.9. Since the spring is intended for outdoor use, it shall be ensured that the spring is not affected by weathering conditions changing with time. It shall have an over all outer sheet metal enclosure, the thickness of sheet being at least 3mm. The enclosure shall be electro-galvanized and be provided with drain holes to drain the rainwater that may collect.
 - 2.10. Adequately designed eyes/hooks as required shall be provided on both sides and on the end plates of the spring so that the spring can be attached to the insulator assembly easily at the time of anchoring the spring.
 - 2.11. The Sag Compensating Springs shall be provided with a copper strip of sufficient length designed for specified short circuit current in parallel with the entire spring assembly to avoid the fault current flowing through the spring and thus damaging it subsequently.
 - 2.12. The EHV System is subjected to heavy short circuits and under the influence of the increasing short circuit forces, the springs will get compressed till they are boxed. Any further increase in the force will only stress the anchoring hooks and plates and guide rods. These shall therefore have sufficient strength to sustain the maximum dynamic force. The spring shall be designed a factor of safety of 2.5 tension loadings. There should be one set or two springs per phase attached at any one side of the span.
 - 2.13. Each Compensating Springs shall be tested individually and bidder shall submit the test reports.
 - 2.14. Tenderer shall furnish basic calculations to establish the suitability of the spring constant in Kg/Cm (f-Kg/Cm) in keeping the sag within the maximum and minimum limits as indicated in the Technical Parameters.
 - 2.15. We have enclosed the Tender purpose drawing for Sag Compensating Spring. The Bidder have to submit their offer based on enclosed drawing and Technical Parameters indicated in the Bid. The Bidder shall submit following information/ drawing for Sag Compensating Spring with their Bid:-
 - (i) Fully Dimensional Drawing giving as assembly and detailed Bill of Material and Weight.
 - (ii) Technical details with descriptive literature / catalog and photographs of offered item.

- (iii) The material used for various parts shall be clearly specified in the drawing.
- (iv) Total assembled weight.
- (v) Any other Technical Parameters.

3.0 TECHNICAL PARAMETERS OF SAG COMPENSATING SPRINGS ON THE BASIS OF WHICH TENDERER HAS TO BE SUBMIT THE OFFER

a. CONDUCTOR DETAILS

- | | | | |
|-----|---|---|---|
| 1. | Conductor | : | ACSR |
| 2. | Stranding | : | 54/7/3.53 mm |
| 3. | Code name | : | MOOSE |
| 4. | Span between the bay | : | 54 Meters. |
| 5. | No. of sub-conductor/phase | : | 4 |
| 6. | Weight per meter | : | 2.004 Kg. |
| 7. | Area of cross section | : | 5.97 cm ² |
| 8. | Co-efficient of linear expansion | : | 19.35 X 10 ⁶ |
| 9. | Modules of elasticity | : | 0.686 x 10 ⁶ Kg/ cm ² |
| 10. | Basic tension per sub conductor | : | 1000 Kg. |
| | (i) at temperature 0 °C | | |
| | (ii) at wind pressure of 45 Kg/ m ² acting on full projected area. | | |
| 11. | Spring required | : | On one end of conductor. |
| 12. | No. of springs/phase | : | Two (1 Set) |
| 13. | Max/Min static tension per spring for a spring Constant of 60 Kg/Cm. | : | 2000/1460 Kg. |

b. PERFORMANCE REQUIREMENT

- | | | | |
|----|---|---|---------------------------------------|
| 1. | Maximum permissible sag. | : | 1700 mm |
| 2. | Maximum permissible differential sag to be Limited by spring. | : | 270 mm |
| 3. | Temp. at site in shade and temp. at site in sun | : | 50 ⁰ C & 65 ⁰ C |
| 4. | Short circuit current & short circuit duration | : | 40 KA per phase, 1 Sec. |
| 5. | Maximum dynamic force for which accessory is to be designed. | : | 7500 Kg. |
| 6. | Temp. Variation Min /Max. | : | 0 ⁰ C / 80 ⁰ C |

4.0 MARKING:

Each Sag Compensating Springs shall be marked with the trade mark of the manufacturer and year of manufacturing. Marks shall be forged or stamped with a steel die. The mark shall be distinct, durable and conspicuous.

5.0 PACKING AND FORWARDING:

- (i) The Sag Compensating Springs shall be packed in suitable sized strong and weather resistant wooden cases/crates. The packing shall be of sufficient strength to withstand rough handling during transit, storage and subsequent handling in the field.

- (ii) All packing cases shall be marked legibly and correctly so as to ensure their safe arrival at their destination and to avoid the possibility of goods being lost or wrongly dispatched on account of faulty or illegible markings. Each wooden case / crate shall have all the markings stenciled on it in indelible ink.
- (iii) The list showing quantity of components, product drawing and assembly / maintenance instructions for the users should be sent with each consignment.

6.0 INSPECTION :

- (i) Purchaser and its representatives shall at all times be entitled to have access to the works and to all places of manufacturing where Sag Compensating Springs are manufactured and the Bidder shall afford all facilities to them for unrestricted inspection of the works, inspection of raw material, inspection of manufacturing process of Sag Compensating Springs and for conducting necessary tests as detailed in the Bidding document.
- (ii) The successful Bidder may keep the Purchaser informed in advance of the time of starting and progress of manufacture of Sag Compensating Springs in its various stages so that arrangements could be made for stage inspection.
- (iii) No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested or inspection waiver is granted.
- (iv) The acceptance of any quantity of Sag Compensating Springs shall in no way relieve the Bidder of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection, if such materials are later found to be defective.
- (v) Immediately after finalization of the programme of acceptance/ routine testing, the successful Bidder shall give advance intimation in writing intimating the date and the place at which the materials shall be ready for inspection and testing. All acceptance tests shall be carried out in presence of Purchaser's representative. They will also provide such assistance as may be required for or as may be reasonably demanded by Purchaser's representative to carry out such tests efficiently. The material shall not be dispatched unless the same is inspected and approved or the waiver of inspection is granted.
- (vi) When the specified tests are conducted successfully in presence of Purchaser's representative, the successful Bidder shall submit the test certificate in duplicate duly witnessed by representative to Purchaser's for approval. The material shall not be dispatched until these certificates are approved.
- (vii) Successful Bidder's request for pre-despatch inspection waiver should invariably accompany with the test certificate in duplicate as per the relevant IS and guaranteed technical particulars of the order, for Purchaser's approval.

7.0 QUALITY ASSURANCE PLAN:

7.1 The Bidder must establish that they are following a proper quality assurance programme for manufacture of Materials. The Bidder shall invariably furnish following information alongwith his Bid;

- i. Statement giving list of important raw materials, names of vendors for the raw material, list of standards according to which the raw material is purchased and copies of test certificates thereof.
- ii. Information and copies of test certificates as in (i) above in respect of bought out items.
- iii. List of manufacturing facilities available.
- iv. Levels 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. List of testing equipment available with the Bidder for final testing of material specified and test plant limitation, if any, vis-à-vis type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

7.2 The successful Bidder 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 Bid.
- ii. Type test certificates of the raw material and bought out accessories.
- iii. Quality Assurance Plan (QAP) with hold-up points for purchaser's inspection. The quality assurance plans and hold-up points shall be discussed between the Purchaser and supplier before the QAP is finalized.

7.3 The successful Bidder shall submit the routine test certificates of bought out items and raw material at the time of routine testing.

8.0 STAGE INSPECTION:

Successful Bidder shall strictly adhere to the approved detailed manufacturing and quality assurance Programme. The MPPTCL have right to depute its officer during the manufacture of the Sag Compensating Springs at various stages of Manufacturing for Stage Inspection.

Intimation for stage inspections as above for various lots shall be given by you one week in advance to organize deputation of inspecting officer. During stage inspections, the inspecting officer shall verify the sources of raw material, its quality etc. During this stage, following documents shall be verified by our inspector as a proof

towards use of raw material for manufacture of Sag Compensating Springs ordered by us.

- i Invoice of the supplier
- ii Factory test certificate
- iii Packing list
- iv Bill of lading, if applicable
- v Bill of entry certificate by customs, if applicable

The Purchaser also reserves the right to carry out stage inspections at other stages also, for which advance intimation shall be given and all necessary cooperation shall be rendered by the manufacturer. Only after approval of the purchaser, the supplier shall proceed ahead for manufacturing of the Sag Compensating Springs. During stage inspection, adherence to the approved Quality Assurance Plan will also be checked. In case the inspecting officer does not visit the works for stage inspection, the supplier may proceed ahead as per their standard manufacturing process.

A complete record of stage inspection shall be kept by you and this record shall be made available for inspection by the representative of the MPPTCL.

SCHEDULE – I (A)

**DESCRIPTION OF MATERIAL FOR SCHEDULE OF RATES AND PRICES TO
BE FURNISHED IN VOLUME – VI**

S.No.	Particulars	Qty
1.	SAG COMPENSATING SPRING	As per Price Schedule

Note :

1. The above description of material is given for the purpose of offering the prices and to mention description of material in Invoice for claiming payment.
2. The quantity of above material has been mentioned in Volume VI.

SECTION – II

2.5.7 TECHNICAL SPECIFICATIONS FOR SUBSTATION TYPE HARDWARE

1.0 SCOPE:

The scope of this bid covers design, manufacturing supply of material as per Section-I, Volume-II. The “bidder” mentioned in the Section of Technical Bid means “Original Equipment Manufacturer (OEM)”. The purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering material of manufacturer as per this bid requirement shall rest on the bidder.

2.0 STANDARDS:

Applicable standards for offered material shall be as per Section-I, Volume-II.

3.0 CLIMATIC CONDITIONS:

Applicable climatic conditions shall be as per Section-I, Volume-II.

4.0 SYSTEM PARTICULARS:

Applicable system particulars shall be as per Section-I, Volume-II.

5.0 BALL AND SOCKET DIMENSIONS:

The Ball and Socket for Hardware fittings shall necessarily conform to the dimensions as stipulated in the Indian Standards. The Ball and Socket dimensions of the Hardware sets to be used with 7000 kg and 9100 kg Electro Mechanical strength Disc Insulators shall conform to designation 16mm/16mm-B in accordance with IS:2486(Part-II) or equivalent International Standard. The Ball and Socket dimension of Hardware to be used with 11500 Kg & 16,500 kg Electro Mechanical strength disc insulator shall conform to designation 20mm in accordance with IS-2486:(Part-II) or equivalent International Standard. The Bidder shall offer full detail of locking device in accordance with IS 2486:(Part-III) or equivalent International Standard along with test reports, gauges and adherence to Standards for Tests on Locking Devices in line with IS:2486 (Part-IV) or equivalent International Standard.

6.0 REQUIRED GUARANTEED STRENGTH OF HARDWARE OF INSULATOR STRINGS:

The Hardwares and Clamps of 132kV/220kV single suspension and double suspension strings suitable for Panther ACSR and Zebra ACSR and all types of suspension and tension strings suitable for sub-station shall have the ultimate breaking strength of not less than 7,000 kgs.

The slipping strength of the suspension clamp shall not be less than 15% and more than 20% of the Conductor strength with which it is to be used.

The Hardware and Compression Clamp of single and double tension strings suitable for Panther ACSR shall have ultimate breaking strength of not less than 9,100 kgs. The

slipping strength of Compression Clamp shall not be less than 95% of the ultimate breaking strength of Panther ACSR.

Each individual Hardware component of double suspension and double tension strings such as ball-clevis, socket clevis etc. shall have minimum breaking strength as specified for respective single suspension and tension string respectively.

7.0 PARTICULARS OF HARDWARE FITTINGS:

Each Hardware fitting for the substation shall be complete in all respect and Bidder should furnish complete drawings and technical particulars of the items quoted. The Hardware fittings should normally comprise items conforming to enclosed drawing as under: -

7.1 Single Suspension Hardware Fittings For Zebra/Twin-Zebra for Sub Station:

The 132/220kV/400KV sub stations Hardware fittings shall comprise of one Ball Hook, one Socket Clevis Eye Horn holder, one Arcing Horn and one Suspension Clamp for respective size of Conductors

7.2 Single Tension Hardware For Twin ACSR Zebra for substation:

Single Tension Hardware shall comprise of U Clevis, one Ball Link, Socket Clevis, Yoke Plate, two Clevis Eyes and two Tension Clamps of bolted type suitable for ACSR Zebra. The minimum breaking and slipping strength of single tension Hardware fitting for twin Conductor shall not be less than 7000 Kgs. One set of additional nuts (as check nuts) should be provided alongwith the bolts and nuts to fix the tension clamp with the conductor so as to avoid the possibility of relative/looseness due to vibration of strings.

7.3 Single Tension Hardware for Panther/Zebra/Twin Zebra for substation:

The Single Tension Hardware shall comprise of one Anchor Shackle, one Ball link, Socket Clevis and one Tension Clamps of bolted type suitable for respective sizes of Conductor. The minimum breaking and slipping strength of single tension Hardware fitting shall not be less than 7000 kgs. One set of additional nuts (as check nuts) should be provided alongwith the bolts and nuts to fix the tension clamp with the conductor so as to avoid the possibility of relative/looseness due to vibration of strings.

7.4 Substation type suspension and tension hardware for ACSRMoose for 400/220KV S/s.

Substation type Suspension hardware fittings for twin Moose ACSR.

The suspension hardware fittings for twin Moose ACSR shall comprise of "U" clevis, ball link, Corona ring, socket eye, yoke plate etc., and suspension clamp with through clamp. The UTS of string H/W shall be 11500 Kg & slip strength of 7000 Kg. The ball & socket shall be designated as 20mm.

Substation type double tension hardware fittings for quadruple ACSR Moose.

The 400 KV Substation type double tension hardware fittings for quadruple Moose ACSR shall comprise of 2 sets of "U" clevis, ball link, socket clevis, yoke plate, corona control ring ,clevis eye, sag plate, shackle etc. & 4 nos. tension clamps. The UTS of hardware shall be 11500 Kg and slip strength of 7000 Kg.

Substation type Double tension hardware fittings for twin ACSR Moose.

The 400 KV tension hardware fittings for twin Moose ACSR shall comprise of “U” clevis, ball link, Corona ring socket eye, yoke plate ball clevis, sag plate etc., and two nos, tension clamp. The UTS of string and clamp shall be 11500 Kg & 7000 Kg (min) respectively with slip strength of 7000 Kg.

7.5 GROUNDWIRE ASSEMBLIES:

The Ground wire tension assembly shall have minimum breaking strength equal to that of the Ground Wire. The slipping strength of the Compression Clamp shall not be less than 95% of the breaking strength of Ground Wire. The Ground wire tension assemblies for Sub-Stations shall be as under: -

The Ground wire tension assembly for Substation shall comprise of one bolted type Clamp and one `D` Shackle complete with minor accessories such as bolts, nuts pins etc. The assembly shall be hot dip galvanized and made inherently resistant to the atmosphere corrosion. The design of the bolted type clamp shall be strictly as per sketch shown in the enclosed drawing.

8.0 DETAILS OF COMPONENTS OF HARDWARE FITTINGS:

8.1. Socket Eye & Ball Clevis:

The Socket Eye and Ball Clevis be made of forged steel as per the drawing enclosed.

8.2. U Clevis:

These shall be made of forged steel complete with galvanised steel rivets washer and Phosphorus Bronze/Stainless Steel pins.

8.3. Ball Fittings:

These shall be made of forged steel in one piece. They shall be normalized to achieve the minimum breaking strength specified in the respective drawings. Before galvanising of ball fittings, all die fleshing on the shank and on the bearing surface of the ball shall be carefully removed without reducing the dimension below the requirements. The dimension of the ball & socket shall be 16mm/20mm designation in accordance with standard dimensions stated in IS:2486 (Part-II).

8.4. Dimensions & Tolerances:

- 8.4.1. The dimensions and tolerances of pin balls and socket ends shall conform to IS 2486 Part-II/IEC-120 and shall be checked by the gauge therein after galvanizing.
- 8.4.2. The pin balls shall be checked with the applicable “GO” gauges in at least two directions, one of which shall be across the line of die flashing and the other 90 deg. to this line. “NO GO” gauges shall not pass in any direction.
- 8.4.3. The bearing surfaces of balls and machined sockets, before galvanizing shall not have surface roughness more than 250 micro inches.
- 8.4.4. The bearing surface of socket ends shall be uniform about the entire circumference without depressions or high spots. The internal contour of the socket ends shall be concentric with the axis of fittings. The axis of the bearing surface of socket ends shall be coaxial with the axis of fittings with no appreciable tilting.

8.5. Socket Fittings:

Socket fittings shall be made of clause IV steel as per IS:2004 or steel of equivalent grade and shall be forged in one piece. They shall be normalized to achieve the minimum breaking strength specified on the respective drawings.

8.6. Security clip for Socket fittings:

- 8.6.1. Socket fittings shall be provided with R-shaped security clip in accordance with IS:2486 (Part-III) to provide positive locking against unintentional disengagement of socket from the ball of the insulator. The security clip shall be humped to maintain the clip in the locked position and shall have both prongs spread to prevent complete withdrawal from the socket. The clip end shall not project outside the recess of socket when the clip is in locked position.
- 8.6.2. The hole for the security clip shall be on the side of the socket opposite to the socket opening. The hole for the clip shall be counter sunk. The clip eye shall be of such design that the same may be engaged by a hotline clip puller to provide for disengagement under energized conditions.
- 8.6.3. The force required to pull the clip to its unlocked position shall not be less than 50 N or more than 500N.
- 8.6.4. The security clip shall be made of stainless steel of type AISI 302 or 304 or phosphor bronze as per IS:7814.

8.7. Clevis-Eye:

These shall be forged steel of malleable cast iron and shall be complete with galvanised pin with flat washer and split pin of Phosphorus Bronze/Stainless Steel.

8.8. Yoke Plate:

- 8.8.1. The yoke plates/link plate shall be made of mild steel plate as per IS:226 or equivalent standards. Shearing/cutting of the plates shall be clean without drawn or ragged edges. If the plates are flame cut, mechanical guides shall be used. It shall be ensured that the grain flow of the yoke plate shall be in the direction of the tensile load.
- 8.8.2. Holes shall be cylindrical clean cut and perpendicular to the plane of the material. The periphery of the holes shall be free from burrs.
- 8.8.3. All the corners and edges should be rounded off with a radius of at least 3mm.
- 8.8.4. Design calculation is for bearing and tensile strength for deciding the dimensions of yoke plate shall be furnished by the bidder. The holes provided for bolts in the yoke plate should satisfy shear edge condition as per IS:800.

8.9. Corona Control Ring :-

- 8.9.1. The corona control ring shall be provided with hardware fittings and shall be of such design that it should cover at-least one disc insulator in insulator strings so that they will reduce the voltage across the insulator units. It shall also improve corona and radio interference performance of the complete insulator string alongwith hardware fittings.
- 8.9.2. The corona control rings shall conform to the specification drawings. The same shall be made of aluminium alloy tube of minimum 2.5mm wall thickness of type 6063 or equivalent. The same shall be heat treated to maintain consistency in material properties during service.
- 8.9.3. Welding of corona control ring shall be done with Argon welding. The welded locations shall be suitably grinded and shall not allow penetration of water inside the tube during service. The mechanical strength of welded joint shall not be less than 20kN.

- 8.9.4. The corona control ring shall be buffed and have a brushed satin finish. No blemish shall be seen or felt while rubbing a hand over the surface.

8.10. Sag Adjustment Device

- 8.10.1. The sag adjustment devices to be provided with double tension hardware fittings shall be of three plate type. The sag adjustment device shall be provided with a safety locking arrangement.
- 8.10.2. Sag adjuster plates shall be made from high quality mild steel plate as per IS:226. The grain flow shall not be in a direction transverse to the tensile load. Cutting/shearing and drilling of holes shall be similar to those for yoke plate mentioned under clause 8.8.
- 8.10.3. The maximum length of the sag adjustment plate from the connecting part of the rest of the hardware fittings shall be 520 mm. The details of the minimum and maximum adjustment possible and the steps of adjustment shall be clearly indicated in the drawing. An adjustment of 150mm maximum at the interval of 6mm shall be possible with the sag adjustment plate.

9.0 IMPORTANT CONDITIONS:

- 9.1 All Hardware items shall be complete with minor items such as security clip, bolts, nuts, washer, split pins and inners etc.
- 9.2 Enclosed drawings show the attachment proposed to be fitted on the towers. The Bidder shall be responsible for satisfying him that the Insulator fittings offered are entirely suitable for the proposed attachments and for the sizes of the Conductor.
- 9.3 All ferrous fittings (except those specified otherwise) shall be hot dip galvanized, after all machining and fitting has been completed, in accordance with relevant Indian Standard. All Hardware items (other than clamps) and those specified otherwise should be made of Drop Forged Steel. Socket items in forged steel must be forged. All forgings supplied should be stress relieved and this treatment should be done at the Bidder works. Forgings, which are not stress relieved, will not be acceptable. The items like Yoke Plate, Arcing Horn, Bolts and Nuts shall be of mild steel and rest of the items shall be of forged steel.
- 9.4 All Bolts, Nuts and Screw heads shall have only wide width standard thread and of sizes indicated in the enclosed drawing. Bolts head and Nuts shall be hexagonal. Where required, nuts shall be locked in approved manner. The thread in Nuts shall be over tapped after galvanizing and shall be cut before galvanizing. The threads shall not be under cut. The Nuts should be tapped such that they are fit on the bolt threads i.e. these should not have loose fitting.

10.0 LENGTH OF STRINGS:

- 10.1 The clearance to the tower steel parts under service conditions of Insulator have been decided on the basis that the overall length of 9 Disc for 132kV line and 13 Disc for 220kV line (both of 7000 kgs EMS for single suspension string) will not exceed the length as indicated in the attached drawings. The dimension of the Disc for Ball and Socket type will be 255mm x145mm for 7000 kgs EMS to be used with suspension strings on 132kV/220kV lines. In case of 400KV Suspension string, 23 disc insulators of 11500 Kgs EMS of Size 280 mm & 145mm (height) will be used.
- 10.2 In case of 132kV tension strings, 10 Disc insulators of 9100 kg EMS of size 255mm (dia) x 145mm (height) will be used. In case of 220kV tension strings, 14 Disc insulators of 16,500 kgs EMS of size 280mm (dia) x 170mm (height) will be used.
- 10.3 In case of 400kV tension strings, 24 Disc insulators of 16500 kg EMS of size 280mm (dia) x 170mm (height) will be used.

11.0 GALVANISING:

- 11.1 Hot dip galvanizing shall conform to Indian Standard specification IS-2633 or equivalent International Standard. Galvanising shall be uniform, free from blisters, and shall not peel off due to abrasion, Zinc coating shall be thick enough to withstand 6

one minute dips in Copper Sulphate solution (prece test) for all ferrous parts except for threaded portions which shall withstand at least 4 one minute dips.

11.2 The Bidder must emboss/engrave their name in each forged steel item and Aluminium castings such as Ball Hook, Yoke Plate, Socket Clevis, Clevis Eye, Clevis-Clevis, Anchor Shackle/D-Shackle, Chain Link, Suspension Clamps of AGS type, Tension Clamps and Arcing Horns. This is very essential. If the Bidder will not agree with this condition, their offer will be treated as non-responsive.

12.0 TESTS

The following Type Tests, Stage Tests, Routine Tests and Acceptance Test shall be carried out on power Conductor & Ground wire Hardware fittings.

12.1 Type Tests

The material offered shall be fully Type Tested as per this specification and 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. For any change in the design/type already Type Tested and the design/type offered against this specification, the purchaser reserves the Rights to demand repetition of test without any extra cost.

12.2 Stage Tests:

Stage Tests during manufacturing shall mean those test required to be carried out during the process of manufacturing to ensure quality control such that last product is of the designed quality conforming to the intent of this specification.

12.3 Routine Tests:

Routine Tests are those tests, which required to be carried out on each and every finished product so as to check with requirements that are likely to vary during production.

12.4 Acceptance Tests:

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

12.5 Test Values:

For all type and acceptance tests, the acceptance values shall be the value guaranteed by the Bidder in the guaranteed technical particulars or the acceptance value specified in this specification, the relevant Indian Standard or equivalent International Standard.

12.6 Test Procedures And Sampling Norms:

The norms and procedure of sampling for the above tests shall be as per the relevant Indian Standard or other internationally accepted Standards. This will be discussed and mutually agreed to between the successful Bidder and Purchaser before placement of order.

13.0 TYPE TESTS:

13.1	On the complete insulator string with hardware fittings (for 400KV only)
------	--

a.	Power frequency voltage withstand and flashover test with corona control grading ring under dry/wet condition.	BS:137 (Part-I)
b.	Switching surge voltage withstand test under wet condition.	IEC:383
c.	Impulse voltage withstand test under dry condition	IEC:383
d.	Impulse voltage flashover test under dry condition	IEC:383
e.	Voltage distribution test	
f.	Corona and RIV test under dry condition.	As per specification.
g.	Mechanical strength test for complete string	
h.	Vibration test	
NOTE	For electrical tests, the insulator string shall be mounted on a stimulated tower.	
13.2	On Suspension Hardware fittings only.	
a.	Magnetic power loss test for suspension assembly.	As per specification
b.	Clamp slip strength for AGS clamp	
c.	Clamp slip strength VS torque test for suspension clamp	
d.	Test on neoprene	
e.	Ozone test.	
f.	Heat resistance test.	
13.3	On Tension Hardware Fittings only	
a.	Electrical resistance test for dead end assembly.	IS:2486(Part-I)
b.	Heating cycle test for dead end assembly	
c.	Slip strength test for dead end assembly.	
d.	Mechanical strength test.	As per specification

- 13.4. All the type tests given under clause no 13.1 above shall be conducted separately on single/double suspension and tension insulator string alongwith hardware fittings.
- 13.5. The tests specified under clause no. 13.1 e & f. (i.e. the voltage distribution test and corona/RIV Dry test) shall also be conducted on single suspension pilot double suspension and single tension insulator string alongwith hardware fittings.
- 13.6. The mechanical strength test given under clause no. 13.1 (g) above shall also be conducted on single suspension pilot, double suspension and single tension insulator string alongwith hardware fittings.
- 13.7. The magnetic power loss test specified under 13.2 (a) shall be conducted on single suspension, single suspension pilot and double suspension assembly.

14.0 ACCEPTANCE TEST / SAMPLE TESTS:

14.1.	On both suspension and tension hardware fittings:	
a.	Visual Examination	IS:2486 (Part-I)
b.	Verification of dimensions	IS:2486 (Part-I)
c.	Galvanising test/Electroplating	As per this specification.
d.	Mechanical strength test of welded joint	As per this specification.
e.	Mechanical strength test for corona control rings.	BS:3288(Part-I)
f.	Test on locking devices for ball & socket coupling.	IEC:372(2)
g.	Mechanical strength test of each components excluding corona control ring and arcing horn.	As per this specification.
14.2.	On suspension Hardware fittings only:	
a.	Clamp slip strength vs torque test for suspension clamp.	As per this specification.
b.	Shore hardness test of elastomer cushion for AG suspension clamp.	
c.	Bend test for armour rod set.	IS:2121 (Part-I)

d.	Re silence test for armour rods set.	
e.	Conductivity test for armour rods set	
14.3.	On tension hardware fittings only	
a.	Slip strength test for dead end assembly	IS:2486 (Part-I)
14.4	Suspension hardware for groundwire.	
i.	Visual examination	
ii.	Dimensional verification.	
iii.	Slip strength test.	
iv.	Mechanical strength test on each component	
v.	Galvanising test	
vi.	Mechanical strength test of welded joint	
14.5	Tension hardware for groundwire	
i	Visual examination	
ii	Dimensional verification.	
iii	Slip strength test.	
iv	Electrical resistance test.	
14.6	Test during manufacture.	
i.	On all components as applicable.	
ii.	Chemical analysis of zinc used for galvanizing	
iii.	Chemical analysis, hardness test grain size inclusion rating and magnetic particle inspection for forgoing/castings.	
iv.	Chemical analysis and proof load test fabricated hardware.	
v.	Tests on malleable castings forgings and fabricated hardware's.	

15.0 DRAWING AND LITERATURE:

The detailed drawings of each component assembly drawings and descriptive literature of the Hardware assembly shall be submitted along with their offer. The detailed dimension drawings for each and all individual Hardware items such as clamps, U Clevis, Socket Eye, Yoke Plate and Socket Clevis etc. shall also be submitted separately. Test certificates for different tests conducted as per relevant ISS, for all the offered items must also be submitted essentially. The offer of such bidders who do not submit the drawings as per requirement may be treated as rejected.

16.0 MATERIALS AND WORKMANSHIP:

- 16.1. All the materials shall be of the latest design and conform to the best modern practice adopted in the extra high voltage field. The Bidder shall offer only such equipment as guaranteed by him to be satisfactory and suitable for 400/220/132kV Sub-stations.
- 16.2. The design, manufacturing process and quality control of all the materials shall be such as to give maximum factor of safety, maximum possible working load, highest mobility, elimination of sharp edges and corners, best resistance to corrosion and a good finish.
- 16.3. All ferrous parts shall be hot dip galvanised, after all machining has been completed. Nuts may, however, be tapped (threaded) after galvanising and the threads oiled. Spring washers shall be electro galvanised. The bolts threads shall be under cut to

- take care of increase in diameter due to galvanising. Galvanising shall be done in accordance with IS:2629-1966 or equivalent International Standard and satisfy the tests mentioned in IS:2633-1972 or equivalent International Standard. Fasteners shall withstand four dips while spring washers shall be guaranteed to withstand at least six dips each lasting one minute under the standard precece test for galvanising.
- 16.4. The Zinc coating shall be perfectly adhere, of uniform thickness, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust stains, bulky while deposits and blisters. The Zinc used for galvanising shall be grade Zn. 99.95 as per IS: 209-1966 or equivalent International Standard.
 - 16.5. In case of castings, the same shall be free from all internal defects like shrinkage, inclusion, blowholes, cracks etc.
 - 16.6. All current carrying parts shall be so designed and manufactured that contact resistance is reduced to minimum.
 - 16.7. No item which would produce high electrical and mechanical stresses in normal working shall have sharp ends or edges, abrasions or projections and shall not cause any damage to the Conductor in any way during erection or during continuous operation. The design of adjacent metal parts and mating surfaces shall be such as to prevent corrosion of the contact surface and no maintain good electrical contact under service conditions.
 - 16.8. Particular care shall be taken during manufacturing and subsequent handling to ensure smooth surface free from abrasion or dents.
 - 16.9. The fasteners shall conform to the requirement of IS: 6639-1972 or equivalent International Standard. All fasteners and clamps shall have locking arrangements to guard against vibration loosening.

17.0 INSPECTION:

- 17.1. Purchaser and its representatives shall at all times be entitled to have access to the works and to all places of manufacturing and the successful Bidder/Supplier shall afford all facilities to them for unrestricted inspection of the works, inspection of material, inspection of manufacturing process and for conducting necessary tests as specified herein.
- 17.2. The successful Bidder shall keep the Purchaser informed in advance of the time of starting and progress of manufacturing of material in its various stages so that arrangements could be made for inspection.
- 17.3. No material shall be despatched from its point of manufacturing unless the material has been satisfactorily inspected and tested.
- 17.4. The acceptance of any quantity of material shall in no way relieve the successful Bidder of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection, if such materials are later found to be defective.

18.0 IDENTIFICATION MARKING:

The main component of the material covered in the specification shall be legibly and indelibly marked with the trademark of the manufacturer, the month and year of manufacture, the guaranteed combined mechanical and electrical strength in kilo-Newton abbreviated by 'kN' to facilitate easy identification and proper use. Marks shall be forged or stamped with a steel die before Galvanizing. The marks shall be distinct, durable and conspicuous. Embossing/Engraving should be done at the time of manufacturing process itself, but before Galvanizing. Smaller component like bolts & nuts, split pin and washers etc. may be excluded from this requirement.

19.0 QUALITY ASSURANCE PLAN:

- 19.1. The Bidder hereunder shall invariably furnish following information along with his offer.
- i. Statement giving list of important raw materials, names of sub-suppliers for the raw material, list of Standards according to which the raw material are tested, list of tests, normally carried out on raw material in presence of Supplier'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 lists of areas where manual processing exists.
 - v. List of areas in manufacturing process, where stage inspections are normally carried out in quality control and details of such test and inspections.
 - vi. Special features provided in the offered material to make it maintenance free.
 - vii. List of testing equipment available with the bidder for final testing of the material specified and test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant Standards. These limitations shall be very clearly brought out in schedule of deviations from specified test requirements.
- 19.2. The successful bidder shall within 30 days of placement of order submit the following information to the Purchaser:
- (i) List of raw material as well as bought out accessories and the names of sub-suppliers selected from those furnished along with the offer.
 - (ii) Type test certificates of the raw material and bought out accessories.
 - (iii) Quality Assurance Plan (QAP) with hold points for Purchaser's inspection. The QAP and Purchaser's hold points shall be discussed between the Purchaser and the Supplier before the QAP is finalized.
- 19.3. The successful bidder shall submit the routine test certificates of bought out items and raw material at the time of routine testing of the material covered in the specification.

20.0 DOCUMENTATION & LIST OF DRAWINGS:

The bidder shall furnish full description, illustrated catalogues and dimensional drawings, along with the bid. The drawing shall include the following information:

- (i) General outline & assembly drawings of all the items /material covered in the specification.
- (ii) Dimensions, unit spacings
- (iii) Unit mechanical and electrical characteristics as also for the complete assembly/set.
- (iv) Weight of each component.
- (v) Identification mark.
- (vi) Material designation used for different components with reference to Standards.
- (vii) Fabrication details such as welds, finishes and coatings
- (viii) Manufacturer's catalogue number.
- (ix) Brief installation instructions.
- (x) Reference of type testing.
- (xi) Relevant technical details of significance.

ANNEXURE-I**TECHNICAL PARTICULARS OF CONDUCTOR AND GROUNDWIRE FOR
400/220/132kV SUBSTATIONS**

The Hardware fitting for 132/220/400kV S/s shall be suitable for the following sizes Conductors.

S.N	Particulars	Panther ACSR	Zebra ACSR	Moose ACSR	Ground Wire
1	Material	ACSR	ACSR	ACSR	Steel
2	Size	130 mm ² Cu Eq.	260 mm ² Cu Eq.	325 mm ² Cu Eq.	--
3	Nominal Alu.area	207 mm ²	419 mm ²	515.70 mm ²	--
4	Stranding and wire diameter (no./mm)	30/3.00 Alu.+ 7/3.00 steel	54/3.18 Alu.+ 7/3.18 steel.	54/3.53 Alu.+ 7/3.53 steel.	7/3.66mm.
5	Number of strands in each layer. Central core 1st layer 2nd layer 3rd layer 4th layer	1 of steel 6 of steel 12 of Alu. 18 of Alu. ---	1 of steel 6 of steel 12 of Alu. 18 of Alu. 24 of Alu.	1 of steel 6 of steel 12 of Alu. 18 of Alu. 24 of Alu.	1 of steel 6 of steel
6	Sectional area of Alu.	212.10 mm ²	428.90 mm ²	515.70	--
7	Total sectional area	261.60 mm ²	484.50 mm ²	597 mm ²	--
8	Appr. overall diameter	21.00 mm	28.62 mm	31.77 mm	10.98 mm
9	Overall diameter when wrapped with preformed Armour Rod	33.78 mm	44.36 mm	-	18.30 mm
10	Approximate weight	976 Kg/ Km	1621 Kg/ Km	2004 Kg/ Km	583Kg/ Km
11	Calculated D.C. resistance at 20° C	0.139 Ohm/Km	0.0691 Ohm/Km	0.0551 Ohm/Km	2.5 Ohm/Km
12	Appr. Breaking Load	9127 Kgs.	13316 Kgs.	16250 Kgs.	6972 Kgs
13	Co-efficient of Linear Expansion	17.73 x 10 ⁻⁶ per °C	19.35 x 10 ⁻⁶ per °C	19.53 x 10 ⁻⁶ per °C	11.5 x 10 ⁻⁶ per °C
14	Final Modulus of Elasticity	0.787 X 10 ⁶ kg/cm ²	0.686 X 10 ⁶ kg/cm ²	0.686 X 10 ⁶ Kg/cm ²	1.931X10 ⁶ Kg/cm ²

APPENDIX – A

PRINCIPLE PARAMETERS FOR SUBSTATION TYPE HARDWARE

1. PRINCIPAL PARAMETERS:

1.1. Details of Hardware Fittings:

The Hardware fittings shall meet the technical requirement as per clause and also general arrangement drawings of Hardware fittings attached herewith. Hardware fittings shall be suitable for single/double suspension Insulator strings, single/double tension Insulator strings. Each Hardware fitting shall be supplied complete in all respect and shall include all components, which are required for making complete set.

1.2. The hardware fittings for substation shall be suitable for ACSR Conductor and ground-wire as per technical parameters indicated in Annexure-I.

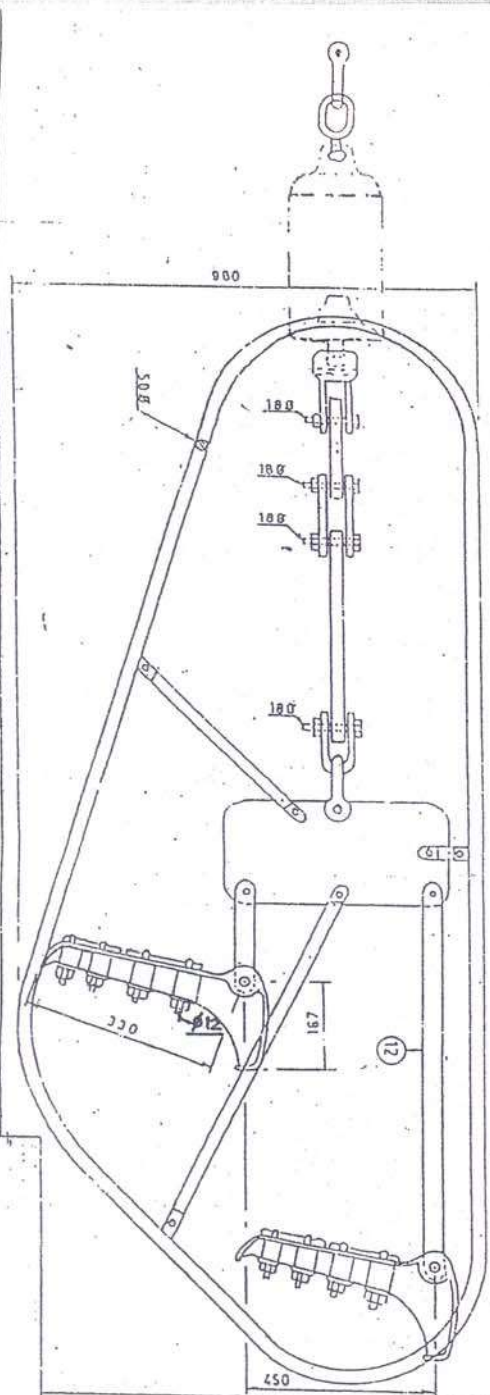
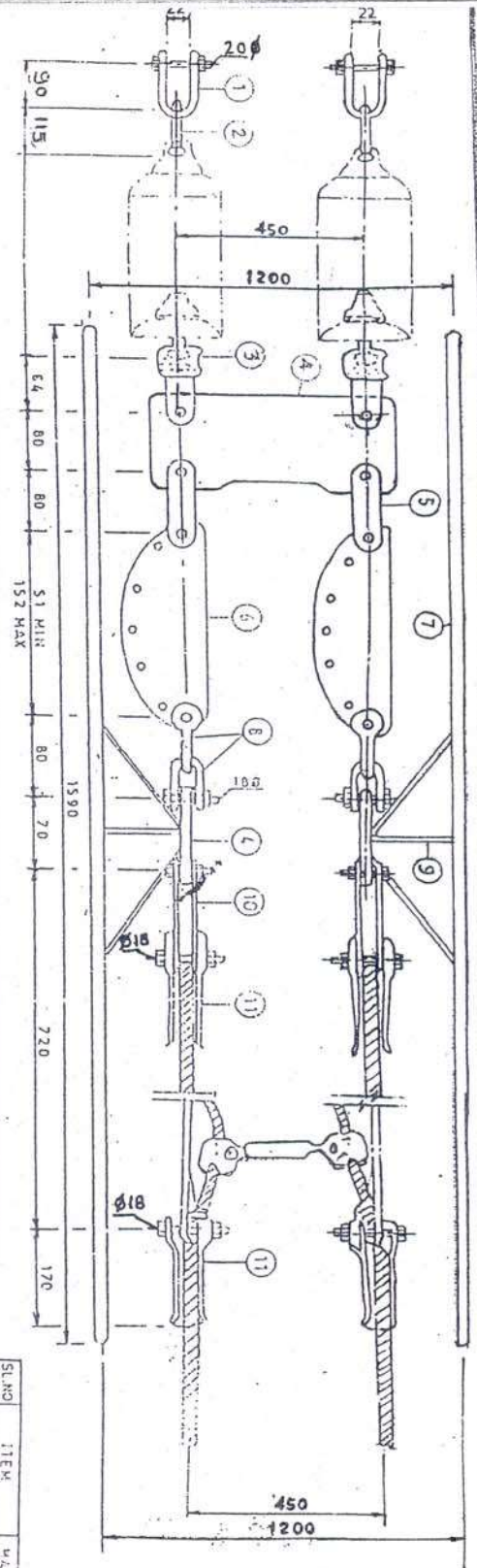
2. INSULATOR STRING CHARACTERISTICS:

2.1 The complete insulator string including Hardware fittings shall have the following characteristics.

S. No.	Characteristics	Single/ Double Suspension			Single/ Double Tension		
		220kV	400kV	132kV	220kV	400kV	132kV
1	No. of Standard Discs	1x13 2x13	1x23 2x23	1x9 2x9	1x14 2x14	1x24 2x24	1x10 2x10
2	Nominal diameter of discs	255	280	255	280	280	255
3	Power frequency withstand voltage (wet) kV (rms)	460	680	280	490	690	300
4	Lighting impulse withstand voltage (dry)(kVp)	1200	1600	800	1200	1700	800
5	Switching surge Withstand voltage (Dry & wet) (kVp)	900	1050	350	900	1050	350
6	Mechanical failing Load (kgf)	7000/ 14000	11500/ 23000	7000/ 14000	16500/ 33000	16500/ 33000	9000/ 18000
7	Pollution	Moderately polluted			Moderately polluted		
8	No deformation load (kgf)	4690/ 9380		4690/ 9380	11055/ 22110		6030/ 12060
9	Corona Extinction voltage (KV rms)	176	320	-	176	320	-

APPENDIX - B
DRAWINGS

S. No.	Drawing No.	Description
1	JICA/MPPTCL/TR-101 TO 107/ Tension for Quad. Moose(400KV)	For bolted type double tension fittings for quadruple Moose ASCR for 400 KV
2	JICA/MPPTCL/TR-101 TO 107/ Tension for Twin Moose(400KV)	For 400 KV bolted type double strain fittings suitable for twin Moose ASCR
3	JICA/MPPTCL/TR-101 TO 107/ Tension for Twin Moose (220KV)	For 220 KV Tension fittings with Twin Moose Hardware
4	JICA/MPPTCL/TR-101 TO 107/ Tension for Single Moose (220KV)	For 220 KV Single Tension fittings with Single Moose Hardware
5	JICA/MPPTCL/TR-101 TO 107/ Susp. for Twin Moose with through clamp (220KV)	For 220 KV Susp. fittings with Twin Moose with through clamp (300 mm)
6	JICA/MPPTCL/TR-101 TO 107/ Susp. for Twin Moose with drop clamp (220KV)	For 220 KV Susp. fittings with Twin Moose with drop clamp (300 mm)
7	JICA/MPPTCL/TR-101 TO 107/Susp. for Single Moose (220KV)	For 220 KV Susp. fittings with Single Moose
8	JICA/MPPTCL/TR-101 TO 107/ 132/220KV S/s Hardwares	For 132/220 KV Substation type of Hardwares
9	JICA/MPPTCL/TR-101 TO 107/ Tension assembly for Earthwire	For 220 KV Bolted type tension assembly for Earthwire



S.NO	ITEM	MATERIAL	QTY
1	U CLEVIS	FORGED STEEL	2
2	BALL LINK	FORGED STEEL	2
3	SOCKET CLEVIS	MILD/ALLOY STEEL	2
4	FORK PLATE	MILD STEEL	2
5	CLEVIS CLEVIS	MILD/ALLOY STEEL	2
6	SAG PLATE	GALV. STEEL	2
7	CORONA RIPP	ALUMINUM TUBE	2
8	SHACKLE	FORGED STEEL	2
9	BRACKET	MILD STEEL	6
10	CLEVIS LINK	MILD STEEL	2
11	STRAIN CLAMP	ALUMINUM	2
12	EXTENSION LINK	MILD STEEL	2

(FOR TENDER PURPOSE ONLY)

UTS OF SET EXCEPT CLAMP --- 11500 KG
 UTS/ SLIP STRENGTH OF CLAMP --- 7000 KG
 UTS OF CORONA RING --- 150 KG
 FERROUS PARTS HOT DIP GALVANISED
 DIMENSIONS IN mm AS PER ISS-2486
 TOLERANCE ± 3%

DOUBLE TENSION SET FOR
 QUADRUPLE MOOSE ACSR
 FOR 400 KV
 TICA/MPTCL/TR-Jet To Jet/ Tension for Quad. Moose (400 KV)

Chief Engineer (Trans.)
 M.P. Power Transmission Company Ltd.

U-CLEVIS LINK BALL CLEVIS TENSION CLAMP
 SOCKET CLEVIS CLEVIS EYE
 CLEVIS CLEVIS LINK
 YOKES PLATE
 SAG PLATE
 CORONA RING
 TENSION CLAMP
 SPLIT PIN W/CLIP
 DIMENSION IN MM
 PERVIOUS PLATE HOT DIP GALVANISED
 TOLERANCE ± 1%

FORGED STEEL, HDG, MCI
 MORGAN-STEEL
 GALV STEEL
 GALV STEEL
 AL ALLOY TUBE
 ALUMINIUM ALLOY
 BRASS BRONZE COPPER
 ALLOY STEEL
 (NON-MAGNETIC)

400 KV
 DOUBLE STRAIN FITTINGS
 SUITABLE FOR TWIN
 MOOSE ACSS
 TIAA/MOPICL/TR-J01 T103/
 Tension for Twin Moose (400KV)

1100
 170 76 80 50 80
 170 76 80 50 80
 450
 U-CLEVIS LINK BALL CLEVIS TENSION CLAMP
 SOCKET CLEVIS CLEVIS EYE
 CLEVIS CLEVIS LINK
 YOKES PLATE
 SAG PLATE
 CORONA CONTROL RING
 TENSION CLAMP
 DIMENSION IN MM

22
 100 100 100 100
 170 170 170
 520
 750
 DIMENSION IN MM

BILL OF MATERIALS

Sl. No.	Item	Nos.
1.	U-Clevis	7
2.	Link	1
3.	Yoke Plate	2
4.	Ball Clevis	2
5.	Socket Clevis	2
6.	Clevis Clevis	2
7.	Sag Plate	2
8.	Corona Control Ring	2
9.	Clevis Eye	2
10.	Tension Clamp	2

1 UTS OF SET EXCEPT CLAMP-11500 KG
 UTSLIP STRENGTH OF CLAMP-2000 KG
 UTS OF CORONA RING 190 KG

Chief Engineer (Trans.)
 M.P. Power Transmission Company Ltd.,
TENDER PURPOSE ONLY

Sl	DESCRIPTION	MATERIAL	QTY
1	U CLEVIS	FORGED STEEL, HDG	2
2	CHAIN LINK	FORGED STEEL, HDG	1
3	YOKE PLATE	GALVD STEEL	1
4	BALL CLEVIS	FORGED STEEL, HDG	2
5	SOCKET CLEVIS	FORGED STEEL, HDG	2
6	GRADING RING	M.S. TUBE 21 ϕ	1
7	YOKE PLATE	GALVD STEEL	1
8	CLEVIS CLEVIS	GALVD STEEL	2
9	SAG PLATE	GALVD STEEL	2
10	CLEVIS EYE	FORGED STEEL, HDG	2
11	TENSION CLAMP	ALUM ALLOY	2

CHIEF ENGINEER (TRANSMISSION)
 MADHYA PRADESH POWER TRANSMISSION COMPANY LIMITED, JABALPUR

SCALE: N.T.S.
 DRAWN BY: []
 APPROVED: []
 DATE: []

REVISION: []

11CB/MPPTCL/TR-1st Test/Transition for Twin Moose
 220 KV DOUBLE STRAIN FITTINGS FOR
 SUITABLE FOR TWIN MOOSE ACSR CONDUCTOR
 TENDER DRAWING

NOTE:-
 1. Fittings conform to IS-2486 (Pt.1)
 2. Fittings are suitable for 20mm B&S insulators
 3. Farnout parts hot dip galvd as per IS-2653
 4. Dimensions in mm Tolerance $\pm 3\%$ (Min ± 1 mm)
 5. UTS of H/W - 11500 Kg UTS of Clamp - 7000 Kg Slip Strength - 7000 Kg
 6. All Bolts, U-Bolts, Nuts & Flat Washer will be of stainless steel and Spring washer of spring steel
 7. Approx. wt. : 27.80 Kg.

ELECTRICAL CHARACTERISTICS
Rated Voltage: 220/132KV

- Power frequency withstand voltage(dry) - 480KV(rms)min. (220KV) - 275KV(rms)min. (132KV)
- Power frequency withstand voltage(wet) - 480KV(rms)min. (220KV) - 275KV(rms)min. (132KV)
- Lightning Impulse withstand voltage(dry) - 1050KV (220KV) - 650KV (132KV) (4ve & -ve Peaks)
- Corona Extinction voltage -156KV (rms) min.(220KV)
- RV level at 156KV (rms) -1000 micro volt (max)(220KV)
- Approx Wt. of Hardware-6.45 Kg
- Total creepage distance of the insulator string - 6125mm (220KV)

NOTES:-

- Bell & Socket Dia-20mm designation as per IS:2486(Pl.II) Reference Standard - IS:2486
- All ferrous parts hot dip galvanized as per IS:2633/2629
- UTS of String - 11500Kgs UTS of Clamp - 7000Kgs Slip Strength - 7000Kgs
- Dimensions in mm
- General tolerance $\pm 3\%$ (Min ± 1 mm)
- Tolerance on total length of hardware fittings $\pm 2\%$
- All forged components are made by drop forging method as per IS:2004

BILL OF MATERIAL

SL	ITEM	DRG No	MATERIAL	IS No	APPROX Wt.(kg)	QTY	UTS(Kg)
1	U CLEVIS		FORGED STEEL	2004		1	11500
2	BALL LINK		FORGED STEEL	2004		1	11500
3	GRADING RING		MILD STEEL TUBE 214	2062		1	150
4	SOCKET EYE		FORGED STEEL	2004		1	11500
5	TENSION CLAMP		ALUM ALLOY	617		1	7000

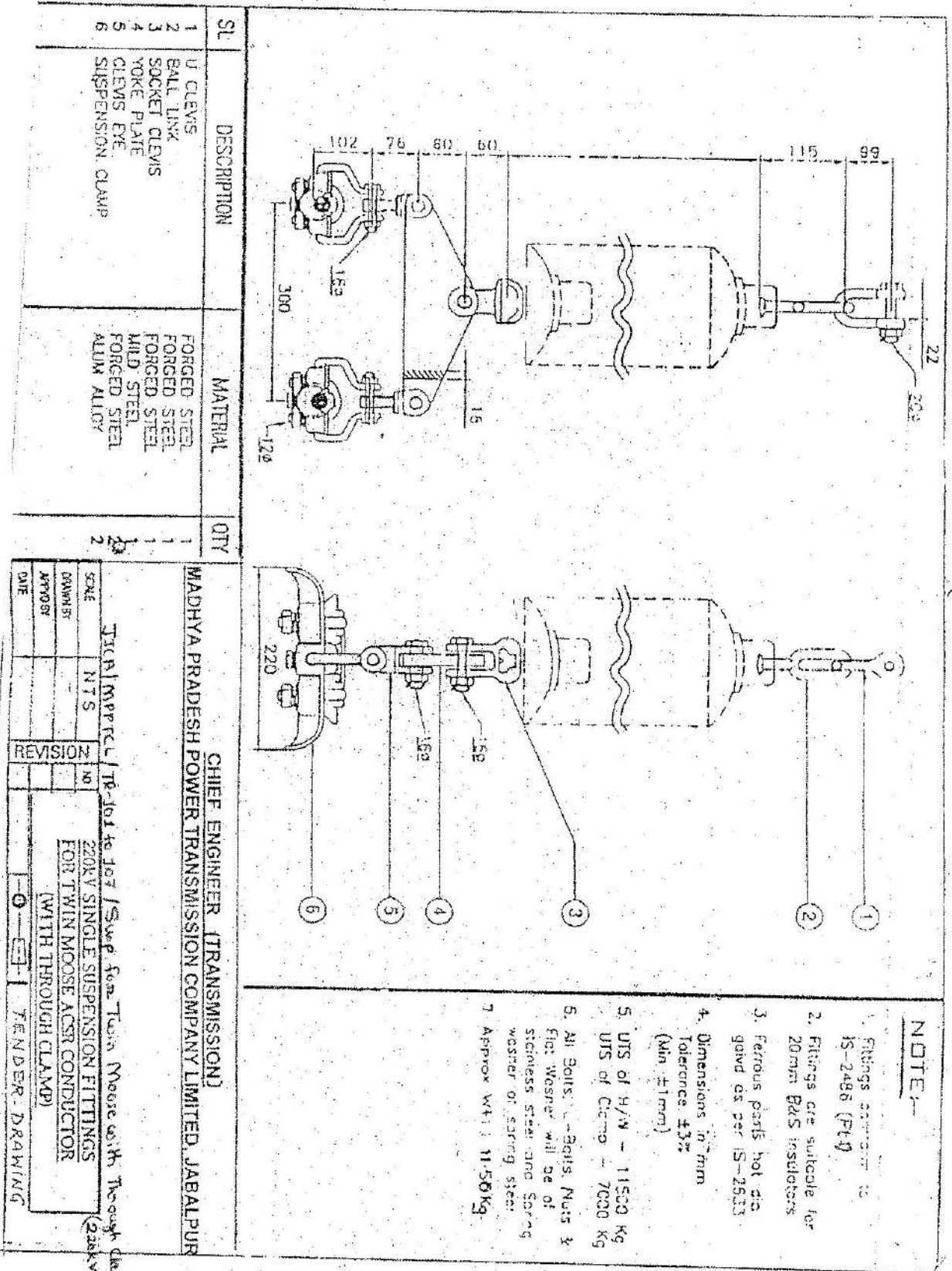
CHIEF ENGINEER (TRANSMISSION)
MADHYA PRADESH POWER TRANSMISSION COMPANY LIMITED, JABALPUR

TICA/MPPTCL/TR-101 To J07/Tension for Single Moose (220KV)

SCALE: N.T.S.
220KV, 132KV SINGLE TENSION FITTINGS
FOR SINGLE MOOSE/TYPE ACSR CONDUCTOR

DRAWING NO. _____ DATE _____

TENDER _____



NOTE:-

- 1. Fittings conform to IS-2486 (Pt.1)
- 2. Fittings are suitable for 20mm B&S insulators
- 3. Ferrous parts hot die gind as per IS-2613
- 4. Dimensions in mm
Tolerance ±.3%(Min. ±1mm)
- 5. UTS of H/W - 11500 Kg
UTS of C/rod - 7000 Kg
- 6. All Bolts, Nuts & Eye Washers will be of stainless steel and Spring washer of spring steel.
- 7. Approx Wt: 11.50Kg.

CHIEF ENGINEER (TRANSMISSION)
MADHYA PRADESH POWER TRANSMISSION COMPANY LIMITED, JABALPUR

TENDR DRAWING

REVISION

SCALE: N.T.S.

DATE: / /

APPROVED BY: /

DATE: / /

Sl.	DESCRIPTION	MATERIAL	QTY
1	D SHACKLE	FORGED STEEL	1
2	BALL LINK	FORGED STEEL	1
3	SOCKET CLEVIS	FORGED STEEL	1
4	YOKE PLATE	MILD STEEL	1
5	CLEVIS EYE	FORGED STEEL	2
6	TENSION CLAMP (DROP TYPE)	ALUM ALLOY	2

CHIEF ENGINEER (TRANSMISSION)
MADHYA PRADESH POWER TRANSMISSION COMPANY LIMITED, JABALPUR

TITAN/MPPTCL/TP-164 to 167/Supp. For Twin Moose with Drop Clamp (220KV)
 SCALE: NTS
 DRAWN BY: 220KV SINGLE SUSPENSION FITTINGS FOR
 APPROVED BY: TWIN MOOSE AC SR CONDUCTOR
 DATE: WITH DROP CLAMP
 TENDER DRAWING

NOTE:

1. Fittings conform to IS-2486 (Part I)
2. Fittings are suitable for 20mm R&S insulators
3. Ferrous parts not dipped galv as per IS-2633
4. Dimensions in mm Tolerance ±1% (Min ±1mm)
5. UTS of H/W - 11500 Kg
 UTS of Drop Clamp - 7000 Kg
 Slip Strength - 7000 Kg
6. All Bolts, U-Bolts, Nuts & Flat Washer will be of stainless steel and Spring washer of spring steel
7. Approx. Wt. : 12.20 Kg.

Sl	ITEM	DRG No	MATERIAL	IS No	QTY	UNITS
1	U CLEVIS		FORGED STEEL	2004	1	11500
2	BALL LINK		FORGED STEEL	2004	1	11500
3	SOCKET EYE		FORGED STEEL	2004	1	11500
4	GRADING RING		HARD STEEL 2 1/4" TUBE	2062	1	150
5	SPRING CLAMP		ALUM ALLOY	617	1	7500

BILL OF MATERIAL

ELECTRICAL CHARACTERISTICS
Rated Voltage: 220KV

- Power frequency withstand voltage (dry) - 450KV (rms) min. (220KV) - 275KV (rms) min. (132KV)
- Power frequency withstand voltage (wet) - 450KV (rms) min. (220KV) - 275KV (rms) min. (132KV)
- Lightning impulse withstand voltage (dry) - 1050KV (220KV) - 650KV (132KV) (+ve & -ve Peaks)
- Corona Exinction voltage (220KV) - 156KV (rms) min.
- RIV level at 156KV (rms) (220KV) - 1000 micro volt. (max)
- Approx Wt. of Hardware - 6.55 Kg

NOTES:

- Ball & Socket Dia - 20mm designation as per IS:2485(P11) Reference Standard - IS:2485
- All ferrous parts hot dip galvanized as per IS:2633/2629
- UTS of String - 11500Kgs
- UTS of Clamp - 7000Kgs
- Ship Strength - 2000Kgs
- Dimensions in mm
- General tolerance ± 0.15 (min 1mm)
- Tolerance on total length of hardware fittings $\pm 2\%$
- All forged components are made by drop forging method as per IS:2004

CHIEF ENGINEER (TRANSMISSION)
MADHYA PRADESH POWER TRANSMISSION COMPANY LIMITED, JABALPUR

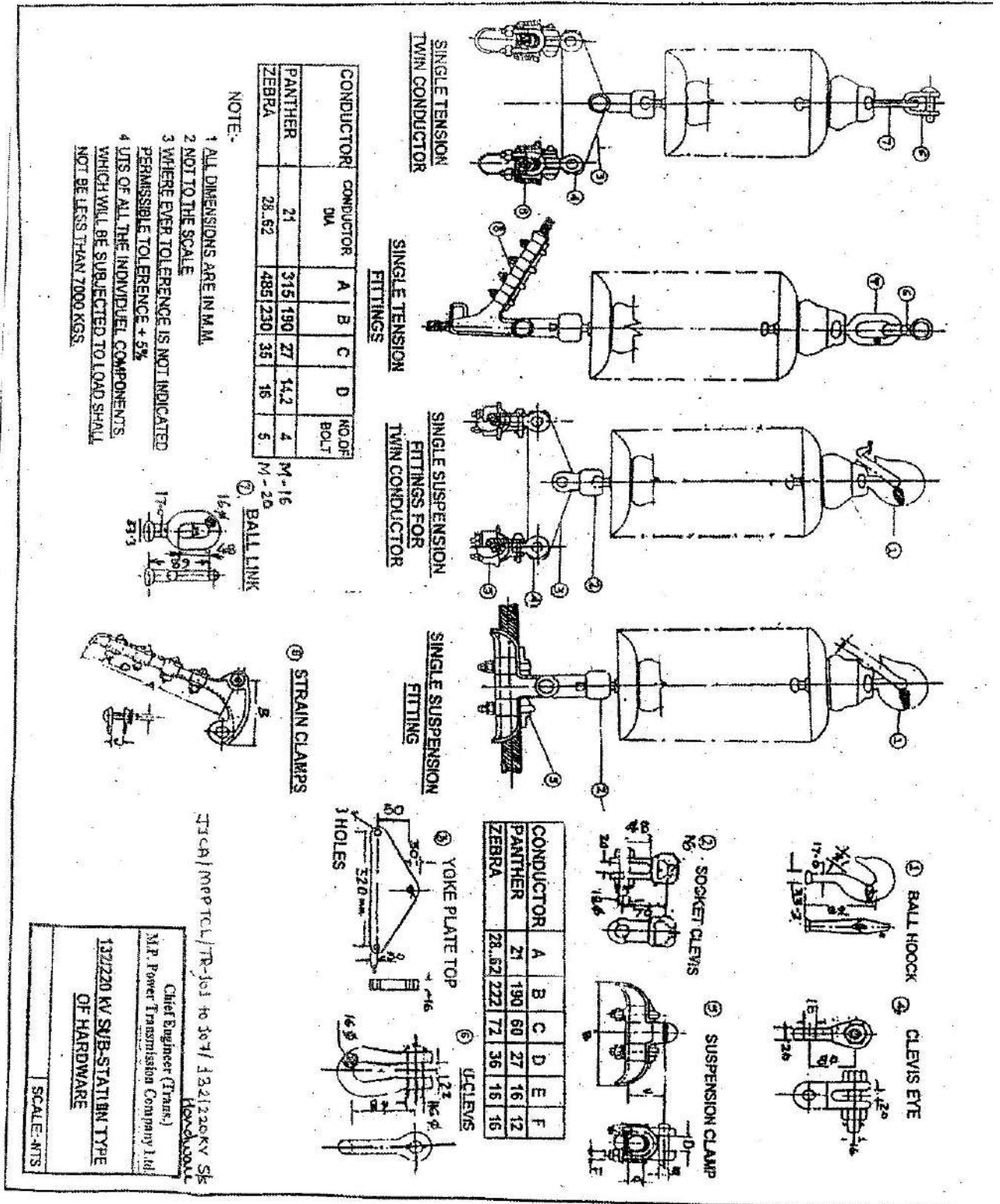
3734/MPP/CL/TR-303 to JCF/ Swap for Single Moose (220KV)

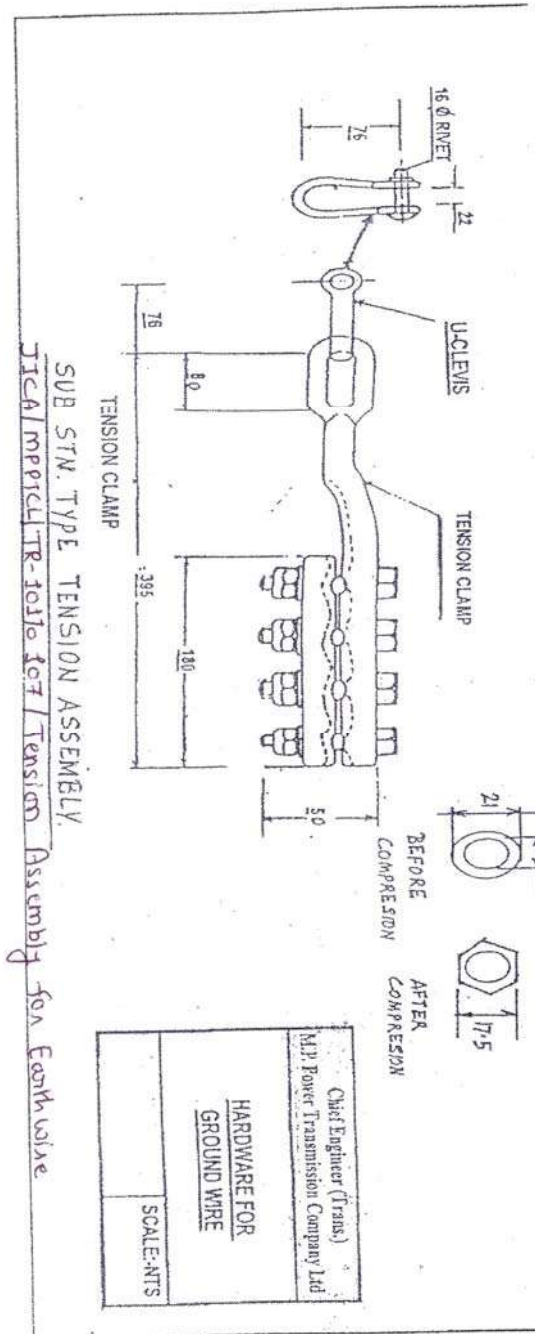
220 KV SINGLE SUSPENSION FITTINGS FOR SINGLE MOOSE AC SR CONNECTOR WITH THROUGH CLAMP

SCALE NTS

TENDER DRAWING.

13





SCHEDULE – I (A)**DESCRIPTION OF EQUIPMENT FOR SCHEDULE FOR RATES AND PRICES TO BE FURNISHED IN VOLUME-VI**

S. No.	Material Particulars	Quantity
	Substation Hardware	As per Price Schedule
	400 KV Switch yard	
1	Double Tension with Quadruple Moose Hardware	
2	Double Tension with Twin Moose Hardware	
3	Suspension with twin moose with through clamp (450 mm)	
4	Suspension with twin moose with Drop clamp (450 mm)	
	220 KV Switchyard	
1	Tension with Twin Moose Hardware(300 mm)	
2	Single Tension with Single Moose Hardware	
3	Susp. with Twin Moose with through clamp (300 mm)	
4	Susp. with Twin Moose with drop clamp (300 mm)	
5	Susp. with Single Moose with drop clamp	
6	Single Susp. with Single Zebra Hardware	
7	Single Susp. with Twin Zebra Hardware	
8	Single Tension with Single Zebra Hardware	
9	Single Tension with Twin Zebra Hardware	
10	Single Tension with single Panther Hardware	
11	Tension Assembly for Earthwire	

NOTE: 1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.

2. The quantity of above equipments has been mentioned in Volume VI

SECTION – II

**2.5.8 TECHNICAL SPECIFICATIONS FOR HOT DIP GALVANIZED EARTHING ROD
3 Mtr. length, 25 mm dia**

TECHNICAL PARTICULARS:

The Hot Dip Galvanized Earthing rod (3 Mtr. length, 25 mm dia.) shall confirm in all respect of high standards of engineering, design and workmanship. The technical specification indicated in this section is for the guidance of the bidder. In case of any deviation, the bidder shall state it clearly in the relevant schedule for this specification stating the reasons and relevant merits of the proposed deviations.

A. HOT GALVANIZED EARTHING RODS 3 Mtr. LENGTH (M.S.)

The Earthing Rods should be mild steel solid rod, confirming to Gr. A as per IS 2062/1984 of 3 Mtr. in length and 25 mm in diameter with one end pointed as indicated in enclosed drawing No. HT- 11/204 dtd. 15.01.2003. The Earthing Rods 3 Mtr. length shall be Hot Dip Galvanized and the Zinc coating shall not be less than 6.10 gram per sq. meter of surface area. The Galvanizing shall be done after all fabrication work is completed.

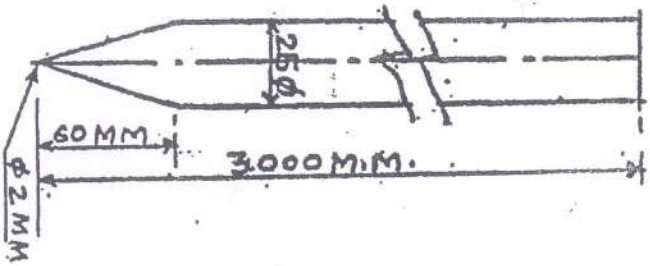
B. TEST(S):

The material covered under this specification shall confirm to the relevant I.S.S. and latest revisions/amendment thereof. The test as specified in relevant I.S.S shall be carried out and test reports in duplicate shall be submitted to the purchaser for approval before dispatch of the materials. For Zinc Coating, tests shall be conducted as per IS 2633/1992. The earthing rod sample shall be subjected to the four successive dips in proper standard solution (each dip of one minute duration).

PREFERRED EXPERIENCE MANUFACTURER:

Based on our past experience for this item we will accept equipment/ material manufactured by IAC/EMI/ERITECH/RUPL as for as this item is concerned.

SMOOTH BUSTER FREE
FINISHING OF ENTIRE
LENGTH INCLUDING
TAPERED PORTION



GALVANISED EARTHING ROD (M.S.)

NOTE:-
ALL DIMENSIONS IN mm

REVISION

Chief Engineer (Trans.)
M.F. Power Transmission Company Ltd.,

DETAILS OF GALVANISED
EARTHING ROD (M.S.)

SRM. B.K.U.

SCALE: NTS

APPD
DATE

Design No. HT-11/201 Date-15.01.2003

SECTION – II

2.6 TECHNICAL SPECIFICATION FOR TRANSFORMER OIL FILTER PLANTS (2250 LPH Plants)

1.0 SCOPE -

This scope of this specification covers design, manufacturing supply of Oil Filter Plant as per Section-I, Volume-II. The bidder mentioned in the Section of Technical specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment / material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS -

Applicable standards for offered equipment / material shall be as per Section-I, Volume – II.

3.0 CLIMATIC CONDITIONS –

Applicable climatic conditions shall be as per Section-I, Volume – II.

4.0 SYSTEM PARTICULARS -

Applicable system particulars shall be as per Section-I, Volume – II.

5.0 GENERAL TECHNICAL REQUIREMENTS

5.1 The Oil Filter plants shall conform to latest version of IS:6034 and shall fulfill testing procedures as laid down under latest version of IS:1866.

- (i) The Filter Plants shall be designed such that the Oil is first passed through the magnetic separator/coarse filter and strainer, followed by heating chamber, where it is subjected to vacuum treatment which dehydrates and degasifies the oil completely. The treated oil thus obtained shall be free from all solid impurities, colloidal matter, dissolved gases, water and volatile acids.
- (ii) The plants shall be operable on 415V, 3 phase, 4 wire 50HZ supply and shall have the flow rate of 2250 LPH The plants shall process oil which will be transformer mineral oil and will be as per latest version of IS:335 with regard to break down voltage, total acidity, neutralization value, gas content, dissipation factor and moisture content. Ionic reaction column with by-pass arrangement shall also be provided for acidity correction, wherever required.
- (iii) The plants shall be so designed that oil is first passed through the coarse filter (with magnet), followed by Ionic reaction column, followed by heating chamber, followed by filter system and finally to the degassing chamber where it will be subjected to vacuum to dehydrate and dehumidify the oil.
- (iv) The constructional features of the plants shall be as under:
 - (a) The units shall be fully mobile.
 - (b) Arrangement for connection to truck or jeep prime mover shall be made depending on plant weight i.e. towing facility shall be provided, which should be of approved design as per requirements of Transport Authority.

- (c) Automatic brakes shall be provided.
- (d) Trolley should be provided with screw jacks and parking breaks.
- (v) The units shall have adequate strength and rigidity to withstand normal conditions of transport and usage. Easy replacement or removal for defectives (in case such a need arises) should be possible. Proper guarding of components liable to cause accidents shall be done. Tubes and tyres shall be resiliently mounted. Tubes and tyres shall be sturdy and shall not twist or deform under normal usage.
- (vi) All electrical cables should run through a covered cable tray from centralized control panel to destination on the floor.
- (vii) Control panel should have anodized electrical control and power diagram drawn on a metal sheet permanently attached from inside of the door.

5.2 ASSEMBLY AND ENCLOSURE

- (i) Each plant shall be assembled entirely on one chassis frame. The entire assembly shall be neatly and fully enclosed in a nest weather proof cover made of sheet metal.
- (ii) **All electrical controllers, such as motor starters, pilot lamps, push buttons etc., shall be housed in a centralized control panel board and shall be of reputed make e.g. L&T, Andrew Yule, Siemens, C&H, etc. or equivalent.**
- (iii) Each unit shall be equipped with two numbers high temperature resistant synthetic rubber hoses with flanges at both ends. Minimum length of each hose pipe shall be 15 meters length.

5.3 AUXILIARY POWER SUPPLY

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

i	Power device (like drive motors)	415 Volt, 3 phase, 4 wire, 50Hz effectively earthed system.
ii	Lighting fixtures, space heaters and fractional horse power motors.	240 Volt, Single phase, 50Hz supply with one point grounded.

The above supply voltage may vary between +10% to -25%, frequency by $\pm 4\%$ and combined voltage and frequency by $\pm 10\%$. All devices must be suitable for continuous operation over the entire range of voltage and frequency.

5.4 FILTRATION REQUIREMENT

Oil filter plants shall be capable to produce following end results after filtration of transformer oil:

- (i) The plants should be able to remove 99.9% of particles of size 1 to 4 microns.
- (ii) Initial water content should be taken as 80ppm and initial gas content in the oil should be taken as 10%. With these initial values the plant should be capable of reducing the water content to 5 ppm or less and gas content should be reduced to 0.1%.
- (iii) While the bidders may offer their own design, it may be noted that the plant should be capable of producing vacuum of less than 10 (Ten) torr in the first pass and in the final pass the plant should produce a vacuum of less than 1 torr. This is

necessary so that filtration of oil could be possible without raising temperature of the oil to excessive limit.

- (iv) **The vacuum pump for the plants and for spares shall be of two stage rotary oil sealed type manufactured to European/ International standards. Best quality vacuum pumps of reliable design should be offered. Preferred makes of vacuum pumps are Shinko Japan, Woo Sung Korea, Tuthill USA, Balzers Germany, PFEIFFER Germany, OERLIKON Germany and Leybold Germany, however minimum capacity of vacuum pump shall be 500 Liters/minute.**

Complete technical details of vacuum pumping system with particular of mechanical booster pump, rotary vacuum pump, their pumping capacity, ultimate vacuum with gas blast closed and open, rating and make etc. shall be furnished in the bid.

- (v) The oil should not be heated beyond 70°C. Thus, keeping maximum temperature limit of 70°C, the plant should be capable of reducing water content to less than 5 ppm and gas content to 0.1% in maximum of 5 passes.
- (vi) Based on the temperature of 70°C, the bidders should offer heating arrangement. The heaters should be in 3 banks with selector switch. Capacity of heater should be 48KW in three banks, each of 16KW. Thermostats to control each group (bank) of heaters shall be provided and one safety thermostat should be provided to take care of any accidental rise of temperature of oil and shall put off the heaters in such eventuality.
- (vii) Ionic reaction column to be provided for acidity correction shall contain activated alumina filled in a basket of wire mesh. Ionic reaction column shall have by-pass arrangement so that it can be taken in to circuit whenever required. First filling of alumina shall be provided alongwith the column. Rating of Ionic reaction column shall be 20 Kgs.
- (viii) The resistivity of Oil after treatment by the filter plants should be above 1500×10^{12} ohm-cm at 27°C and 100×10^{12} ohm-cm at 90°C. Also the Oil should withstand at least 60KV for one minute with 13 mm spheres, 2.5 mm apart.
- (ix) The tangent delta of treated oil should be below 0.005 at 90°C and neutralization value (total acidity maximum) should be 0.08 mg KOH/gram.

As detailed above, required parameters of oil after filtration are tabulated here under ;

Parameters	Before Processing	After Processing
Break down Voltage (Across 2.5mm Gap)	30 KV	60 KV
Moisture Content	80 PPM	5 PPM
Suspended Particles	Many particles	Particles less than 1 Micron
Gas Content	10% by Volume	0.1% by Volume
Acidity	0.3 mg KOH/gms of Oil	0.08 mg KOH/gms of Oil
Resistivity	--	1500×10^{12} Ohm cm at 27°C(Max)
Ten Delta	--	0.005 at 90°C

On the basis of above final parameters of treated oil, the bidders may offer suitably designed plants. **The verification of Plants to achieve the required parameters shall be done during inspection as per clause 8.0.**

5.5 FILTRATION SYSTEM

The bidders shall provide filtering system of adequate capacity to ensure that the plants offered are capable of producing end results as described under clause '5.4' above. In this connection, the following shall be taken into account:

- (i) Filtering system may consist of edge type filter in the form of closely compressed discs of specially treated paper. The oil from filter discs shall enter degasification chamber. Edge type filters shall be easily removable for maintenance purpose.
- (ii) For the purpose of cleaning edge type filters, separate compressor with provision of air bottle of adequate capacity shall be provided. The complete scheme which will form a part of main equipment shall be explained in details.
- (iii) Arrangement to indicate the pressure of compressed air should be made. Complete scheme contemplated for cleaning of filter system along with associated accessories shall be explained.
- (iv) Alternative filtration system like single use throw away type filter or any other type of filter system shall not be acceptable.
- (v) Offered filter media should be capable of handling moderate amount of sludge which may be present in used oil.

5.6 INTERLOCKS/SAFETY CONTROLS

5.6.1 Oil filter plants shall ensure the following inter-locking/ safety controls for their safe and satisfactory operation:

- (i) Inter-locking shall be provided between the input pump and the heaters, so that unless input pump is 'ON', heaters can not be switched 'ON'. Suitable interlocking arrangement between input/output pump and low/high level float switches shall be provided.
- (ii) Heater switches shall be interlocked with outlet valve of heater chamber to ensure that unless outlet valve is 'open', heater is not switched 'ON'.
- (iii) Two thermostats shall be provided in the system, one in the line to control oil temperature in line and another on the heater chamber itself. Thus, in case inter-locking between input pump and heater chamber fails to operate back-up protection is provided by the thermostat provided with heater chamber to ensure that in case temperature goes beyond preset level, the heaters are switched 'OFF'.
- (iv) Interlocking shall be provided to ensure that heaters cannot be switched 'ON' unless heater chamber is filled with oil.
- (v) Suitable vapor condenser system shall be provided to ensure that after degasification of oil aromatics contained in the oil which are likely to vaporize during degasification are returned to the oil.

- (vi) An additional valve shall be provided between inlet and outlet pipe for circulation of oil during dry out.
- (vii) Excessive oil pressure shall not be generated in the plant. However, a valve shall be provided for release of excessive pressure, if any, developed in the system.
- (viii) Arrangement shall be provided for automatic control of oil level in filter plant. An oil flow control valve shall be provided across the gear pump to regulate control of flow of oil. A visual indicator alongwith necessary controlling devices shall be provided in the degassing chamber for regulating the level of oil.
- (ix) Solenoid valves, one each on the inlet and outlet pipe shall be provided to avoid mixing of treated and untreated oil in the filter plants in the event of failure of power supply. For this purpose interlocking between inlet and outlet valve shall also be provided.
- (x) Suitable by-pass arrangement shall be provided in the inlet pipe.

5.6.2 OTHER REQUIREMENTS

- (i) Intake system, for oil filter plant shall, have pumps of adequate capacity and design to ensure that the pumps are able to handle old/impure oil with solid impurities. It should be noted that the inlet oil being at low temperature will have low viscosity. In view of this, bidders should carefully consider these requirements and offer for a suitable intake system.
- (ii) Separate motors should be used for inlet pump, outlet pump, compressor and vacuum pumps.
- (iii) Two numbers dial type thermometer one at oil inlet to gear pump and another at outlet of heater / inlet of filter shall be provided.
- (iv) Flow rates/ ratings for input pumps, outlet pump and compressor horse power/ KW rating for motors for inlet pump, outlet pump and compressor have not been specified with the consideration that the bidders will select and provide these equipments with liberal ratings, based on their own design, with the assurance that the ratings considered are adequate for satisfactory operation of the plants. The bidders in their bid in this regard must furnish details.
- (v) Vacuum gauges shall be provided on the suction line of the degassing chamber connecting the degassing chamber to vacuum pump and also a vacuum gauge shall be provided for transformer evacuation system. Quantity of vacuum gauges shall be two numbers.
- (vi) For each plant two numbers pressure gauges, one before filter bank and one for compound gauge near degassing column shall be provided.
- (vii) For each plant additional one number vacuum pump as spare of same rating as indicated in Appendix-A alongwith its complete set i.e. vacuum gauge, motor, pipes etc. shall be supplied for utilizing the same for taking vacuum in transformer tank.

5.6.3 Necessary isolating arrangement, control valves, pressure gauges etc., shall be provided to enable putting the plant to any of the following duties:

- (i) Filling oil from drums to transformer tank.
- (ii) Heating the transformer.
- (iii) For subjecting the transformer simultaneously to vacuum and removal of moisture from insulation.

5.6.4 Required principal parameters and make of items/ equipments have been listed in Appendix-A. Bidders should specifically confirm that the offered Plants shall be designed for meeting all requirements as per Appendix-A or with higher values and better quality equipments.

5.7 ACCESSORIES

5.7.1 The following accessories shall be offered along with each filter plant:

- (i) Gear type input pump with pressure release valve and flow control valve, with adequate suction head.
- (ii) Centrifugal type outlet pump with adequate suction head.
- (iii) Vacuum pump of specified rating.
- (iv) Air compressor complete with storage tank, pressure gauge and safety valve.
- (v) Four number separate motors for input pump, output pump, vacuum pump and air compressor.
- (vi) Heater chamber with heating element.
- (vii) Two number thermostats, one on the heater chamber and another in the oil line.
- (viii) Degassing chamber.
- (ix) Magnetic strainer and preliminary filter on the input side.
- (x) Two number solenoid valves on the input and output side.
- (xi) Inlet and outlet oil line valves and one additional valve for re-circulation and by pass, connecting the inlet and outlet system.
- (xii) Oil flow indicator on the outlet side.
- (xiii) Pressure gauges on the inlet line and on the pressure tank of air compressor system.
- (xiv) Vacuum gauge of required quality.
- (xv) Vapor condenser system with condensate tank with required valves.
- (xvi) Two number flow switches one for the low level of oil and another for high level of oil.
- (xvii) Drain valves in the heater chamber and outlet line.
- (xviii) One number Thermometer having range 0^oc to 150^oC.

- (xix) Non-return valve for the vacuum pump.
- (xx) Two numbers hose pipes, each of minimum 15 meter length.
- (xxi) Suitable control panel with mimic diagram.
- (xxii) Contactors, accessories and arrangements necessary for proper functioning of electrical system.
- (xxiii) Ionic reaction column, with by pass arrangement.

5.7.2 The bidders may please note that only those offers will be considered for evaluation wherein the bidders submit a specific confirmation to the effect that the oil filter plants will be supplied complete with all fittings and accessories exactly in line with various requirements indicated in the technical specification. The details of accessories/ fittings included with oil filter plant shall be indicated in enclosed Schedule-III of "List of fittings and accessories to be provided with Oil filter plant". The basic offered cost should take into consideration the cost of all fittings and accessories and spare vacuum pump complete in all respect as mentioned above and indicated elsewhere in the specification.

5.7.3 Any other item or accessories which are not indicated above but are considered necessary/ essential for satisfactory operation of oil filter plants shall be deemed to have been included in the accepted price without any extra cost to the purchaser, irrespective of whether these are specifically indicated here or not.

5.8 TRAINING

The supplier shall arrange to give complete demonstration & training of test kit at site for 1 day period to a batch of our engineers on "free of cost" basis for each kit. The training shall cover familiarization with techniques & procedures of installation, testing, commissioning, operation of software, creation of database and trouble shooting of kits.

5.9 SCOPE OF SUPPLY

2250 LPH Transformer Oil Filter Plants alongwith one no. additional spare vacuum pump with its complete set alongwith oil filter plant.

6.0 The Plants shall be painted as per modern practice to ensure best finish. Successful bidder shall furnish the details of painting process and obtain purchaser's specific approval before commencing manufacture.

7.0 CALCULATION REQUIRED TO BE FURNISHED TO JUSTIFY DESIGN OF PLANTS;

The bidders may please note that they will have to furnish detailed calculations and illustrative graphs to justify design of their filter plants as described below;

- (i) Calculations to prove through out capacity of the vacuum pump. The calculation should be based on the reduction of water content and gas content as mentioned in the preceding paragraphs. Also the calculation should take into consideration the number of passes in which end results will be obtained.
- (ii) Detailed calculation to justify heating capacity provided in the plant.

9.0 INSPECTION:

- (i) The Purchaser shall have access at all times to the works and all other places of manufacture, where the equipments are being manufactured and the Bidder shall provide all facilities for unrestricted inspection of the Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.
- (ii) The successful Bidder 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 arrangements could be made for inspection.
- (iii) No material shall be dispatched from the works of manufacturer unless the material has been satisfactorily inspected and tested.
- (iv) The acceptance of any quantity of the equipment shall in no way relieve the successful bidder 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.
- (v) It may be noted by the Bidders that before accepting supplies of Filter plants, inspection of plants shall be carried out by the purchaser's engineer. During inspection, required parameters of oil after filtration, as stipulated in clause 5.4, by the ordered plants shall be achieved and supplies of Filter plants shall be accepted only after required parameters, as stipulated in clause 5.4, are achieved through the Filter plants after successful inspection.

10.0 QUALITY ASSURANCE PLAN:

10.1 The Bidder must establish that they are following a proper quality assurance program for manufacture of equipments. The Bidder shall invariably furnish following information along with his offer. Information shall be separately given for individual type of equipment offered.

- i) Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of Bidder's representative and copies of test certificates.
- ii) Information and copies of test certificates as mentioned in (i) above in respect of bought out items.
- iii) List of manufacturing facilities available.
- iv) Levels 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 equipment available with the Bidder for final testing of equipment specified and test plant limitations, if any, vis-à-vis type tests, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

10.2 The successful Bidder shall within 30 days of placement of order, submit following information to the Purchaser.

- i) List of raw materials as well as bought out accessories and the names of sub supplier selected from the lists furnished along with offer.
- ii) Type test certificate of the raw material and bought out accessories.
- iii) Quality Assurance Plan (QAP) with hold points by Purchaser's inspection. The quality assurance plans and hold points shall be discussed between the Purchaser and Bidder before the QAP is finalised.

10.3 The successful Bidder shall submit the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

11.0 DATA AND DRAWINGS:

11.1 The bidder shall furnish two sets of under mentioned drawing and descriptive information along with the bid. All drawings shall conform to latest version of International Standards Organization (ISO) 'A' series of drawing sheet/Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for micro testing. All dimensions and data shall be in S.I.Units.

- (i) Complete assembly drawing of the oil filtration plant.
- (ii) Drawing showing arrangement of vacuum drying of transformer in association with the filtration plant.
- (iii) Schematic diagram showing the control panel which shall house various controls.
- (iv) Operation and maintenance manual for individual components and the complete plant.

11.2 The successful bidder shall furnish one set of approved drawings and manuals along with each Filter plant and 10 sets to the order placing authority.

12.0 MANUALS:

12.1 The successful Bidder shall send 4 sets nicely printed and bound manuals, with each ordered equipment for distribution. Each such manual shall contain inspection & calibration report; Test Reports; Complete details & description of parts; Schematic & approved drawings; Operation, maintenance and erection instructions in English Language. One Manual shall be kept inside the crate with the equipment. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. Approval of drawings & manual by Purchaser shall not relieve the Bidder of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material, which in his judgment is not in full accordance therewith.

13.0 ENGRAVING, PACKING AND FORWARDING :

13.1 The details such as order no. and date, year of manufacture and "MPPTCL" should be engraved on each and every equipment. The equipment shall be packed suitable for vertical/horizontal transport, as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The Bidder shall be responsible for any damage during transit, due to improper and inadequate packing and

handling. 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. Bidder shall supply, any material, found short inside the packing cases without any extra cost.

13.2 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.

13.3 The Bidder shall ensure that the packing list and bill of material is approved by the Purchaser before despatch.

APPENDIX - A

S. No.	Particulars	2250 LPH (500 GPH) Plants
1	Vacuum Pump Make	
	(i) Flow rate capacity	600 LPM
	(ii) Rated vacuum at the time of first pass	<10 torr
	(iii) Rated vacuum at the fifth/ final pass	<1 torr
2	(iv) Motor power (At least)	1 HP
	Heaters	
	(i) Rating (At least)	48kW
	(ii) Number of Banks (At least)	3
3	(iii) Make	Reputed make
	Oil intake system	
	(i) Type	Gear
4	(ii) Rating	2250 LPH
	(iii) Make	Tushanco/ Rotodel
	Discharge pump	
5	(i) Type	Centrifugal
	(ii) Rating	2250 LPH
	(iii) Make	Jyoti or better reputed make
6	Solanoid valve	
	(i) Rating	Inlet : 25 NB Outlet : 25 NB
	(ii) Make	Reputed make
7	Hose pipe	
	(i) Inlet Length	15 Mtrs
	(ii) Outlet Length	15 Mtrs
8	(iii) Make	Hypress
	Vacuum gauge; Make	Fiebig, Alot, Hitek
	Pressure gauge; Make	Alot, Hitek
9	Compound gauge Make	Fiebig, Alot, Hitek
10	Flow Indicator Make	Reputed make
11	Float Switch Make	Reputed make
12	Non return valve Make	Reputed make
13	Drain valve Make	Reputed make
14	Oil line valve Make	Reputed make
15	Flow control valve Make	Reputed make
16	Arcing valve Make	Reputed make
17	Vacuum valve Make	Reputed make
18	Thermometer	
	(i) Range	0 to 150° C
	(ii) Make	Thermax
19	Thermostat	

S. No.	Particulars	2250 LPH (500 GPH) Plants
	(i) Range	30 to 110° C
	(ii) Make	Jumbo
20	Magnetic separator	
	(i) Type	Mesh
	(ii) Make	Reputed make
21	Preliminary Filter	
	(i) Type	Mesh/ Magnet
	(ii) Make	Reputed make
22	(a) Assembly Tyre	Pneumatic
	(i) Size	7.50 - 16
	(ii) Make	CEAT/ BKT
	(b) Wheel	
	(i) Size	7.50 - 16
	(ii) Make	Reputed make
23	Air Compressor system	
	(a) Air Compressor/Pressure tank	
	(i) Rating	7 Kg/cm ²
	(ii) Make	Automatic
	(b) Motor	
	(i) Rating	0.5 HP
	(ii) Make	KEC/ CGL/ BBL/ AREVA
	(c) Pressure guage	
	(i) Rating	1 to 7 Kg/cm ²
	(ii) Make	Fiebig
	(d) Valve	
	(i) Rating	15 NB to 50 NB
	(ii) Make	Reputed
24	Motor ratings for	
	(i) Gear pump	1 HP
	(ii) Centrifugal pump	5 HP
25	Quantity of oil in filter system	50 Ltrs
26	Electrical Controllers; make	L&T, Andrew Yule, Siemens, C&H, etc. or equivalent.

SCHEDULE – I (A)

**DESCRIPTION OF MATERIAL FOR SCHEDULE OF RATES AND
PRICES TO BE FURNISHED IN
VOLUME -VI**

S.No.	Particulars	Qty
1.	2250 LPH (500 GPH) Oil filter plant complete set including spare vacuum pump with all arrangement for evacuation of transformer.	As per Price Schedule

Note :

1. The above description of material is given for the purpose of offering the prices and to mention description of material in Invoice for claiming payment.
2. The quantity of above material has been mentioned in Volume VI

SECTION – II

2.6 TECHNICAL SPECIFICATION FOR TRANSFORMER OIL FILTER PLANTS (6000 LPH Plants)

1.0 SCOPE -

This scope of this specification covers design, manufacturing supply of Oil Filter Plant as per Section-I, Volume-II. The bidder mentioned in the Section of Technical specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment / material of manufacturer as per this specification requirement shall rest on the bidder.

2.0 STANDARDS -

Applicable standards for offered equipment / material shall be as per Section-I, Volume – II.

5.0 CLIMATIC CONDITIONS –

Applicable climatic conditions shall be as per Section-I, Volume – II.

6.0 SYSTEM PARTICULARS -

Applicable system particulars shall be as per Section-I, Volume – II.

5.0 GENERAL TECHNICAL REQUIREMENTS

5.1 The Oil Filter plants shall conform to latest version of IS:6034 and shall fulfill testing procedures as laid down under latest version of IS:1866.

- (i) The Filter Plants shall be designed such that the Oil is first passed through the magnetic separator/coarse filter and strainer, followed by heating chamber, where it is subjected to vacuum treatment which dehydrates and degasifies the oil completely. The treated oil thus obtained shall be free from all solid impurities, colloidal matter, dissolved gases, water and volatile acids.
- (ii) The plants shall be operable on 415V, 3 phase, 4 wire 50HZ supply and shall have the flow rate of 6000 LPH The plants shall process oil which will be transformer mineral oil and will be as per latest version of IS:335 with regard to break down voltage, total acidity, neutralization value, gas content, dissipation factor and moisture content. Ionic reaction column with by-pass arrangement shall also be provided for acidity correction, wherever required.
- (iii) The plants shall be so designed that oil is first passed through the coarse filter (with magnet), followed by Ionic reaction column, followed by heating chamber, followed by filter system and finally to the degassing chamber where it will be subjected to vacuum to dehydrate and dehumidify the oil. For 6000 LPH Plants, two stage degassing chamber shall be provided.
- (iv) The constructional features of the plants shall be as under:
 - (a) The units shall be fully mobile.
 - (b) The unit shall be mounted on a undercarriage with four pneumatic tyres.

- (b) Arrangement for connection to truck or jeep prime mover shall be made depending on plant weight i.e. towing facility shall be provided, which should be of approved design as per requirements of Transport Authority.
- (c) Automatic brakes shall be provided.
- (d) Trolley should be provided with screw jacks and parking breaks.
- (v) The units shall have adequate strength and rigidity to withstand normal conditions of transport and usage. Easy replacement or removal for defectives (in case such a need arises) should be possible. Proper guarding of components liable to cause accidents shall be done. Tubes and tyres shall be resiliently mounted. Tubes and tyres shall be sturdy and shall not twist or deform under normal usage.
- (vi) All electrical cables should run through a covered cable tray from centralized control panel to destination on the floor.
- (vii) Control panel should have anodized electrical control and power diagram drawn on a metal sheet permanently attached from inside of the door.

5.2 ASSEMBLY AND ENCLOSURE

- (i) Each plant shall be assembled entirely on one chassis frame. The entire assembly shall be neatly and fully enclosed in a nest weather proof cover made of sheet metal.
- (ii) **All electrical controllers, such as motor starters, pilot lamps, push buttons etc., shall be housed in a centralized control panel board and shall be of reputed make e.g. L&T, Andrew Yule, Siemens, C&H, etc. or equivalent.**
- (iii) Each unit shall be equipped with two numbers high temperature resistant synthetic rubber hoses with flanges at both ends. Minimum length of each hose pipe shall be 20 meters length.

5.3 AUXILIARY POWER SUPPLY

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

i	Power device (like drive motors)	415 Volt, 3 phase, 4 wire, 50Hz effectively earthed system.
ii	Lighting fixtures, space heaters and fractional horse power motors.	240 Volt, Single phase, 50Hz supply with one point grounded.

The above supply voltage may vary between +10% to -25%, frequency by $\pm 4\%$ and combined voltage and frequency by $\pm 10\%$. All devices must be suitable for continuous operation over the entire range of voltage and frequency.

5.4 FILTRATION REQUIREMENT

Oil filter plants shall be capable to produce following end results after filtration of transformer oil:

- (i) The plants should be able to remove 99.9% of particles of size 1 to 4 microns.
- (ii) Initial water content should be taken as 80ppm and initial gas content in the oil should be taken as 10%. With these initial values the plant should be capable of reducing the water content to 5 ppm or less and gas content should be reduced to 0.1%.

- (iii) It should be noted that the above reduction in water content and gas content as per (ii) above should be achieved in 3 passes.
- (iv) While the bidders may offer their own design, it may be noted that the plant should be capable of producing vacuum of less than 10 (Ten) torr in the first pass and in the final pass the plant should produce a vacuum of less than 1 torr. This is necessary so that filtration of oil could be possible without raising temperature of the oil to excessive limit.
- (v) **The vacuum pump for the plants shall be of two stage rotary oil sealed type manufactured to European/ International standards. Best quality vacuum pumps of reliable design should be offered. Preferred makes of vacuum pumps are Shinko Japan, Woo Sung Korea, Tuthill USA, Balzers Germany, PFEIFFER Germany, OERLIKON Germany and Leybold Germany, however minimum capacity of vacuum pump shall be 2500 Liters/minute.**

The Vacuum pump shall be of combination of mechanical booster and rotary oil sealed pump. For smooth functioning of oil filter plant, it is essential that above pump should be compatible. Complete technical details of vacuum pumping system with particular of mechanical booster pump, rotary vacuum pump, their pumping capacity, ultimate vacuum with gas blast closed and open, rating and make etc. shall be furnished in the bid.

- (v) The oil should not be heated beyond 70⁰C. Thus, keeping maximum temperature limit of 70⁰C, the plant should be capable of reducing water content to less than 5 ppm and gas content to 0.1% in maximum of 5 passes.
- (vi) Based on the temperature of 70⁰C, the bidders should offer heating arrangement. The heaters should be in 3 banks with selector switch. Capacity of heater should be 132KW in three banks, each of 44KW. Thermostats to control each group (bank) of heaters shall be provided and one safety thermostat should be provided to take care of any accidental rise of temperature of oil and shall put off the heaters in such eventuality.
- (vii) Ionic reaction column to be provided for acidity correction shall contain activated alumina filled in a basket of wire mesh. Ionic reaction column shall have by-pass arrangement so that it can be taken in to circuit whenever required. First filling of alumina shall be provided alongwith the column. Rating of Ionic reaction column shall be 60 Kgs.
- (viii) The resistivity of Oil after treatment by the filter plants should be above 1500×10^{12} ohm-cm at 27⁰C and 100×10^{12} ohm-cm at 90⁰C. Also the Oil should withstand at least 60KV for one minute with 13 mm spheres, 2.5 mm apart.
- (ix) The tangent delta of treated oil should be below 0.005 at 90⁰C and neutralization value (total acidity maximum) should be 0.08 mg KOH/gram.

As detailed above, required parameters of oil after filtration are tabulated here under ;

Parameters	Before Processing	After Processing	Within three pass
Break down Voltage (Across 2.5mm Gap)	30 KV	60 KV	70 KV
Moisture Content	80 PPM	5 PPM	2 PPM
Suspended Particles	Many particles	Particles less than 1 Micron	Particles less than 1 Micron
Gas Content	10% by Volume	0.1% by Volume	0.05% by Volume
Acidity	0.3 mg KOH/gms of Oil	0.08 mg KOH/gms of Oil	0.08 mg KOH/gms of Oil
Resistivity	--	--	1500 x 10 ¹² Ohm cm at 27°C(Max)
		--	100 x 10 ¹² Ohm cm at 90°C(Max)
Ten Delta	--	--	0.005 at 90°C

On the basis of above final parameters of treated oil, the bidders may offer suitably designed plants. **The verification of Plants to achieve the required parameters shall be done during inspection as per clause 8.0.**

5.5 FILTRATION SYSTEM

The bidders shall provide filtering system of adequate capacity to ensure that the plants offered are capable of producing end results as described under clause '5.4' above. In this connection, the following shall be taken into account:

- (i) Filtering system may consist of edge type filter in the form of closely compressed discs of specially treated paper. The oil from filter discs shall enter degasification chamber. Edge type filters shall be easily removable for maintenance purpose.
- (ii) For the purpose of cleaning edge type filters, separate compressor with provision of air bottle of adequate capacity shall be provided. The complete scheme which will form a part of main equipment shall be explained in details.
- (iii) Arrangement to indicate the pressure of compressed air should be made. Complete scheme contemplated for cleaning of filter system along with associated accessories shall be explained.
- (iv) Alternative filtration system like single use throw away type filter or any other type of filter system shall not be acceptable.
- (v) Offered filter media should be capable of handling moderate amount of sludge which may be present in used oil.

5.6 INTERLOCKS/SAFETY CONTROLS

5.6.1 Oil filter plants shall ensure the following inter-locking/ safety controls for their safe and satisfactory operation:

- (i) Inter-locking shall be provided between the input pump and the heaters, so that unless input pump is 'ON', heaters can not be switched 'ON'. Suitable interlocking arrangement between input/output pump and low/high level float switches shall be provided.

- (ii) Heater switches shall be interlocked with outlet valve of heater chamber to ensure that unless outlet valve is 'open', heater is not switched 'ON'.
- (iii) Two thermostats shall be provided in the system, one in the line to control oil temperature in line and another on the heater chamber itself. Thus, in case inter-locking between input pump and heater chamber fails to operate back-up protection is provided by the thermostat provided with heater chamber to ensure that in case temperature goes beyond preset level, the heaters are switched 'OFF'.
- (iv) Interlocking shall be provided to ensure that heaters cannot be switched 'ON' unless heater chamber is filled with oil.
- (v) Suitable vapor condenser system shall be provided to ensure that after degasification of oil aromatics contained in the oil which are likely to vaporize during degasification are returned to the oil.
- (vi) An additional valve shall be provided between inlet and outlet pipe for circulation of oil during dry out.
- (vii) Excessive oil pressure shall not be generated in the plant. However, a valve shall be provided for release of excessive pressure, if any, developed in the system.
- (viii) Arrangement shall be provided for automatic control of oil level in filter plant. An oil flow control valve shall be provided across the gear pump to regulate control of flow of oil. A visual indicator alongwith necessary controlling devices shall be provided in the degassing chamber for regulating the level of oil.
- (ix) Solenoid valves, one each on the inlet and outlet pipe shall be provided to avoid mixing of treated and untreated oil in the filter plants in the event of failure of power supply. For this purpose interlocking between inlet and outlet valve shall also be provided.
- (x) Suitable by-pass arrangement shall be provided in the inlet pipe.

5.6.2 OTHER REQUIREMENTS

- (i) Intake system, for oil filter plant shall, have pumps of adequate capacity and design to ensure that the pumps are able to handle old/impure oil with solid impurities. It should be noted that the inlet oil being at low temperature will have low viscosity. In view of this, bidders should carefully consider these requirements and offer for a suitable intake system.
- (ii) Separate motors should be used for inlet pump, outlet pump, compressor and vacuum pumps.
- (iii) Two numbers dial type thermometer one at oil inlet to gear pump and another at outlet of heater / inlet of filter shall be provided.
- (iv) Flow rates/ ratings for input pumps, outlet pump and compressor horse power/ KW rating for motors for inlet pump, outlet pump and compressor have not been specified with the consideration that the bidders will select and provide these equipments with liberal ratings, based on their own design, with the assurance that the ratings considered are adequate for satisfactory operation of the plants. The bidders in their bid in this regard must furnish details.

- (viii) Vacuum gauges shall be provided on the suction line of the degassing chamber connecting the degassing chamber to vacuum pump and also a vacuum gauge shall be provided for transformer evacuation system. Quantity of vacuum gauges shall be three numbers.
- (ix) For each plant two numbers pressure gauges, one before filter bank and one for compound guage near degassing column shall be provided.
- (x) For each plant additional one number vaccum pump as spare of same rating as indicated in Appendix-A alongwith its complete set i.e. vaccum guage, motor, pipes etc. shall be supplied for utilizing the same for taking vaccum in transformer tank.

5.6.3 Necessary isolating arrangement, control valves, pressure gauges etc., shall be provided to enable putting the plant to any of the following duties:

- (i) Filling oil from drums to transformer tank.
- (ii) Heating the transformer.
- (iii) For subjecting the transformer simultaneously to vacuum and removal of moisture from insulation.

5.6.4 Required principal parameters and make of items/ equipments have been listed in Appendix-A. Bidders should specifically confirm that the offered Plants shall be designed for meeting all requirements as per Appendix-A or with higher values and better quality equipments.

5.7 ACCESSORIES

5.7.1 The following accessories shall be offered along with each filter plant:

- (i) Gear type input pump with pressure release valve and flow control valve, with adequate suction head.
- (ii) Centrifugal type outlet pump with adequate suction head.
- (iii) Vacuum pump of specified rating.
- (iv) Air compressor complete with storage tank, pressure gauge and safety valve.
- (v) Four number separate motors for input pump, output pump, vacuum pump and air compressor.
- (vi) Heater chamber with heating element.
- (vii) Two number thermostats, one on the heater chamber and another in the oil line.
- (viii) Degassing chamber.
- (ix) Magnetic strainer and preliminary filter on the input side.
- (x) Two number solenoid valves on the input and output side.
- (xi) Inlet and outlet oil line valves and one additional valve for re-circulation and by pass, connecting the inlet and outlet system.
- (xii) Oil flow indicator on the outlet side.

- (xiii) Pressure gauges on the inlet line and on the pressure tank of air compressor system.
- (xiv) Vacuum gauge of required quality.
- (xv) Vapor condenser system with condensate tank with required valves.
- (xvi) Two number flow switches one for the low level of oil and another for high level of oil.
- (xvii) Drain valves in the heater chamber and outlet line.
- (xviii) One number Thermometer having range 0°C to 150°C .
- (xix) Non-return valve for the vacuum pump.
- (xx) Two numbers hose pipes, each of minimum 20 meter length.
- (xxi) Suitable control panel with mimic diagram.
- (xxii) Contactors, accessories and arrangements necessary for proper functioning of electrical system.
- (xxiii) Ionic reaction column, with by pass arrangement.

5.7.2 The bidders may please note that only those offers will be considered for evaluation wherein the bidders submit a specific confirmation to the effect that the oil filter plants will be supplied complete with all fittings and accessories exactly in line with various requirements indicated in the technical specification. The details of accessories/ fittings included with oil filter plant shall be indicated in enclosed Schedule-III of "List of fittings and accessories to be provided with each Oil filter plant". The basic offered cost should take into consideration the cost of all fittings and accessories and spare vacuum pump complete in all respect as mentioned above and indicated elsewhere in the specification.

5.7.3 Any other item or accessories which are not indicated above but are considered necessary/ essential for satisfactory operation of oil filter plants shall be deemed to have been included in the accepted price without any extra cost to the purchaser, irrespective of whether these are specifically indicated here or not.

5.8 TRAINING

The supplier shall arrange to give complete demonstration & training of test kit at site for 1 day period to a batch of our engineers on "free of cost" basis for each kit. The training shall cover familiarization with techniques & procedures of installation, testing, commissioning, operation of software, creation of database and trouble shooting of kits.

5.9 SCOPE OF SUPPLY

6000 LPH Transformer Oil Filter Plants alongwith one no. additional spare vacuum pump with its complete set alongwith each oil filter plant.

6.0 The Plants shall be painted as per modern practice to ensure best finish. Successful bidder shall furnish the details of painting process and obtain purchaser's specific approval before commencing manufacture.

7.0 CALCULATION REQUIRED TO BE FURNISHED TO JUSTIFY DESIGN OF PLANTS;

The bidders may please note that they will have to furnish detailed calculations and illustrative graphs to justify design of their filter plants as described below;

- (i) Calculations to prove through out capacity of the vacuum pump. The calculation should be based on the reduction of water content and gas content as mentioned in the preceding paragraphs. Also the calculation should take into consideration the number of passes in which end results will be obtained.
- (ii) Detailed calculation to justify heating capacity provided in the plant.

8.0 INSPECTION:

- (i) The Purchaser shall have access at all times to the works and all other places of manufacture, where the equipments are being manufactured and the Bidder shall provide all facilities for unrestricted inspection of the Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.
- (ii) The successful Bidder 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 arrangements could be made for inspection.
- (iii) No material shall be dispatched from the works of manufacturer unless the material has been satisfactorily inspected and tested.
- (iv) The acceptance of any quantity of the equipment shall in no way relieve the successful bidder 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.
- (v) It may be noted by the Bidders that before accepting supplies of Filter plants, inspection of plants shall be carried out by the purchaser's engineer. During inspection, required parameters of oil after filtration, as stipulated in clause 5.4, by the ordered plants shall be achieved and supplies of Filter plants shall be accepted only after required parameters, as stipulated in clause 5.4, are achieved through the Filter plants after successful inspection.

9.0 QUALITY ASSURANCE PLAN:

9.1 The Bidder must establish that they are following a proper quality assurance program for manufacture of equipments. The Bidder shall invariably furnish following information along with his offer. Information shall be separately given for individual type of equipment offered.

- viii) Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of Bidder's representative and copies of test certificates.
- ix) Information and copies of test certificates as mentioned in (i) above in respect of bought out items.
- x) List of manufacturing facilities available.
- xi) Levels of automation achieved and list of areas where manual processing exists.

- xii) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.
- xiii) Special features provided in the equipment to make it maintenance free.
- xiv) List of testing equipment available with the Bidder for final testing of equipment specified and test plant limitations, if any, vis-à-vis type tests, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

9.2 The successful Bidder shall within 30 days of placement of order, submit following information to the Purchaser.

- iv) List of raw materials as well as bought out accessories and the names of sub supplier selected from the lists furnished along with offer.
- v) Type test certificate of the raw material and bought out accessories.
- vi) Quality Assurance Plan (QAP) with hold points by Purchaser's inspection. The quality assurance plans and hold points shall be discussed between the Purchaser and Bidder before the QAP is finalised.

9.3 The successful Bidder shall submit the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

10.0 DATA AND DRAWINGS:

10.1 The bidder shall furnish two sets of under mentioned drawing and descriptive information along with the bid. All drawings shall conform to latest version of International Standards Organization (ISO) 'A' series of drawing sheet/Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for micro testing. All dimensions and data shall be in S.I.Units.

- (i) Complete assembly drawing of the oil filtration plant.
- (ii) Drawing showing arrangement of vacuum drying of transformer in association with the filtration plant.
- (iii) Schematic diagram showing the control panel which shall house various controls.
- (iv) Operation and maintenance manual for individual components and the complete plant.

10.2 The successful bidder shall furnish one set of approved drawings and manuals along with each Filter plant and 10 sets to the order placing authority.

11.0 MANUALS:

11.1 The successful Bidder shall send 4 sets nicely printed and bound manuals, with each ordered equipment for distribution. Each such manual shall contain inspection & calibration report; Test Reports; Complete details & description of parts; Schematic & approved drawings; Operation, maintenance and erection instructions in English Language. One Manual shall be kept inside the crate with the equipment. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. Approval of drawings & manual by Purchaser shall not relieve the Bidder of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and

Purchaser shall have the power to reject any work or material, which in his judgment is not in full accordance therewith.

12.0 ENGRAVING, PACKING AND FORWARDING :

12.1 The details such as order no. and date, year of manufacture and “MPPTCL” should be engraved on each and every equipment. The equipment shall be packed suitable for vertical/horizontal transport, as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The Bidder shall be responsible for any damage during transit, due to improper and inadequate packing and handling. 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. Bidder shall supply, any material, found short inside the packing cases without any extra cost.

12.2 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.

12.3 The Bidder shall ensure that the packing list and bill of material is approved by the Purchaser before despatch.

APPENDIX - A

S. No.	Particulars	6000 LPH Plants
1	Vacuum Pump Make	
	(i) Flow rate capacity	Rotary : 2250 LPM Booster : 10000 LPM
	(ii) Rated vacuum at the time of first pass	<10 torr
	(iii) Rated vacuum at the fifth/ final pass	<1 torr
	(iv) Motor power (At least)	Rotary : 1 HP Booster: 3/5 HP
2	Heaters	
	(i) Rating (At least)	132kW
	(ii) Number of Banks (At least)	3
	(iii) Make	Reputed make
3	Oil intake system	
	(i) Type	Gear
	(ii) Rating	6000 LPH
	(iii) Make	Tushanco/ Rotodel
4	Discharge pump	
	(i) Type	Centrifugal
	(ii) Rating	6000 LPH
	(iii) Make	Jyoti or better reputed make
5	Solanoid valve	
	(i) Rating	Inlet : 40 NB Outlet : 40 NB
	(ii) Make	Reputed make
6	Hose pipe	
	(i) Inlet Length	20 Mtrs
	(ii) Outlet Length	20 Mtrs
	(iii) Make	Hypress
7	Vacuum gauge; Make	Fiebig, Alot, Hitek
8	Pressure gauge; Make	Alot, Hitek
9	Compound gauge Make	Fiebig, Alot, Hitek
10	Flow Indicator Make	Reputed make
11	Float Switch Make	Reputed make
12	Non return valve Make	Reputed make
13	Drain valve Make	Reputed make
14	Oil line valve Make	Reputed make
15	Flow control valve Make	Reputed make
16	Arcing valve Make	Reputed make
17	Vacuum valve Make	Reputed make
18	Thermometer	
	(i) Range	0 to 150° C
	(ii) Make	Thermax
19	Thermostat	

S. No.	Particulars	6000 LPH Plants
	(i) Range	30 to 110° C
	(ii) Make	Jumbo
20	Magnetic separator	
	(i) Type	Mesh
	(ii) Make	Reputed make
21	Preliminary Filter	
	(i) Type	Mesh/ Magnet
	(ii) Make	Reputed make
22	(a) Assembly Tyre	Pneumatic
	(i) Size	7.50 - 16
	(ii) Make	CEAT/ BKT
	(b) Wheel	
	(i) Size	7.50 - 16
	(ii) Make	Reputed make
23	Air Compressor system	
	(a) Air Compressor/Pressure tank	
	(i) Rating	7 Kg/cm ²
	(ii) Make	Automatic
	(b) Motor	
	(i) Rating	0.5 HP
	(ii) Make	KEC/ CGL/ BBL/ AREVA
	(c) Pressure guage	
	(i) Rating	0 to 7 Kg/cm ²
	(ii) Make	Fiebig
	(d) Valve	
	(i) Rating	15 NB to 50 NB
	(ii) Make	Reputed
24	Motor ratings for	
	(i) Gear pump	5 HP
	(ii) Centrifugal pump	5 HP
25	Quantity of oil in filter system	150 Ltrs
26	Electrical Controllers; make	L&T, Andrew Yule, Siemens, C&H, etc. or equivalent.

SCHEDULE – I (A)

**DESCRIPTION OF MATERIAL FOR SCHEDULE OF RATES AND
PRICES TO BE FURNISHED IN
VOLUME -VI**

S.No.	Particulars	Qty
1.	6000 LPH Oil filter plant complete set including spare vacuum pump with all arrangement for evacuation of transformer	As per Price Schedule

Note :

1. The above description of material is given for the purpose of offering the prices and to mention description of material in Invoice for claiming payment.
2. The quantity of above material has been mentioned in Volume VI

SECTION – II

2.7 TECHNICAL SPECIFICATION OF 10 KL OIL STORAGE TANKS

1.0 SCOPE -

This scope of this specification covers design, manufacturing supply of Fiber Glass Oil Storage Tank as per Section-I, Volume-II. The bidder mentioned in the Section of Technical specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the “MPPTCL”.

In case bidder is not OEM, sole responsibility of offering equipment / material of manufacturer as per this specification requirement shall rest on the bidder.

1.2 STANDARDS -

Applicable standards for offered equipment / material shall be as per Section-I.

1.3 CLIMATIC CONDITIONS –

Applicable climatic conditions shall be as per Section-I.

1.4 SYSTEM PARTICULARS -

Applicable system particulars shall be as per Section-I.

2.0 DESIGN & CONSTRUCTION OF FRP TANKS HAVING CAPACITY 10KL

- 2.1 FRP tanks shall be corrosion-resistant to the specified tank contents and shall be suitable for the intended service life. FRP tanks shall have roofs capable of withstanding an external uniformly distributed loading of 50 pounds per square foot. Flat-top tanks to have a maximum 25 pounds per square foot. Additional loads from mixers, pumps, or catwalks shall be supported externally from the tank.
- 2.2 Dimensional Requirements-Cylindrical Vessels and Tanks: Diameters shall be measured internally. Tolerance on nominal diameter including out-of-roundness shall be plus or minus 1 percent. Measurements shall be taken with the tank in the vertical position. Taper shall not exceed 0.25 percent per side. The minimum knuckle radius on formed heads shall be 1-1/2 inches unless noted otherwise on the attached data sheets.
- 2.3 All FRP tanks shall be designed for outdoor service with direct sunlight exposure. Tanks shall be designed to meet pressure, loading or seismic criteria using strengthening ribs, unless otherwise indicated on the data sheets. Where no strengthening ribs are specified, loads shall be distributed over a uniform side shell thickness.

3.0 MATERIALS

Material of Construction :

Shell, Top, Bottom	FRP	Lifting Lug	Ms Painted
Nozzle Neck	FRP	Stiffening Ring	Is Flate 100 X 6
Nozzle Flange	FRP	Saddles	
Manhole Neck	FRP	Barrier Plate	
Manhole Flange/Cover	FRP		
Gasket	FRP		
	NEOPRENE RUBBER		

A. Resin:

1. The equipment shall be fabricated using the corrosion-resistant resin specified below. Unless otherwise specified, the resin shall be used throughout all laminates
2. Catalyst/promoter/accelerators shall be commercial grade cobalt naphthenate with dimethyl aniline, benzoyl peroxide, and methyl ethyl ketone peroxide appropriate to the resin blend, enforcement and manufacturer's equipment. Positive measurement control of catalysts, promoters, and resins shall be maintained at all times.
3. No fillers, additives, or pigments shall be employed in the resin, except as specified below. A thixotropic agent for viscosity control may be used as recommended by the resin manufacturer. No thixotropic agent is to be used in the corrosion liner or on surfaces to be in contact with the corrosive environment. Use of this additive is subject to the approval of the Contractor.
4. Resin putty shall be made using the same resin as was used in the component laminates. Resin putty shall contain a minimum 15 percent by weight of milled glass fibers. The use of silica flour, grinding dust or other fillers is not allowed.
5. Resin: acceptable commercial-grade vinyl-ester resins, including Co-Rezyn 8300, Derakane 411, and Hetron 922. The manufacturer shall confirm the recommended resin and corrosion barrier is appropriate for the specified contents. All corrosion barrier surfaces must be fabricated from the same resin blend.

B. Reinforcement:

1. All glass fiber reinforcing shall have epoxy compatible with silane-type surface finish and binder that is recommended by the glass manufacturer for the particular resin system to be used.
2. Surfacing veils on interior surfaces shall be 10-mil Nexus® veil or Type C-glass veil as specified on the tank data sheets.
3. Surfacing veil used on the tank exterior (if requested) surfaces shall be 10-mil Type C-glass veil.
4. Mat shall be type E glass, 1 ½ ounces or ¾ ounce per square foot as specified in the laminate sequence charts with nominal fiber length of 1.25 plus or minus 0.75 inch.
5. Continuous roving used in chopper gun for spray up shall be Type E glass.
6. Woven roving shall be Type E glass, nominal 24 ounces per square yard, 4 by 5 weave with silane-type finish.
7. Continuous roving used for filament winding shall be Type E glass with a silane-type finish with a nominal yield of 110 yards or more per pound.

- C. The final exterior coat shall be pigmented to form a uniform color coat. The pigment shall be dispersed in the resin used for the final coat. Tanks shall have a UV inhibitor added to the final exterior resin coat. Tank colors will be submitted with bid request.

- 3.1 10 KL tanks should have following dimensions.

Sr.No.	Capacity	Length	Dia
1	10 KL	4200 mm	1650 mm

- 3.1.1 Dimensions and other arrangements for 10 KL capacity storage tank are indicated in drawing. The length and dia of the tank as indicated above are not to be modified since any increase in the dimensions may create transportation problems.
- 3.2 All nuts and bolts shall be of hexagonal head and hot dip galvanized chromium plated conforming to IS : 1367 latest revision.
- 3.3 Oil storage tanks shall be in accordance with the requirements specified in the existing rules of Inspector of Explosives, Govt. of India.
- 3.4 Tenderers shall supply the tanks complete with all pipings, bolts, gaskets and other accessories as indicated in enclosed drawing.

4.0 **ACCESSORIES :**

The following accessories are required to be provided on the oil storage tanks as indicated in the enclosed drawing. The basic offered cost must take into consideration cost of all the accessories, otherwise the offer will be rejected. It may please be ensured that all the fittings and accessories offered shall be of reputed make, which shall be to our approval.

4.1 **Manhole :**

Each storage tank shall be provided with a man hole of size 750mm x 750mm on top of the tank as indicated in drawing. Suitable air tight cover with proper sealing arrangement shall be provided ensuring that oil has no accessibility to atmospheric air. Suitable handles for lifting the cover shall be provided. The gasket for man hole should be of best quality neoprene material. Two spare gaskets with each tank will have to be supplied.

4.2 **Silica gel Breather :**

Each storage tank shall be provided with detachable Silica gel breather having charge capacity of 2 Kg. The container of breather should be of suitable metal with transparent window all along the periphery. It may please be noted that plastic container for silicagel shall not be acceptable.

4.3 **Valves :**

Each storage tank shall be provided with following valves at various locations as indicated in the drawing. All valves shall be made of gun metal and wheel type (flanged) only. This requirement has to be confirmed by the tenderers without any deviation. All valves shall have position indicator indicating the status i.e., valves are in open or shut position.

5.3.1. Filter Valve :

Two nos. 50 mm dia valves suitable for connecting 38mm internal dia hose pipe shall be provided each on the top and bottom location but on diagonally opposite sides to enable cross current circulation of oil using two filter machines.

5.3.2. Drain Valve :

At the bottom of the tank, one no. 50mm dia valve with a plug shall be provided for draining of the oil.

4.4 Oil Level Indicator :

A plain oil level indicator shall be provided on either side of the tank. The indicator shall be of flush mounting type, to cover the entire height. The arrangement should be such that the indicator does not get damaged during handling and transportation. Oil level indicator is shown in three pieces in the drawing. Any other suitable arrangement shall also be accepted.

4.5 Lifting Lugs :

Four number suitable lugs (two nos. on each side) shall be provided for lifting the complete tank without any damage or distortions .

4.6 Hoses :

4.6.1 High temperature resistant hoses made of best quality neoprene materials with wire reinforcements are to be supplied with oil storage tanks of each capacity covered in this specification . Two lengths, each of 20 meters, shall be supplied with each tank. Internal diameter of hoses shall be 38mm. The offered prices of 10 KL tanks therefore should take in to account the cost of two length of 20 meters hose pipes.

4.6.2 These hoses shall be suitable for circulation of oil to be used in transformers with temperature as high as 100°C . The hoses should be suitable for suction cum pressure for very high degree of vacuum, almost absolute vacuum and pressure. It should be ensured that material used does not contaminate the transformer oil passing through it.

4.6.3 The pipe flange arrangements shall be suitable to match the arrangement provided by tenderers in storage tank for inlet/outlet of transformer oil. The tenderers shall submit a sample of the hose (about 0.5m length) pipe offered by them, alongwith the tender.

7.0 TESTS & TEST CERTIFICATES FOR FIBER OIL STORAGE TANK

7.1 TYPE TESTS

The tank offered shall be fully type tested as per IS 10661-1983 or any equivalent acceptable International Standard & technical specification. In case the Oil Storage Tanks offered are as per MPPTCLs' technical specifications and are already type tested in an independent test laboratory, the Tenderer shall furnish one set of tests reports along with the offer. These tests must not have been conducted earlier than five years from the date of opening of Bids. MPPTCL reserves the right to demand repetition

of some or all the type tests in the presence of owners' representative. For this purpose, the Tenderer may quote unit rates for carrying out each type test. These prices shall be taken in to consideration for bid evaluation.

7.2 ROUTINE TESTS

Before despatch each of tank shall be subjected to the routine tests at the manufacturer's works in accordance with the details specified in relevant IS Or any equivalent acceptable International Standards .

MPPTCL has all the rights to conduct the test including type tests, at its own cost by an independent agency whenever there is a dispute regarding the quality of supply or interpretation of test results.

8.0 INSPECTION :

- i. The MPPTCL shall have access at all times to the works and all other places of manufacture, where the oil storage tanks are being manufactured and the Tenderer shall provide all facilities for unrestricted inspection of the Tenderer's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.
- ii. The successful Tenderer shall keep the MPPTCL informed in advance of the time of starting and 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 the 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 successful Tenderer of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipment are later found to be defective.

9.0 QUALITY ASSURANCE PLAN & STAGE INSPECTION :

9.1 For the purpose of supply of above equipments, you will have to follow strict quality assurance programme, which will include thorough verification of samples of critical assemblies and accessories by us, verification of sources of raw materials, detailed verification of your drawing & design, checking up of all calculations regarding size of tank stage inspection at various critical stages of manufacture and minor modifications consequent to such stage inspections as per our requirements and all other related requirements, which have generally been brought out in bidding documents and the detailed contract. It is expected that you would be very serious and prudent in meeting these requirements without any loss of time, so that supply of equipments in line with quality assurance programme is ensured within targeted schedule.

The MPPTCL reserves the right to specify various stages for stage inspections and also for manufacture of a proto type unit for inspection & testing, before according clearance for bulk manufacturing.

9.2 The Tenderer must establish that they are following a proper quality assurance programme for manufacture of oil storage tanks.

The Tenderer shall invariably furnish following information along with his bid.

- i. Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of Tenderer's representative, copies of test certificates.
- ii. Information and copies of test certificates as in (i) above in respect of bought out items.
- iii. List of manufacturing facilities available.
- iv. Levels 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 equipment available with the Tenderer for final testing of equipment specified and test plant limitations, if any vis-à-vis type, special, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

9.3 The successful Tenderer shall within 30 days of placement of order, submit following information to the MPPTCL.

- i. List of raw materials as well as bought out accessories and the names of sub supplier selected from the lists furnished along with bid.
- ii. Type test certificate of the raw material and bought out accessories.
- iii. Quality Assurance Plan (QAP) with hold points for MPPTCL's inspection. The quality assurance plans and holds points shall be discussed between the MPPTCL and Tenderer before the QAP is finalized.

9.4 The successful Tenderer shall submit the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

10.0 DOCUMENTATION :

10.1 All drawings shall conform to the latest version of international standards organization (ISO) 'A' series of drawing sheet/ Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. Units.

10.2 LIST OF DRAWINGS AND DOCUMENTS :

The Tenderer shall furnish four sets of following details and drawings along with his bid :-

- a. General outline and assembly drawings of the oil storage Tank.
- b. Sectional views showing:
 - i) General Constructional Features.
 - ii) Materials/ Gaskets/ Sealings used.
- d. Name plate.
- e. Schematic drawing.

- f. Type Test reports in case the equipment has already been type tested.
- g. Test reports, literature, pamphlets of the bought out items and raw material.

10.3 The successful Tenderer shall within two weeks of placement of order, submit four sets of final versions of all the above drawings for MPPTCL's approval. The MPPTCL shall communicate his comments/approval on the drawings to the Tenderer within reasonable time. The Tenderer shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for MPPTCL's approval within two weeks from the date of MPPTCL's comments. After receipt of MPPTCL's approval, the Tenderer shall within three weeks submit 20 prints and two good quality reproducible of the approved drawings for MPPTCL's use.

10.4 The Tenderer for distribution, before commencement of supply, shall submit six sets of the type test reports, duly approved by the MPPTCL. Adequate copies of acceptance and routine tests certificates, duly approved by the MPPTCL shall accompany the dispatched consignment.

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

10.6 Twenty (20) copies of nicely printed and bound volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment supplied shall be submitted by the Tenderer for distribution, prior to the dispatch of the equipments. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. The manual shall also contain a set of all the approved drawings, type test reports etc.

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

11.0 PACKING AND FORWARDING :

11.1 The equipment shall be packed in crates suitable for vertical/ horizontal transport, as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The Tenderer shall be responsible for any damage during transit, due to improper and inadequate packing and handling. 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. Tenderer shall supply any material found short inside the packing cases without any extra cost.

11.2 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.

11.3 The Tenderer shall ensure that the packing list and bill of material are approved by the MPPTCL before dispatch.

ANNEXURE-I**TECHNICAL REQUIREMENTS OF OIL STORAGE TANK**

This schedule of guaranteed technical particulars for Oil Storage Tank is to be submitted by the Tenderers. It may be carefully noted that filling/ reply of each and every clause described below is a must.

S. No	Particulars	Technical Requirement
1	Design Standard	British Standard 4994-1987
2	Design Pressure	Atmospheric + Static Head
3	Design Temperature	70 ^o c
4	Service Fluid	Transformer Oil
5	Type of Service	Storage & Transportation
6	Operating Pressure	Atmospheric + Static Head
7	Operating Temperature	60 ^o c
8	Liquid Density	0.83 To 0.89
9	Hydro Test Pressure	Atm Static Head Only
10	Volume Full	10,000 Litre
11	Volume Operating	11,235 Litre
12	Type of Tank	Horizontal, Cylindrical With Dished Ends
13	Size	1650 Mm Dia X 4200 Mm Long
14	M.O.C	FRP
15	Equipment Name	Oil Transportation Tank
16	Thickness In Mm	
17	Dished Ends	10 Mm
18	Shell	8 Mm
19	Barrier Plate	8 Mm
20	Finishing-Inside	Mirror
21	Finishing-Outside	Matt-D.A Grey Pigmented Colour
22	Nozzles Standard	Ansi B 16.5 # Asa 150
23	Nozzles Projection	150 Mm
24	Colour	D.A Grey (Pigmented)
25	Empty Weight (Approx.)	Please Furnish
26	Manufacturing Process	Hand Lay Up Process With Atmospheric Curing
27	Manufacturing Technique	Moulding – Single Part Consolidation
28	Lamination Swquence	Please Furnish
29	Inspection	At Our Stire Prior To Despatch
30	Testing	A. Physical Dimensions
		B. Thickness Testing
		C. Hydrostatic Testing With Full Water For 48 Hrs.

SCHEDULE – I (A)

**DESCRIPTION OF MATERIAL FOR SCHEDULE OF RATES AND PRICES TO
BE FURNISHED IN VOLUME – VI**

S.No.	Particulars	Qty
1.	Fiber Glass Oil Storage Tank	As per Price Schedule

Note :

1. The above description of material is given for the purpose of offering the prices and to mention description of material in Invoice for claiming payment.
2. The quantity of above material has been mentioned in Volume VI.

SECTION-II**2.8 TECHNICAL SPECIFICATION FOR FIRE FIGHTING EQUIPMENTS****1.0 SCOPE:**

The scope of this bid covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Bid means "Original Equipment Manufacturer (OEM)". The purchaser means the 'MPPTCL'.

In case bidder is not OEM, sole responsibility of offering equipments/material of manufacturer as per this bid requirement shall rest on the bidder.

2. Technical requirements:

2.1 The fire fighting equipments (extinguishers) of various types shall be provided for electrical installation like outdoor switchyards, live electrical equipments, control room, lead acid battery room, stores yards, building, etc. fire fighting equipments (extinguishers) of various types shall be supplied in following quantities strictly conforming to Indian Standards mentioned against each:

S. No.	Description	Capacity of each extinguisher	Total nos. required.	IS reference
1	Carbon Di-oxide (CO ₂) type trolley mounted	22.5 Kgs	336	IS:2878
2	Mechanical foam type trolley mounted	50 Ltr.	358	IS:13386
3	Dry chemical powder (DCP) type trolley mounted	75 Kgs.	180	IS:10658
4	Set of fire buckets comprising of 6 buckets of 10 Ltrs. capacity each with stand	-	395	IS:2546

2.2 **Carbon-di-oxide type fire extinguishers** shall be designed for mainly extinguishing class-B & C fire involving inflammable liquid, gaseous substances electrical & electronic equipments, transformer & switchgear fires. Carbon-di-oxide type fire extinguisher and accessories shall be as per IS-2878. The CO₂ type 22.5 kg. capacity fire extinguisher shall be mounted on detachable trolley having valve bearing fitted solid rubber wheels 300 x 15 mm. The body of the extinguishers shall be of seamless steel cylinder conforming to latest IS :2878 or of such cylinders which are approved by the Chief Controller of Explosive, Govt. of India, with Sl. No. & certificate, fitted with ISI mark discharge wheel valve complete with 5 mtr. Length high-pressure rayon braided discharge hose with cold insulated rubber handle and horn. The hose pipe shall have bursting pressure of 275 kgf./cm.². The discharge horn shall be of material, which is non-conductor of electricity. The fire extinguisher shall be painted in accordance with IS:536 :1961. The equipment shall be completed with first charge of CO₂ gas conforming to IS:307:1966.

2.3 **Mechanical foam type fire extinguishers** shall be used for class-A & B fires i.e. fires in inflammable liquids. Foam type fire extinguishers and accessories shall be as per IS-13386 (for 50 ltr. Capacity). The body of the 50 ltr. Capacity fire extinguisher shall be fabricated from M.S. steel sheet not less than 1.25 mm in thickness. It shall be welded type

constructed and painted with zinc or lead tin alloy applied by hot dipping electrolytic process to withstand internal or external corrosion. The neck ring nozzle and cap shall be mounted on solid rubber wheel 300 x 15 mm for easy portability and shall be painted with "Fire Red" confirming to shade No.536:of IS:2932.

2.4 Dry power type extinguishers shall be used for B & C class fires, especially for combating three dimensional or running fires involving inflammable liquids like transformer oil, paints, electrical wiring, live machinery solvents or industrial gases. They shall also be used on energized equipments. Fire extinguishers and its accessories shall be as per IS 10658 (75 kg. capacity trolley mounted). Dry powder fire extinguisher 75 kg. capacity shall be having constructional features as per IS:10658 – 1983. The body of this equipment shall be fabricated from minimum 3.15 mm thick M.S. plate. The neck ring may also be made of stainless tube. The construction of body shall be welded type and painted with zinc or lead tin alloy applied by hot dipping or electrolytic process to withstand external & internal corrosion. The CO₂ gas filled cylinder (confirming to IS:7285 – 1974) shall be fitted externally with easily detachable type clamps support. The discharge clamps support, the discharge hose shall be fitted with not less than 50 kg.F/cm² the nozzle shall be trigger controlled. The pneumatic rubber connecting to CO₂ gas cylinder and main tank shall confirm to bursting pressure 275 kgf/cm² the equipment shall be mounted on wheeled carriage having ball bearing fitted solid rubber wheels 300 x 15 mm size. The first charge of chemical powder confirming to IS : 4308 – 1982, shall be supplied separately complete equipments shall be painted with "FIRE RED" confirming to shade No: 536 of IS : 1961.

2.5 Set of fire buckets comprising 6 no. buckets of capacity–10 Ltrs. each with stand. The **Bucket** shall be in conical shape having dome shaped bottom, made of 1mm thick good quality MS galvanized sheet confirming to IS 2546. The Overall height of the bucket should be 346mm (min).The diameter at top shall be 360mm (min) & at bottom shall be 170mm (min).It shall have Main handle of 10m dia & bottom handle of 8mm. Main handle to be free and to lie along the edge of bucket. The internal and external surfaces of the bucket shall be free from defects, is certified to be not less than the calculated minimum wall thickness plus additional allowance. Outer shall of each bucket shall be painted fire red or post office red conforming to shade No.536 or 537 or IS 5 & inside of the bucket shall be painted with white colour. Every bucket shall be marked " FIRE " with white paint. The dimensions of stand shall be 1050 mm x 750 mm (Height), should be made from 35mm X 35mm X 5mm size angle made of mild steel. Stand shall also be painted fire red or post office red conforming to shade No.536 or 537 or IS 5.Suitable hanging arrangement should be there to hang 6 buckets.

2.6 Design and manufacture of all equipment shall conform to the highest engineering standard to ensure safe and reliable operation. The items shall be suitable for the respective design pressure, temperature and service conditions as stipulated elsewhere in this specification.

2.7 The bidders shall offer the equipment strictly as per the specification laid down in this bid document.

The bidder shall submit the detailed BIS license with endorsement for manufacture of Aqueous film forming foam and dry chemical powder along with the bid.

2.8 First charge of chemicals in each extinguisher shall be provided. All chemical charges shall be refilled after testing at site.

2.9 Spanners and other accessories as required shall be supplied with each fire extinguisher.

2.10 Nature and charging of chemical shall be in accordance with the respective Indian Standard. **The chemicals to be used with fire extinguishers should have test certificate from Govt. approved laboratory. Wherever required a certificate from Chief Explosive Deptt. Nagpur shall be submitted.**

2.11 Bidders should invariably furnish a Notarized copy of their valid BIS license with all the enclosures of the BIS license held by the Firm using IS/BIS mark, wherever applicable.

2.12 The successful Bidder wherever possible, will require to emboss / engrave the words "Property of MPPTCL" along with the purchase order number on each extinguisher and accessories. Also suppliers should emboss / engrave / affix their company name plate with details or manufacturer's name and trade mark.

2.13 The method of sampling and criteria for conformity shall be as per the relevant ISS.

2.14 The bidder shall have to demonstrate the equipments offered to us at his own cost at Jabalpur as and when required by the purchaser. However, it would not be binding to the purchaser to place the order on this basis.

2.15 If required, the technical committee of MPPTCL may visit factory premises to conform the manufacturing facilities before issuing supply order.

2.16 In the event of placement of order, the successful bidder shall have to provide demonstration for charging of chemicals, operation of equipments, their routine maintenance and guidelines in that respect etc. at three places in M.P. namely Jabalpur, Bhopal & Indore.

3. Detailed Technical Specification for fire fighting equipments:

3.1 Fire extinguisher, carbon-di-oxide,(CO₂) type, trolley mounted:

The extinguisher shall be of following capacities:

Trolley mounted :

- a. Mild steel body - 22.5 Kg.

3.1.1 Rating suitability:

The rating of extinguishers shall be based on the amount of extinguishing medium used to extinguish the fire of maximum size under the condition of the test. This amount shall not be less than the appropriate minimum value given below:

S/N	Nominal size/ CO ₂ content Kg.	Discharge time	Class B rating	Fire size/ fuel heptanes.
i	22.5	20-60 s	20 B, C	20 m ² (20 l)

The capacity of the extinguisher shall be the mass of carbon-di-oxide when filled in the container. The filling ratio will not be more than 0.667 ± 0.033 percent. The carbon dioxide gas shall conform to IS 15222. The extinguishers shall be cleaned internally and shall be fitted with liquefied carbon dioxide to the filling ratio mentioned above. The quantity shall be determined by weighing. The weight of extinguisher shall not be less than 10% of the mass marked on it for fully charged extinguisher as per IS-2190.

3.1.2 Operating temperatures:

[Extinguishers shall be capable of operating reliably between the following temperatures ranges:

- 30°C to + 55°C

The temperature range shall be marked on the fire extinguishers.

3.1.3 Material :

The material for construction of various components is given below:

S. No.	Component	Material	Conforming to relevant Indian Standard
1	2	3	4
i	Discharge valve	-	IS 3224 (sequence grip valve).
ii	Safety device	-	IS 5903
iii	Syphon tube	a) Brass	Alloy No.2 of IS 407
		b) Copper	IS 1545
		c) Aluminium	IS 738
iv	Hose	The minimum bursting pressure shall be 275 kgf/ cm ² in control discharge and 140 kgf/ cm ² without control discharge.	
v	Discharge horn	Non-conductor of electricity like polyethylene, fibre-glass and similar material.	
Note:	1- Safety device conforming to IS 5903 shall be in-built in discharge valve conforming to IS 3224. 2- Carbon dioxide extinguisher with metal horn does not qualify the electrical fire rating.		

3.1.4. Constructions:

3.1.4.1 The extinguishers shall be in cylindrical shape having concave base. In case of steel body it shall conform to IS 7285. In case of aluminium, containers shall be seamless. The composition of material and the mechanical properties of the finished container shall be as per IS 2878.

3.1.4.2 Manufacture:

3.1.4.2.1 Process of manufacture

The container shall be made:

- By cold or hot extrusion from cast or extruded billets; or
- By cold or hot extrusion followed by cold drawing from cast or Extruded billets; or
- By cupping and cold drawing sheet or plate: or

- d) By necking at both ends extruded or cold drawn tube.

They shall be made only by a process that has been shown to produce containers free from cracks or other flaws that could adversely affect the safety of the containers.

The ends shall be of an approved shape and shall be formed by forging, swaging, or spinning. Ends shall not be welded on and metal shall not be added in the process of closing.

3.1.4.2.2 Examination of the cylinders before closing in operation:

Each cylinder shall be examined before final closing in operation for external and internal surface defects, finished thickness and circularity of the cylinder shell.

- a. Surface defects:

The internal and external surfaces of the cylinder shall be free from defects, which might adversely affect the safe shoring of the cylinder. A cylinder which has a surface defect greater than 5 percent of the shell thickness may have the defect ground out to the satisfaction of the inspecting is checked before closing in operation and is certified to be not less than the calculated minimum wall thickness plus additional allowance.

- b. Finished thickness:

The agreed finished thickness shall be not less than the minimum calculated wall thickness obtained by the formula at any point and at any transverse section of the cylindrical portion. If required by the purchaser, suitable allowance to cover corrosion, manufacturing tolerances and stresses due to horizontal acceleration and retardation during transportation may also be provided.

- c. Circularity:

The difference between the maximum and minimum external diameter measured at any cross-section of the cylindrical portion of the cylinder shall not exceed 1 percent of the nominal internal diameter.

- d. Mass:

The minimum and maximum mass of the cylinder shall be within the limits agreed upon between the manufacturer and the purchaser, depending on size, type and required thickness.

- e. Water capacity:

The water capacity of the cylinders shall be such that the nominal water capacity for the permanent gases and minimum water capacity for liquefiable gases shall be obtained.

- f. Permissible pressure:

The test pressure on which the design of the extinguisher container is based shall be not less than:

$1/0.85 \times$ the pressure developed by the gas at the reference temperature (for liquefiable gases).

3.1.4.2.3 Heat treatment:

Each container shall be heat treated at a temperature within the range 515°C to 545°C and water quenched and then artificially aged at a temperature selected within the range 150°C to 200°C.

Minimum values of mechanical properties required in the finished container after heat treatment and at room temperature shall be as given in Table 4 of IS-2778.

The operations involving heat treatment shall be carried out carefully in furnaces equipped to control temperatures accurately, and the containers shall be maintained at the stipulated temperatures for the length of time necessary to ensure that all parts have reached the required temperature and all necessary metallurgical changes have been effected.

3.1.4.3. Discharge valve or operating head:

The valve shall be provided and it shall be squeeze grip type or wheel type.

3.1.4.4 Discharge fittings:

i). The hose of not less than 10mm internal diameter shall be provided for 22.5 Kg. capacity fire extinguishers. The length of the hose shall be not less than 5 m for 22.5 kg. capacity fire extinguishers.

ii) A discharge horn with a suitable handle shall be provided.

3.1.4.5. Trolley:

The details of trolley shall be as given in IS-2878. The dimensions of trolley shall be 300mm x 50mm x 25mm.

3.1.5 Anti-corrosive treatment:

The external surface of the body shall be completely coated with epoxy powder of minimum 0.050 mm thickness. The thickness of the coating shall be measured as per the procedure given in IS 3203.

3.1.6. Painting:

i) Each extinguisher shall be painted fire red or post office red conforming to shade No.536 or 537 or IS 5.

ii) A picture showing operation of the extinguisher in the correct manner shall be provided on the body of the extinguishers.

iii) The extinguisher shall be marked with the letters B and C indicating their suitability for respective classes of fires as laid down in IS 2190. The letters B and C shall be of 2.5 cm size printed in white colour centrally contained in a square of 4 cm size and a circle of 2 cm radius respectively and shall be coloured black.

iv) The paint shall conform to IS 2932.

3.1.7 Performance requirements:

3.1.7.1 Discharge duration:

The design and construction of the extinguisher shall be such that when operated at an angle of not more than 45° from the vertical at a temperature of $27 \pm 2^{\circ}\text{C}$, it shall expel not less than 95 percent of the contents in the form of a continuous discharge within the following period from the time of operating the valve. The body shall be weighed 30mm after the discharge period and shall be wiped and dried before checking the contents. The minimum effective discharge time of extinguishers shall not be less than the appropriate value given in clause – 3.1.1.

Note: Extinguisher should be conditioned for 1 h before testing.

3.1.7.2 Intermittent operation:

An extinguisher shall be capable of being operated intermittently without freeze up of the valve seat and causing any leak when conditioned at $27 \pm 2^{\circ}\text{C}$. The valve shall be opened for 3 s and closed for 10 s and the cycle shall be repeated and shall discharge at least 95 percent of the contents.

3.1.7.3 Leakage test:

The extinguisher without its attachment shall be filled with CO_2 gas to the specified filling ratio and dipped in water for 2 min. and then check that no bubbles come out or soap solution test for leakage be carried out.

3.1.7.4 Class B Test Fire:

It shall be in accordance with IS: 2878.

3.1.7.5 Special requirements:

The extinguisher horn shall be constructed to withstand crushing when 25 kg is applied to its extremity for 5 min. immediately after having completely discharged the extinguisher through the horn.

Subject the horn to the following test:

- a. Condition the horn at 55°C for 18 h.
- b. Attach the horn to a fully charged extinguisher.
- c. Discharge the extinguisher with the valve fully open.
- d. Subject the horn to a static load of 25 kg using a circular contact surface of 50 mm diameter for 5 min. applied at the end of the horn; and
- e. Check that the horn does not show any evidence of cracking or breakage.

3.1.8 Marking :

3.1.8.1 Every extinguisher shall be clearly and permanently marked in accordance with the requirements.

3.1.8.2 The following information shall be marked on the extinguisher:

- a. Manufacturer's name or trade mark.
- b. Method of operation in prominent letters.
- c. The words CARBON DIOXIDE TYPE in prominent letters.
- d. Capacity.
- e. Year of manufacture of extinguisher and date of refilling and
- f. Source, year of manufacture of the cylinder and its test pressure.

3.1.8.3 The following information to facilitate filling or recharging shall also be marked on the head of extinguisher or on the neck of the cylinder.

- a. Empty weight of extinguisher (to include operating head, internal discharge tube and carrying handle but not any hose or discharge horn assembly), shown as EW: and
- b. Filled weight of extinguisher (to include operating head, internal discharge tube, carrying handle and gas-filled contents but not any hose or discharge horn assembly), shown as FW.

3.1.8.4 BIS certification marking:

The extinguisher may also be marked with the Standard Mark.

The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act 1986 and the Rules and Regulations made there under. The details of conditions under which a license for the use of the Standard Mark may be granted to manufactures or producers may be obtained from the Bureau of Indian Standards.

3.2. Fire Extinguisher, Mechanical foam type, Trolley mounted (50 ltr. Capacity):

The total liquid capacity of the extinguishers when filled with the charge, i.e. foam concentrate liquid and water up to the specified level shall be:

- i. 50 ± 0.5 ltr.

3.2.1 Material:

The material for construction of various parts of extinguishers shall be as given below:

S. No.	Component	Material	Requirements, Relevant to IS
i	Body	Mild steel sheet	Any Grade of IS 513
ii	Neck ring	a) Leaded tin bronze	IS 6913
		b) Mild steel pipe	IS:1239 (Part I) : 1979
iii	Cap	a) Leaded-tin-bronze	Grade LTB 2 of IS 318
iv	Cap washer	Rubber	Conforming to the requirements of hardness as applicable to type 3 of IS 538 and also acid and alkali resistant.
v	Spring	Spring steel	Grade I of IS 4454 (Part-I)
vi	Syphon tube	a) Brass	Alloy No.2 of IS 407
		b) HDPE	IS 4984
		c) Mild steel	IS 3601
		d) Copper	IS 1545
vii	Discharge fittings	a) Leaded-tin-bronze	Grade LTB 2 of IS 318
		b) Brass	Grade 2 of IS 291 or Type 1 of IS 319
		c) Plastic (for nozzle)	Annex B
viii	Foam making	a) Aluminium alloy	Grade 4450 or 4425 of IS 617

	branch pipe	b) Leaded-tin-bronze	Grade LTB 2 of IS 318
		c) Plastic	IS 7328
ix	Gas Cartridge	-	IS 4947
x	Hose	Braded rubber plastic	Having bursting pressure of not less than 50 Kg/ Cm ² .
xi	Snifter valve	a) Brass	Type 1 of IS 319
		b) Stainless steel	Grade 04 Cr 18 Ni 10 of IS 6603

3.2.2 Shape:

The shape of the body shall be cylindrical with outside diameter and thickness of mild steel sheet as mentioned below:

- i. Dia - 300 ± 25 mm
- ii. Thickness - 3.15 mm.

3.2.3 Construction :

3.2.3.1 General :

The top dome and bottom dish of the body shall be without reverse of curvature and shall be dished outwards to a radius not exceeding the outside diameter of the body to which these are fixed or of which one or both form a part if solid drawn therewith.

- i. Nonferrous metal parts shall be mechanically tightened and soldered, if needed, or brazed to the body.

3.2.3.2 Body :

Circumferential and horizontal joints of the body shall be of welded type.

- i. The welded construction to one of the types given below and shall conform to Indian Standard mentioned against each.
 - a. Spot welding (for attachment of fittings only) shall conform to IS 819: 1957, and
 - b. Metal arc welding shall conform to IS 9595 : 1980.

3.2.3.3 Carrying Handle:

The carrying handle shall be made of mild steel rod or tube of not less than 16mm diameter. If tube, the thickness of the sheet used shall be not less than 1.25 mm.

3.2.3.4 Neck Ring:

The neck ring shall provide a clear opening of not less than 75mm diameter. It shall have parallel screw threads conforming to class A of IS 2643 (Part 1) : 1975 for a effective length of not less than 28mm. The neck ring shall be firmly fixed to the body by welding.

3.2.3.5 Cap:

The cap shall be threaded for not less than 25mm effective length with parallel threads conforming to class A of IS 2643 (Part 1): 1975. At least four holes of not less than 2.5mm diameter each shall be drilled through threads of the cap to form vents. The centre of the vent holes shall be 6.5 mm maximum from the face of the cap joint washer.

3.2.3.6 Snifter valve:

A snifter valve (breathing device) shall be fitted to extinguishers for upright type and the design shall be such that when variation in atmospheric temperature is within $\pm 10^{\circ}\text{C}$ there shall be no spouting of liquid through nozzle.

3.2.3.7 Safety Pressure Release Valve:

The cap or body should have a safety pressure release valve mechanism by which if the pressure inside the container exceeds 25 Kgf/Cm^2 , the safety pressure release valve will release the internal pressure automatically.

3.2.3.8 Liquid Level Indicator:

The 50 ltr level of the solution inside the body shall be indicated on the exterior of the body. It shall also be permanently indicated in the interior, or means shall be provided to demonstrate that the solution level is correct.

3.2.3.9 Hose

The discharge hose shall have a bore of not less than 12.5 mm and a length of not less than 3m.

3.2.3.10 Foam Making Branch and other discharge fittings:

The design of the foam making branch and other discharge fittings shall be such that when the extinguisher is set in operation, it shall be capable of discharging foam as in 9.07.

3.2.3.11 Syphon Tube:

The syphon tube shall be fitted inside the body.

3.2.3.12 Drain Plug:

At the bottom of the body a drain plug of size 25mm minimum with rubber washer shall be fitted.

3.2.3.13 Wheeled Carriage:

The fire extinguisher shall be provided with wheeled carriage with rubber – tyred wheels of size 250 mm x 50mm x 25mm and axle of mild steel rod of 25mm minimum diameter. Tolerance for wheeled carriage shall be 10mm. The fitting shall ensure the lowest part of the body remains not less than 10 cm above the ground when it is in the vertical position.

3.2.3.14 Gas Cartridge:

The capacity of gas cartridge shall not exceed 300 (+10g, -3 g).

3.2.4 Charge:

The charge shall consist of foam concentrate conforming to IS 4989 (Part 2): 1984 and quantity not less than 3 ltr (6 percent concentrate) or 1.5 ltr (for 3 percent concentrate) and balance quantity of water to make the foam water solution to 50 ltr.

3.2.5 Anti – Corrosive Treatment:

All internal surfaces of the body be completely coated with lead-tin alloy (tin not less than 10 percent), applied by electrolytic process or by hot dipping process to a thickness of not less than 0.012 mm. The thickness of the coating shall be measured as given in IS 3203: 1982. The external surface of the body and both surfaces of siphon tube shall also be subjected to this anti-corrosive treatment. There shall be no visible uncoated area both internally or externally.

Phosphating in accordance with the provisions of IS 3618: 1966 may be applied on the external surface of the body as an alternative to lead-tin alloy.

3.2.6 Painting:

Each extinguisher shall be painted fire red conforming to shade No.536 or 537 of IS 5:1978. Each extinguisher shall be marked with letters A and B, indicating their suitability for respective classes of fires as laid down in IS 2190. The letters A and B shall be of 2.5 ± 0.5 cm size printed in black colour, centrally contained in a square of 4 ± 0.5 cm size. The square shall be coloured cream (lemon yellow) conforming to shade No.355 of IS5. The paint shall conform to IS 2932 : 1974.

3.2.7 Test requirement:

3.2.7.1 The extinguisher shall be discharging not less than 90 percent by mass of the actual rated capacity of the extinguisher, when the extinguisher is set into operation under normal temperature conditions of $27 \pm 5^\circ\text{C}$, the foam solution shall be expelled in the form of a foam jet which will maintain a throw of not less than 10m for the minimum period of 40 seconds. The maximum period of discharge of minimum 90 percent of the liquid shall be 180 seconds. The test shall be carried out so that the stream is discharged in horizontal direction in still air conditions from a height of 1.25m from the ground.

3.2.7.2 The foam produced shall have minimum expansion 6 and 25 percent, drainage time 70 to 120 seconds and formation of film as per IS 4989 (Part 2): 1984.

3.2.7.3 The extinguisher body and the cap (without the safety release valve) shall be tested separately to an internal hydraulic pressure of 3.0 MN/m^2 (30 kgf/cm^2) for a period of 2 min. During this test, it shall not show any sign of leakage.

3.2.7.4 In case of hydraulic burst failure test for body, the mechanical failure shall not occur at a pressure of less than 4.5 MN/m^2 (45 kgf/cm^2).

3.2.8 Optional requirements:

3.2.8.1 The product may carry along with instructions for proper use so as to maximize product performance with statutory warning, if any, minimize waste and method of safe disposal.

3.2.8.2 The material uses for product packaging (excl. refills) shall be recyclable, reusable or biodegradable.

3.2.8.3 The product must display a list of critical ingredients in descending order of quantity present in percent by weight. The list of such critical ingredients shall be identified by the Bureau of Indian Standards.

3.2.9 Specific Requirements:

3.2.9.1 The fire extinguisher shall not contain any Ozone Depleting Substance (ODS).

3.2.9.2 Gas based extinguisher media once discharged in the atmosphere should not have atmospheric life time of more than a year.

3.2.9.3 Chemical used should not have global warming potential.

3.2.9.4 The metallic body and other metal parts of the fire extinguishers shall be free of lead or lead alloys.

3.2.9.5 The coating used for the metallic part shall not be formulated with mercury and mercury compounds or be tinted with pigments of lead, cadmium, chromium VI and their oxides. Excluded are natural impurities entailed by the production process up to the amount 0.1 percent by weight, which are contained in the raw material.

3.2.10 Marking :

3.2.10.1 Each extinguisher shall be clearly and permanently marked with the following information:

- a. Indication of the source of manufacture.
- b. Method of operation in prominent letters.
- c. The word Mechanical Foam Fire Extinguishers:
- d. The capacity of extinguisher in litres.
- e. The words after discharge the extinguisher must be washed out carefully with fresh water using at least two changes in prominent letter.
- f. A declaration to the effect that the body of the extinguisher has been tested to pressure 3.0 MN/m² (30 kgf/cm²) and
- g. Year of manufacture
- h. Class of fire that is A & B.

3.2.10.2 The extinguisher may also be marked with Standard Mark.

3.3. FIRE EXTINGUISHER, DRY CHEMICAL POWDER (DCP) TYPE, TROLLEY MOUNTED:

3.3.1 CAPACITY

The total capacity of the dry powder extinguisher when filled shall be as under:

75 kg + 5% (tolerance).

3.3.2. MATERIALS

The material for construction of various parts of the extinguisher shall be as given below:

S. No.	Component	Material	Requirements Relevant to IS
i	Body	Mild steel sheet	IS 1079 or IS 2041 or IS 2062
ii	Neck ring	Leaded tin bronze	Grade LTB 2 of IS 318
		Seamless mild steel tube	IS 1239 (Part I)
		Copper	IS 6912

iii	Nozzle	Brass	Grade II of IS 291 or type I of IS 319
		Leaded tin bronze	Grade LTB 2 of IS 318
		Plastic	IS 7328
		Aluminium alloy	Grade 4450 of IS 617
iv	Cap	Leaded-tin-bronze	Grade LTB 2 of IS 318
		Brass	Type I of IS 319
v	Drain plug	Leaded-tin-bronze	Grade LTB 2 of IS 318
		Brass	Type I of IS 319
vi	Cap washer	Rubber	Conforming to the requirements of hardness as applicable to type 3 of IS 5382 and also acid and alkali resistant.
vii	Syphon tube	Seamless mild steel tube	IS 1239 (Part-I), IS 3601
viii	Discharge valve	-	IS 3224

3.3.3. CONSTRUCTION

3.3.3.1 Body

The construction of the body shall be welded conforming to the requirements given in IS 9595. The shape of the body shall be cylindrical having diameter not more than 75 cm. The domed ends of the body shall be without reverse of curvature and shall be dished outwards to a radius not exceeding the internal diameter of the body to which these are fixed.

3.3.3.2 Neck Ring

The neck ring shall provide a clear opening of not less than 75 mm. It shall have parallel screw threads for effective length of not less than 22 mm. The neck ring shall be firmly secured to the body by brazing or welding.

3.3.3.3 Cap

The cap shall be threaded for fixing to the neck ring in the body for not less than 22 mm effective length. The parallel threads shall be in accordance with IS 2643 (Part 1). At least 3 holes of not less than 3 mm diameter each shall be drilled through the threads of the cap to form vents for release of any pressure remaining in the body during withdrawal of the cap. The centres of the vent holed shall be 6.5 mm maximum from the face of the cap joint washer. The extinguisher shall be fitted with safety valve which shall release at a pressure of 2.5 MN/m² (25 kgf.cm²) as per requirement of IS 5903.

3.3.3.4 Cap Joint Washer

The cap joint washer shall be provided in the recess in the cap.

3.3.3.5 Expansion Space

A space shall be provided above dry powder level in the body of the extinguisher. It shall be of sufficient volume to ensure that when discharge nozzle is temporarily closed

and the extinguisher is operated at a temperature of $27 \pm 5^\circ \text{C}$, the internal pressure shall not exceed 1.5 MN/m^2 (15 kgf/cm^2) and the body shall not show any sign of leakage.

3.3.3.6 Discharge Hose

Discharge hose shall be of braided rubber or PVC of nominal bore 19 mm diameter fitted with not less than 5 m. The hose shall have bursting pressure of not less than 50 kgf/cm^2 .

3.3.3.7 Cylinder

The CO_2 gas cylinder shall conform to IS 7285 and shall be of capacity 3 litres and shall be filled with carbon dioxide (IS 307) having maximum filling ratio of 0.667 which is the ratio of mass of carbon dioxide charged in the container to the mass of water required to fill the container at 27°C .

3.3.3.8 Copper Tubing (Required if Gas Cylinder is Used):

It shall conform to bursting pressure of 275 kgf/cm^2 .

3.3.3.9 Nozzle and other Discharge Fittings:

The nozzle shall be trigger controlled and shall be capable of discharging dry powder as in 3.3.6.1, and shall be so designed as to eliminate moisture penetration.

3.3.3.10 Actuation Mechanism

The CO_2 cylinder shall have wheel valve to operate and discharge gas.

3.3.3.11 Drain Plug

The drain plug of not less than 25 mm diameter shall be provided on the body except in case of 25 kg capacity and the washer shall be provided to make the joint water tight.

3.3.4 ANTI-CORROSIVE TREATMENT

3.3.4.1 All internal and external surfaces of the body and internal parts shall be completely coated with zinc or lead-tin alloy (tin 10 percent minimum) applied by hot-dipping or electrolytic process to a thickness of not less than 0.025mm. The thickness of the coating shall be measured as given in IS 3203. There shall be no visible uncoated area both internally and externally.

3.3.4.2 Phosphating (see IS 3618) may be applied on the external surface of the body as an alternative to zinc or lead-tin alloy coating.

3.3.4.3 Epoxy polyester powder coating of 50-micron thickness may be applied on both surfaces of the body as an alternative to lead-tin alloy coating

3.3.5 PAINTING

Each extinguisher shall be painted fire red conforming to shade No.536 of IS 5. All components of trolley and other items other than the fire extinguisher shall be painted with the primer and finishing paints of two coats each. The paint shall conform to IS 2932:

3.3.6 TEST REQUIREMENTS

3.3.6.1 Performance Test

The extinguisher shall be capable of discharging minimum of 85 percent by mass of the actual rated capacity of dry powder when the extinguisher is operated at a temperature of $27 \pm 5^\circ \text{C}$ in still weather condition. The contents shall be expelled in the form of a continuous discharge, which shall comply with the following requirements:

Capacity of Extinguisher Kg	Durations in see	Range of Jet Throw (Minimum Throw) m
75	50 to 60	10

3.3.7 WHEELED CARRIAGE

The fire extinguisher shall be provided with wheeled carriage according to IS-10658. The fitting shall ensure that the lowest part of the body remains not less than 20 cm for 75 kg above the ground when it is in the vertical position.

3.3.8 MARKING

3.3.8.1 Each extinguisher shall be clearly and permanently marked with the following information.

- a) Name of the manufacturer or trade-mark, if any
- b) Method of operation in prominent letter
- c) Words 'Dry Powder Extinguisher's
- d) Capacity of the extinguisher in kg'
- e) Words 'Recharge After Use';
- f) A declaration to the effect that the body of the extinguisher has been tested to a pressure of 3.0 MN/m² (30 kgf/cm²);
- g) Letters indicating the various classes of fires for which the extinguisher is suitable;
- h) Year of manufacture;
- i) Working and design pressure;
- j) Working and design pressure;
- k) Capacity of gas cartridge ; and
- l) Capacity of gas cylinder with filling ratio.

3.3.8.2 BIS Certification Marking

The product may also be marked with the Standard Mark.

3.1 Set of fire buckets comprising 6 no. buckets of capacity–10 Ltrs. each with stand

BUCKET

3.4.1 Material

3.4.1.1 Mild Steel Black Sheets

Mild steel black sheets used for the manufacturer of buckets shall confirm to Grade St.34 or Grade St 42 of IS : 1979-1968.

3.4.1.2 Mild Steel Rod

Mild steel rod used for the top and bottom handles shall conform to IS : 226-1969.

3.4.1.3 Mild Steel Wire

Mild steel wire used for stiffening the top rim shall conform to IS : 280-1962.

3.4.1.4 Paints

Paints used for painting of fire buckets shall conform to the appropriate Indian Standards given in Table-1 of IS-2546-1974. The shade of the outside colour shall be fire red and inside shall be of the white, conforming to shade of respective IS.

3.4.2 Shape and Essential Dimensions

3.4.2.1 The shape and the essential dimensions of fire bucket shall conform to those described in IS-2546-1974.

3.4.3 Manufacture

3.4.3.1 Body

The body shall be in two halves which shall be joined together by butt welding. The top rim of the body shall be wired and uniformly beaded. The beading shall be fully formed without gaps. The thickness of body shall be 1 mm and diameter of beading wire 3.55 mm. IS-2546-1974.

3.4.3.2 Bottom

The bottom shall be dished and shall be joined to the body by butt welding so that there is no raw edge or crevice on the inside of the bucket. The thickness of the bottom sheet shall be 1mm.

3.4.3.3 Ears

The ears shall be made of mild steel sheet and shall be fitted to the body at the top by means of welding with the flat head on the side. The thickness of sheet for ears shall be 2.8mm.

3.4.3.4 Top handle

The top handle shall be of mild steel rod of 10mm in diameter with its ends bent up as shown in Fig.1 of IS-2546-1978.

3.4.3.5 Bottom handle

The bottom handle shall be of mild steel rod of 10mm in diameter and it shall be joined to the bottom by welding as shown in Fig.1. The grip shall have not sharp edges.

3.4.3.6 General

All gas welds shall be free from porosity, blow holes and brittleness.

3.4.4 Finish

3.4.4.1 All parts of the bucket shall be finished smooth and sharp edges rounded off.

3.4.4.2 The bucket shall be **galvanized** after manufacturer as per IS:2629-1966, The thickness of coating of zinc conforming to S:13229-1991 specification for zinc for galvanizing on any portion shall be not less than 0.06g/cm² (both sides inclusive). Alternately, it may also be galvanized of lead tin alloy to a thickness of not less than 0.012 mm.

3.4.4.3 Bucket shall, in addition to galvanizing be painted with two coats of white paint on the inside and two coats of red paint on the outside (see also 3.4.1.4). The handles and the ears shall be painted with two coats of black paint.

3.4.4.4 The word FIRE shall be painted in black centrally on the outside, its letters shall be 75mm high and approximately 12mm thick.

3.4.5 PERFORMANCE REQUIREMENTS

3.4.5.1 The bucket shall be water tight and tested for leakage as given in 3.4.5.2 and 3.4.5.3.

3.4.5.2 The bucket shall be filled with water to the brim and kept for 15 minutes. The bucket shall not show any sign of leakage during this period.

3.4.5.3 A water tank of suitable size and full of water shall be used for conducting the test. The dry empty bucket with its top facing upwards shall be pressed down the water vertically taking care that the top is at least 6mm above the water level. It shall be observed whether any water gets into the bucket from the bottom or sides of the bucket. If any water enters the bucket, it shall be considered to have failed the test.

3.4.5.4 The bucket shall be withdrawn, reversed (with top downwards) and again pressed down the water vertically without agitating the water. Should any air bubble be seen escaping through the water, the bucket shall be considered to have failed the test.

3.4.6 Inspection and manufacturers' certificate

3.4.6.1 The purchaser or his representative shall, if desired, be granted facilities for inspection of finished goods prior to dispatch at the manufacturer's works.

3.4.7 Scale of sampling and criterion for conformity

3.4.7.1 In any consignment, all the buckets from the same batch of manufacturer shall be grouped together to constitute a lot.

3.4.7.2 Sample size

The number of buckets to be selected from the lot shall depend on the size of the lot and shall be in accordance with Col.(1) and (2) of Table.2 of IS:2546 -1974.

3.4.7.3 Number of Test - All the buckets selected as in 3.4.7.2 shall be inspected for shape and dimensions, manufacturing defects and finish and tested for leakage. Any bucket which fails to satisfy the requirement of any one or more of the characteristics shall be considered as defective bucket.

3.4.7.4 Criterion for conformity - The lot shall be considered as conforming to the requirements of this standard if the number of defective buckets among those

inspected does not exceed the corresponding number given in col.3 of table.2 of IS-2546-1978, other wise it shall be considered as not conforming to the requirements of the standard.

3.4.8 Marking and packing

3.4.8.1 Each bucket shall be stamped or embossed on its side with the manufacturer's name or trade-mark, year of manufacture and its capacity. Embossing shall be sufficiently deep so that the marking remains quite legible after galvanizing.

3.4.8.2 The fire bucket may also be marked with the ISI certification mark.

3.4.9 **STAND**

3.4.9.1 Material should be made from 35mm X 35mm X 5mm size angle made of mild steel.

3.4.9.2 Paint

Stand shall also be painted fire red or post office red conforming to shade No.536 or 537 or IS 5.

3.4.9.3 Shape & Dimensions

The dimensions of stand shall be 1050 mm x 750 mm (Height), should be made from 35mm X 35mm X 5mm size angle made of mild steel. Stand shall have shape suitable to hang 6 buckets. Suitable hanging arrangement should be there to hang 6 buckets

3.4.9.4 All parts of the bucket shall be finished smooth and sharp edges rounded off.

4 SUBMISSION OF DESIGN DETAILS -

4.1 Requirements for participating in this Bid are as under :-

- a. Bidder must have established manufacturing facility in his factory to manufacture the materials as specified in this bid. The bidder shall clearly state his experience and capability to undertake the manufacture of these items. The minimum acceptable experience is five years as per Section – I qualification requirement.
- b. Details of such manufacture specified above and supply including type, quantity, date of order, date of commencement and completion of supplies, name of purchaser shall be furnished with the bid along with his full address.
- c. Bidder should have adequate testing facilities to test the product offered in his factory to the satisfaction of the purchaser. The bid shall include complete details of testing facilities available in manufacturer's works.

5 PRE-TREATMENT AND PAINTING PROCESS -

Sheet steel fabricated members for Fire Fighting Equipments shall be subjected to pre-treatment process before painting. The process shall be carried out as under. The process can broadly be divided as 'Metal treatment and painting'.

5.1 METAL TREATMENT -

- i. **Degreasing** : This can be achieved either by immersing in hot alkaline degreasing bath or in hot dry chlorothelence solution. In case degreasing is done by alkaline bath rinse with cold water thoroughly.
- ii. **Pickling**: This is to remove rust and metal scales. Immersing indiluted sulphuric acid (approximately 20%) at nearly 60 deg. Centigra de. Unit scale and rust are totally removed.
- iii. Rinse it in cold water twice to remove traces of acids.
- iv. Treat with phosphoric acid base neutraliser for removal of chlorine from the above acid pickling and again wash with running water.
- v. **Phosphating** : Immerse in grenodine `zinc phosphate solution for about 20 minutes at 80 to 90 deg. centigrade. The uniform phosphate coating of 4 to 5 gms per sq.meter shall be achieved.
- vi. Swill in cold water.
- vii. Rinse in Deorylyte bath at 70 to 80 deg. centigrade to neutralise any traces of salts.
- viii. Seal the above phosphate coating with hot/dilute chromoto solution.
- ix. Dry with compressed air.

5.2 PAINTING –

- i. **Primer** : spray one coat wet on wet specially developed `High lusture' zinc chromote primer and stove at 150 deg. centigrade to 160 deg. centigrade for 25 to 30 minutes. Alternatively red-oxide primer with zinc chromate contents may be used. However, former process is preferred.
- ii. **Rubbing and puttying** : Apply putty to fill up the scars if any to present smooth surface and stove 15 to 20 minutes. Apply putty several times to get the perfectly smooth finish.
- iii. **Surfacing** : Sand down with mechanical abrasive and stove for 20 minutes.
- iv. **Primer** : Spray second coat of primer as per (i) above or grey primer surface wet on wet and stove for 20 to 40 minutes at 150 deg. centigrade.
- v. **Finish paint** : Rubbing down dry and spray first coat of synthetic enamel finish paint wet on wet and stove for 30 minutes.
- vi. **Surfacing** : Sand down or rub dry to prepare for final finish spray. Final finish shall be obtained after spraying 2 Coats of synthetic enamel finish paint wet on wet and stove it at 150 deg. centigrade for 30 minutes.
- vii. Colour of finishing paint for Fire Fighting Equipments shall be as described in clause-3.1 to 3.4 of this section –II.

NOTE -

- i. Necessary stiffeners may be welded between large cut outs to provide rigidity before painting process.
- ii. Painting process shall be done within 24 hours of completion of treatment.
- iii. Small coating paint shall be supplied alongwith equipment for touching up at site.

6. TESTS:

6.1 TYPE TEST:

All the equipment offered, shall be fully type tested as per relevant Indian Standards during the last five years from the date of bid opening. Copy of test reports shall be enclosed with the bid. For any change in the design/type already type tested and the design/type offered against this bid, the Purchaser reserves the right to demand repetition of same or all type tests without any extra cost.

6.2 ACCEPTANCE AND ROUTINE TESTS:

i. The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards in presence of purchaser's representative.

ii. Immediately after finalisation of the programme of type/ acceptance/ routine testing, the manufacturer shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

6.3 The successful Bidder shall submit the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

7 DOCUMENTATION:

7.1 All drawings shall conform to latest version of Indian Standards Specification. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. Units.

7.2 LIST OF DRAWINGS AND DOCUMENTS:

The Bidder shall furnish four sets of following details and drawings along with his bid:-

- i. General outline and assembly drawings of the equipment.
- ii. Name plate.
- iii. Schematic drawing.
- iv. Type Test reports in case the equipment has already been type tested.
- v. Test reports, literature, pamphlets of the bought out items and raw material.

7.3 The successful Bidder shall within 15 days of placement of order, submit a set of final versions of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments / approval on the drawings to the Bidder within reasonable time. The Bidder shall, if necessary, modify the drawings and resubmit the modified drawings for Purchaser's approval.

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

7.5 Thirty four (34) copies of nicely printed and bound volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment supplied shall be submitted by the Bidder for distribution, prior to the dispatch of

the equipment. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. The manual shall also contain a set of all the approved drawings, type test reports etc.

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

10 QUALITY ASSURANCE PLAN -

10.1 The Bidders must establish that they are following a proper quality assurance programme for manufacture of Materials. The bidder shall invariably furnish following information along with their bid. Information shall be separately given for each type of cable:

- (i) Statement giving list of important raw materials, names of sub-suppliers for the raw material, list of standards according to which the raw material is purchased and copies of test certificates thereof.
- (ii) Information and copies of test certificates as in (i) above in respect of bought out items.
- (iii) List of manufacturing facilities available.
- (iv) Levels 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) List of testing equipment available with the bidder for final testing of material specified and test plant limitation, if any, vis-à-vis type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

10.2 The successful bidder 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 Bid.
- (ii) Type test certificates of the raw material and bought out accessories.
- (iii) Quality Assurance Plan (QAP) with hold-up points for purchaser's inspection. The quality assurance plans and hold-up points shall be discussed between the Purchaser and supplier before the QAP is finalized.

11 SCHEDULE –

The Schedules, questionnaire and annexure attached with this specification are the integral part of the specification and shall be submitted duly filled in by the bidders alongwith the offer. The bill of material for each equipment shall be submitted by the bidders separately.

12 DISCREPANCY IN TECHNICAL PARTICULARS -

It has been noticed that some of the information furnished in the schedule of technical particulars, technical questionnaire and price schedule do not match with each other. In

order to avoid any discrepancy, it may be noted that for the purpose of price evaluation the details brought out by the bidders in "Schedule-III' Technical Questionnaire" will be treated as final and evaluation will be done based on the information which will be given in this Schedule -III. In case of any discrepancy in regard to information given in any other table, responsibility will rest on the Bidder. While this condition shall be applicable for the purpose of price evaluation, at the time of acceptance of bid, the Purchaser will have the right to take such of the values which are advantageous to the Purchaser.

SCHEDULE-I(A)**DESCRIPTION OF EQUIPMENT FOR
SCHEDULE FOR RATES AND PRICES TO BE FURNISHED
IN VOLUME-VI**

S.No.	Particulars of equipment/ Item	Qty.
1	Carbon Di-oxide (Co ₂) type trolley mounted of 22.5 kgs capacity	As per Price Schedule
2	Mechanical foam type trolley mounted of 50 Ltrs capacity	
3	Dry chemical powder (DCP) type trolley mounted of 75 Kgs capacity	
4	Set of fire buckets comprising of 6 nos. buckets of 10 Ltrs. capacity each with stand	

- NOTE:**
1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.
 2. The quantity of above equipments has been mentioned in Volume VI.

SECTION-II

2.9 TECHNICAL SPECIFICATION FOR 200KVA DG SET

1.0. SCOPE OF SUPPLY

1.1. The scope covers supply of Diesel Generator set of stationary type having a net electrical output of 200kVA capacity at specified site conditions of 50° C ambient temperature and 100% relative humidity on FOR site basis. DG set shall be equipped with:

- (i) Diesel engine complete with all accessories as mentioned below.
 - (a) 125mm dia exhaust pipe with flanges, supports & necessary hardware
 - (b) Aluminum cladding material for 125mm exhaust pipe.
 - (c) 25 mm x 3 mm GI strip with sleeves for body earthing.
 - (d) 25 mm x 3 mm copper strip with sleeves for neutral earthing
 - (e) Control cable 4 core X 4 sqmm copper armoured
 - (f) Supply of 3.5C X 195 Sqmm aluminium armoured cable with required supports and fasteners for clamping the cable
 - (g) Supply of earthing materials
 - (h) Copper bottom earth plate 600X600X3 mm alongwith earthing material as per scope of the tender
 - (i) GI bottom earth plate 600X600X3 mm alongwith earthing material as per scope of the tender
- (ii) An alternator directly coupled to the engine through coupling, complete with all accessories.
- (iii) Automatic voltage regulator.
- (iv) Complete starting arrangement, including two nos. batteries & chargers.
- (v) Base frame, foundation bolts etc.
- (vi) Day tank of 350 Litre capacity.
- (vii) Engine Cooling and lubrication system.
- (viii) Engine air filtering system.
- (ix) Exhaust silencer package.
- (x) Set of GI pipes, valves, strainers, unloading hose pipes as required for fuel transfer system from storage area to fuel tank including electrically driven fuel pump.
- (xi) All lubricants, consumable, touch up paints etc. for first filing, testing & commissioning at site. The fuel oil for first commissioning will also be provided by the contractor.
- (xii) AMF panel for control, metering and alarm.
- (xiii) Enclosure for silent type D.G. Set

1.1.1 CLIMATIC CONDITIONS:

Applicable climatic conditions shall be as per Section-I Vol.II .

1.2. SCOPE OF SERVICE

1.2.1. The Contractor shall provide following services:

- a) Design, manufacture, shop testing including assembly test.
- b) Despatch, transportation to site.
- c) Erection, testing & commissioning with all equipments/ materials required for the purpose.
- d) Drawings, data, design calculations and printed erection, operation & maintenance manual.
- e) Certification and compliance for meeting noise level & emission parameters and other requirements in accordance with latest Notification of MOEF.

1.3. TECHNICAL REQUIREMENTS

1.3.1. The rating of DG sets are as follows:

1.3.1.1. DG set net out put after considering deration for engine and alternator separately due to temperature rise in side the enclosure and on account of power reduction due to auxiliaries shall be 200kVA, 1500RPM, 0.8Pf, 415V, 3 phase, 50Hz. The above ratings are the minimum requirements.

1.3.1.2. DG sets shall also be rated for 110% of full load for 1 hour in every twelve hrs of continuous running.

1.3.2. The output voltage, frequency and limits of variation from open circuit to full load shall be as follows:

- a) Voltage variation +5% of the set value provision shall exist to adjust the set value between 90% to 110% of nominal Generator voltage of 415V.
- b) Frequency 50Hz +2%

1.3.3. The Diesel Generator and other auxiliary motor shall be of H class with temperature rise limited to Class-F for temperature rise consideration.

1.3.4. NOISE LEVEL & EMISSION PARAMETERS: These shall be as per latest Notification of MOEF.

1.4. PLANT DESIGN

1.4.1. DIESEL ENGINE

1.4.1.1. The engine shall comply with the IS 10002/BS 5514/ISO 3046; latest edition.

1.4.1.2. Diesel engine shall be turbo charged multicylinder V-type in line type with mechanical fuel injection system.

1.4.1.3. The engine with all accessories shall be enclosed in a enclosure to make it work Silently (within permissible noise level) without any degradation in its performance.

1.4.1.4. The Diesel Engines shall be directly water cooled. Cooling of water through radiator and fan as envisaged.

1.4.1.5. The fuel used shall be High Speed Diesel oil (HSD) or Light Diesel Oil (LDO) as per IS: 1460.

1.4.2. AIR SUCTION & FILTRATION

1.4.2.1. Suction of air shall be from indoor for ventilation and exhaust flue gasses will be let out to outside atmosphere, Condensate traps shall be provided on the exhaust pipe.

1.4.2.2. Filter shall be dry type air filter with replaceable elements.

1.4.3. FUEL AND LUBRICATING OIL SYSTEM

1.4.3.1. The engine shall have closed loop lubricating system. No moving parts shall require lubrication by hand prior to the start of engine or while it is in operation.

1.4.4. ENGINE STARTING SYSTEM

1.4.4.1. Automatic electric starting by DC starter motor shall be provided.

1.4.5. FUEL INJECTION AND REGULATOR

1.4.5.2. The engine shall be fitted with a heavy, dynamically balanced fly wheel suitable for constant speed governor duty.

1.4.5.1 The engine shall be fitted with electronic governor suitable for as per IS 10000.

1.4.6 ALTERNATOR

1.4.6.1. The alternator shall comply with BS 2613/IS 4722/IEC 34;

latest edition.

1.4.6.2. The alternator shall be of continuously rated duty, suitable for 415 V, 3 phase, 50 Hz. Power development having brush-less, synchronous, self-excited, self-regulating system.

1.4.6.3. The alternator shall be drip-proof, screen protected as per IP-23 degree of Protection.

1.4.6.4. The rotor shall be dynamically balanced to minimize vibration.

1.4.6.5. The alternator shall be fitted with shaft mounted centrifugal fan.

1.4.6.6. It shall have the winding of class H but limited to Class-F for temperature rise consideration.

1.4.6.7. The Alternator regulator shall be directly coupled to the engine and shall be complete with the excitation system, automatic voltage regulation of +/- 1%, voltage adjusting potentiometer and under/over speed protection.

1.4.6.8. TERMINAL BOX

1.4.6.8.1. Six (6) output terminals shall be provided in alternator terminal box. Terminals shall be Suitable for 1 No. of single core, 630 mm² XLPE cables per phase for 200kVA DG set and 3½Core 300 mm² XLPE cable for 100kVA DG set. The neutral shall be formed in AMF panel. The generator terminal box shall be suitable to house necessary cables and should be made of non-magnetic material.

1.4.6.9. The alternator with all accessories shall be enclosed in a enclosure to make it work Silently (within permissible noise level).

1.4.7. COUPLING

1.4.7.1. The engine and alternator shall be directly coupled by means of self-aligning flexible flange coupling to avoid misalignment.

1.4.7.2. The coupling shall be provided with a protecting guard to avoid accidental contract.

1.4.8 MOUNTING ARRANGEMENT

1.4.8.1. The engine and alternator shall be mounted on a common heavy duty, rigid fabricated steel base frame constructed from ISMC of suitable sections.

1.4.8.2. Adequate number of anti-vibration mounting pads shall be fixed on the common base frame on which the engine and the alternator shall be mounted to isolate the vibration from passing on to the common base frame or the foundation of the D.G. Set.

1.4.9. PERIPHERALS

1.4.9.1. FUEL TANK

1.4.9.1.1. The Fuel tank of 350 Litre capacity shall be provided on a suitably fabricated steel platform. The tank shall be complete with level indicator marked in litres, filling inlet with removable screen, an outlet, a drain plug, an air vent, an air breather and necessary piping. The tank shall be painted with oil resistant paint and shall be erected in accordance with Indian explosive act of 1932. Fuel tank shall be kept outside of enclosure. The fuel piping shall be carried out to connect the D.G set kept inside.

1.4.9.1.2. For transferring fuel to Fuel tank transfer pump is envisaged. The capacity of transfer pump shall be adequate to fill the day tank in about 30 minutes. Fuel pump shall be electrically driven.

1.4.9.2. BATTERY & BATTERY CHARGER

1.4.9.2.1. Two nos. 24V batteries complete with all leads, terminals and stand shall be provided. Each battery shall have sufficient capacity to give 10 nos. successive starting impulse to the diesel engine.

1.4.9.2.2. The battery charger shall be complete with transformer, suitable rating (415 V, 3 Ph., 50 Hz./230V, 1Ph., 50 Hz) rectifier circuit, charge rate selector switch for "trickle"/"boost' charge, D.C. ammeter & voltmeter, annunciation panel for battery charge indication / loading / failures.

1.4.9.2.3. The charger shall float and Boost Charge the battery as per recommendation of manufacturer of battery. The charger shall be able to charge a fully discharged battery to a state of full charge in 8 Hrs. with 25% spare capacity.

1.4.9.2.4. Manual control for coarse and fine voltage variation shall be provided. Float charger shall have built-in load limiting features.

1.4.9.2.5. Ripple shall not be more than 1%(r.m.s) to get smooth DC voltage shall be provided.

1.4.9.2.6. Charger shall be provided with Output Voltmeter & Ammeter.

1.4.9.2.7. Changeover scheme for selecting battery and battery charger by changeover switch should be provided.

1.5. CONTROL AND INSTRUMENTATION

1.5.1. Each D.G. Set shall be provided with suitable instruments, interlock and protection arrangement, suitable annunciation and indications etc. for proper start up, control, monitoring and safe operation of the unit. One local AMF control panel alongwith each D.G. set shall be provided by the Supplier to accommodate these instruments, protective relays, indication lamps etc. The AMF Panel shall have IP-52 degree of Protection as per IS:12063.

1.5.2. The D.G. sets shall be provided with automatic start facility to make it possible to take full load within 30 seconds of Power Supply failure.

1.5.3. Testing facility for automatic operation of D.G.Set shall be provided in AMF panel.

1.5.4. A three attempt starting facility using two impulse timers and summation timer for engine shall be proved and if the voltage fails to develop within 40 sec. from receiving the first impulse, the set shall block and alarm to this effect shall be provided in the AMF panel.

1.5.5. Following instruments shall be provided with Diesel Engine

- a) Lub oil pressure gauge
- b) Water temperature thermometers
- c) Engine tachometer/HR
- d) Any other instruments necessary for DG Set operation shall be provided.

1.5.6. DG set shall be capable of being started/ stopped manually from remote as well as local. (Remote START/STOP push button shall be provided in 415V ACDB). However, interlock shall be provided to prevent shutting down operation as long as D.G. set is closed.

1.5.7. The diesel generator shall commence a shutdown sequence

whenever any of the following conditions appear in the system:

- a) Overspeed
- b) Overload
- c) High temperature of engine and cooling water.
- d) High temperature inside enclosure
- e) Low lube oil pressure
- f) Generator differential protection
- g) Short circuit protection
- h) Under voltage
- i) Over voltage
- j) Further interlocking of breaker shall be provided to prevent parallel operation of DG set with normal station supply.

1.5.8. Following indication lamps for purposes mentioned as under shall be provided in AMF panel:

1.5.8.1. Pilot indicating lamp for the following:

- a) Mains ON
- b) Alternator ON
- c) Charger ON/OFF
- d) Breaker ON/OFF
- e) Main LT Supply ON/OFF

1.5.8.2. Visual annunciation shall be provided for set shut down due to:

- a) engine overheating
- b) low oil pressure
- c) lack of fuel
- d) Set failed to start in 30 secs after receiving the first start impulse
- e) high cooling water temperature
- f) Low level in daily service fuel tank
- g) Overspeed trip
- h) Audio & visual Annunciation for alternator fault.

1.5.9. Thermostatically controlled space heaters and cubicle illumination operated by Door Switch shall be provided in AMF panel. Necessary isolating switches and fuses shall also be provided.

1.5.10. AMF panel shall have facility for adjustment of speed and voltage including fine adjustments in remote as well as in local mode. Following shall also be provided in AMF panel:

- a) Frequency meter
- b) 3 Nos. single phase CT's for metering
- c) 3 Nos. (Provided by LT swgr manufacturer) single phase CT's with KPV 300V & RCT 0.25 ohm for differential

protection of DG Set on neutral side only for 200kVA.

- d) One (1) DC Ammeter (0-40A)
- e) One (1) DC Voltmeter (0-30V)
- f) One (1) Voltmeter Selector switch
- g) One (1) AC Ammeter
- h) One (1) AC Voltmeter
- i) Three (3) Timers (24V DC)
- j) Two (2) Auto/Manual Selector Switch
- k) Two (2) Auto/test/Manual Selector Switch
- l) Eleven (11) Aux. Contactors suitable for 24V DC
- m) One (1) Motorised potentiometer for voltage adjustment
- o) One (1) Set Phase & Neutral busbars.
- p) Any other item required for completion of Control scheme shall be deemed to be included.

1.6. D.G. SET Enclosure

1.6.1. General requirements

1.6.1.1. Diesel engine, alternator, AMF panel, Batteries and Chargers shall be installed outdoor in a suitable weather-proof enclosure which shall be provided for protection from rain, sun, dust etc. Further, in addition to the weather proofing, acoustic enclosures shall also be provided such that the noise level of acoustic enclosure DG set shall meet the requirement of MOEF The diesel generator sets should also conform to Environment (Protection) Rules, 1986 as amended. An exhaust fan with louvers shall be installed in the enclosure for temperature control inside the enclosure. The enclosure shall allow sufficient ventilation to the enclosed D.G. Set so that the body temperature is limit to 50°C. The air flow of the exhaust fan shall be from inside to the outside the shelter. The exhaust fan shall be powered from the DG set supply output so that it starts with the starting of the DG set and stops with the stopping of the DG set. The enclosure shall have suitable viewing glass to view the local parameters on the engine.

1.6.1.2. Fresh air intake for the Engine shall be available abundantly; without making the Engine to gasp for air intake. A chicken mess shall be provided for air inlet at suitable location in enclosure which shall be finalised during detailed engineering.

1.6.1.3. The Enclosure shall be designed and the layout of the equipment inside it shall be such that there is easy access to all the serviceable parts.

1.6.1.4. Engine and Alternator used inside the Enclosure shall carry their manufacturer's Warranty for their respective Models and this

shall not degrade their performance.

1.6.1.5. Exhaust from the Engine shall be let off through Silencer arrangement to keep the noise level within desired limits. Interconnection between silencer and engine should be through stainless steel flexible hose/ pipe.

1.6.2. All the Controls for Operation of the D.G. Set shall be easily assessable. There should be provision for emergency shut down from outside the enclosure.

1.6.3. Arrangement shall be made for housing the Battery set in at Enclosure.

1.6.4. Construction Features:

1.6.4.1. The enclosure shall be fabricated from at least 14 Gauge CRCA sheet steel and of Modular construction for easy assembling and dismantling. The sheet metal components shall be pre-treated by Seven Tank Process and Powder coated (PURO Polyester based) both-in side and out side – for long life. The hard-ware and accessories shall be high tensile grade. Enclosure shall be given a lasting anti-rust treatment and finished with pleasant environment friendly paint. All the hardware and fixtures shall be rust proof and able to withstand the weather conditions.

1.6.4.2. Doors shall be large sized for easy access and provided with long lasting gasket to make the enclosure sound proof. All the door handles shall be lockable type.

1.6.4.3. The Enclosure shall be provided with anti-vibration pads (suitable for the loads and vibration they are required to carry) with minimum vibration transmitted to the surface the set is resting on.

1.6.4.4. High quality rock wool of required density and thickness shall be used with fire retardant thermo – setting resin to make the Enclosure sound proof.

1.6.5. Provision for Neutral/Body Earthing

1.6.5.1. Points shall be available at two side of the enclosure with the help of flexible copper wires from alternator neutral, and electrical panel body respectively. The earthing point shall be isolated through insulator mounted on enclosure.

1.7. INSTALLATION ARRANGEMENT

1.7.1. DG set enclosed in enclosure shall be installed on Concrete Pedestal 300mm above FGL

1.8 DOCUMENTS

1.8.1. Following drawings and data sheet shall be submitted for approval:

- (i) Data sheet for Engine, Alternator, Battery, AMF panel and Enclosure
- (ii) GA drawing of DG set
- (iii) Layout of DGset in the enclosure along with sections
- (iv) GA and schematic of AMF panel
- (v) Arrangement of inclined roof and pedestal.

1.8.2. The D G Set shall be supplied with

- (i) D G Set test certificate
- (ii) Engine Operation & maintenance Manual.
- (iii) Engine Parts Catalogue.
- (iv) Alternator Operation, maintenance & Spare parts Manual.
- (v) Alternator test certificate.

1.9. TESTS

- a) The Diesel generator sets shall be tested for routine and acceptance tests as per the relevant IS/IEC standards.
- b) The type test report for diesel engine and alternator are not required to be submitted or the makes indicated at Annexure-E of Section: GTR/POWERGRID approved list of subvendors. For the new makes (Other than those indicated at Annexure-E/POWERGRID approved list of subvendors) type test reports as per relevant standard shall be submitted for purchaser's approval.

1.10. Commissioning Checks

In addition to the checks and test recommended by the manufacturer, the Contractor shall carryout the following commissioning tests to be carried out at site.

1. Load Test

The engine shall be given test run for a period of atleast 6 hours. The set shall be subjected to the maximum achievable load as decided by Purchaser without exceeding the specified DG Set rating:

During the load test, half hourly records of the following shall be taken:

- a) Ambient temperature.
- b) Exhaust temperature if exhaust thermometer is fitted.

- c) Cooling water temperature at a convenient point adjacent to the water output from the engine jacket.
- d) Lubricating oil temperature where oil cooler fitted.
- e) Lubricating oil pressure.
- f) Colour of exhaust gas
- g) Speed
- h) Voltage, wattage and current output.
- i) Oil tank level

The necessary load to carryout the test shall be provided by the purchaser.

2. Insulation Resistance Test for Alternator

Insulation resistance in mega-ohms between the coils and the frame of the alternator when tested with a 500V megger shall not be less than $IR=2x(\text{rated voltage in KV}) + 1$

3. Check of Fuel Consumption

A check of the fuel consumption shall be made during the load run test. This test shall be conducted for the purpose of proper tuning of the engine.

4. Insulation Resistance of Wiring

Insulation resistance of control panel wiring shall be checked by 500V Megger. The IR shall not be less than one mega ohm.

5. Functional Tests

- a) Functional tests on control panel.
- b) Functional test on starting provision on the engine.
- c) Functional tests on all Field devices.
- d) Functional tests on AVR and speed governor.

6. Measurement of Vibration

The vibration shall be measured at load as close to maximum achievable load and shall not exceed 250microns.

7. Noise Level check as per relevant standard

8. The tests shall be carried out with the DG set operating at rated speed and at maximum achievable load. Necessary correction for Test environment condition & background noise will be applied as per IS:12065.

1.11 DISCREPANCIES IN TECHNICAL PARTICULARS:

It has been noticed that some of the information furnished in the schedule of technical particulars, technical questionnaire and price schedule do not match with each other. In order to avoid any discrepancy, it may be noted that for the purpose of price evaluation the details brought out by the Tenderers in "Schedule-III" Technical Questionnaire" will be treated as final and evaluation will be done based on the information which will be given in this Schedule III. In case of discrepancy in regard to information given in any other table,

responsibility will rest solely on the Tenderer. It may please be noted that while this condition shall be applicable for the purpose of price evaluation, at the time of acceptance of Tender, the Purchaser will have the right to take such of the values which are advantageous to the Purchaser.

1.12 Services for Supervision of Erection & Commissioning OF DG Set:

1.12.1 Services for Supervision of Erection & Commissioning:

It is obligatory on the part of the Bidder to provide “free services” of their erection & commissioning team to supervise erection & commissioning of each DG set. Bidder may please note that services of their engineer shall be required for the following activities at substation sites.

S. No.	Description
1	Installation including positioning of 200KVA DG set, AMF panel, accessories, CPCB approve acoustic enclosure etc.
2	Supervision charges for installation & commissioning of DG set
3	Carrying out earthing with Copper bottom earth plate & GI bottom earth plate both 600 x 600 x 3 mm as per BIS including digging, chamber construction etc.
4	Laying of Control cable 4 core X 4 sqmm copper armoured
5	Laying of 3.5C X 195 Sqmm aluminium armoured cable with required supports and fasteners for clamping the cable

Normally MPPTCL has trained staff for erection of DG set based on guidelines, which are to be furnished by the manufacturer. While undertaking erection work the purchaser will require services of supervision engineer for suitable period depending upon design of equipment and these services for required period will have to be made available on free of cost basis. In case any manufacturer feels that their experienced engineer for final supervision of erection and testing will need assistance of any junior grade supervisor also, services of the same should also be provided on free of cost basis. In any case free services by way of deputation of required number of personnel for sufficient period will have to be ensured by the bidder on free of cost basis. The intention is that the services are made available until supervision of erection & commissioning is completed. These services shall be provided for each unit. It will be obligatory on the part of bidders to depute their erection supervisor and commissioning engineer positively within one week of telephonic intimation from MPPTCL.

Schedule-I
DESCRIPTION OF EQUIPMENT FOR SCHEDULE OF RATES AND
PRICES TO BE FURNISHED IN THE BIDDING FORM OF
SECTION-IV, VOL.I

S. No	Particulars of Item	Qty.
Supply of DG set & panel		
1	200 KVA Capacity Diesel Generating set consisting of Diesel Engine, alternator, base plate, suitable fuel tank of 350 ltrs capacity, in built standard engine mounted instrument panel, batteries with stand in CPCB approved acoustic enclosure and AMF control panel (Single contactor sensing amf as per the detailed technical specifications enclosed in the technical bid including all the (accessories as per Clause No.1) with changeover arrangement of the technical specifications enclosed in the technical bid	As per price schedule

NOTE:

1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.
2. The quantity of above equipments has been mentioned in Volume VI

(Signature of the Tenderer)

Name

Designation

Seal of the company

SCHEDULE - II
GUARANTEED TECHNICAL PARTICULARS FOR
200KVA DG SET

S.No.	Particulars	
1.0	DIESEL ENGINE AND AUXILIARIES : (DESIGN FEATURES)	
1.1	Name of manufacturer	
1.2	Rating standard BHP	
1.3	Engine rating at site	
1.4	Maximum engine rating at site	
1.5	Derating factors	
a)	Altitude	
b)	Inlet air temperature	
c)	Humidity	
d)	Others	
1.6	Period of maximum engine rating	
1.7	Operating speed	
1.8	No. of strokes per cycle	
1.9	No. of cylinders	
1.10	Arrangement of cylinders	
1.11	Rotation direction (Viewed from alternator end)	
1.12	Compression ratio	
1.13	Super charging air pressure at rated speed	
1.14	Firing order (Viewed from power take-off end)	
1.17	Fuel system injector pressure	
1.18	Fuel system booster pump pressure	
1.19	Lubricating oil temperature at pump in engine sump	
1.20	Lubricating oil pressure at pump discharge	
1.21	Minimum level of Lubricating oil	
1.22	Fuel oil system	
1.22.1	Type	
1.22.2	Filters :	

S.No.	Particulars	
a)	Type	
b)	Number	
c)	Location	
1.22.3	Day tank :	
a)	Capacity	
b)	Material	
c)	Location	
1.22.4	Grade of fuel oil to be used	
1.23	Lubricating oil system	
1.23.1	Type	
1.23.2	Filters :	
a)	Type	
b)	Number	
c)	Location	
1.23.3	Lubricating oil tank (sump) :	
a)	Capacity	
b)	Material	
c)	Location	
1.23.4	Grade of Lubricating oil to be used	
1.23.5	Lubricating oil pump :	
a)	Type	
b)	Capacity	
1.23.6	Lubricating oil cooler :	
a)	Type & heat transfer area	
b)	Oil inlet and outlet temperature	
1.24	Jacket water system :	
1.24.1	Type	
1.24.2	Quality of water to be used	
1.24.3	Quantity of water (Mtr.cu./hr.)	
a)	Engine cooling circuit	
b)	Lubricating oil cooler	
c)	Turbo charged cooler	
1.24.4	Make up tank :	

S.No.	Particulars	
a)	Capacity	
b)	Material	
c)	Location	
1.25	Air intake system :	
a)	Intake filter type	
b)	Location	
1.25.1	Total air quantity required :	
a)	For engine	
b)	For cooler	
c)	For charging	
1.26	Exhaust gas system :	
1.26.1	Manifolds :	
a)	Location	
b)	Size	
c)	Construction	
d)	Material	
1.26.2	Exhaust silencer :	
a)	Type	
b)	Location	
c)	Quality of exhaust gas	
1.27	Minimum loading of D.G. sets up to which it can be operated economically	
1.28	Period between major overhauling	
1.29	Starting time of D.G. sets	
1.30	List of all auxiliaries with ratings	
1.31	List of spare parts for 2 years maintenance period	
2.0	GENERATOR AND ACCESSORIES :	
2.1	Name of the manufacturer	
2.2	Design rating	
2.3	Continuous output rating at site conditions	
2.4	Maximum rating	
2.5	Power factor	
2.6	Rated voltage and time taken to reach full voltage	

S.No.	Particulars	
2.7	Rated current per phase	
2.8	Speed	
2.9	Frequency	
2.10	Insulation class :	
a)	Stator	
b)	Rotor	
c)	Exciter	
2.11	Temperature rise above ambient (by thermometer)	
a)	Stator	
b)	Rotor	
c)	Core	
2.12	Generator parameters :	
a)	Synchronous reactance	
b)	Transient reactance	
c)	Sub-transient reactance	
d)	Zero sequence reactance	
e)	Negative sequence reactance	
f)	Open circuit field time constant	
g)	Short circuit ratio	
h)	Resistance of field winding at operating temperature	
i)	Resistance of stator winding at operating temperature	
j)	Maximum circuit current	
k)	Duration for which D.G. set can withstand above	
2.12	Efficiency :	
a)	½ load	
b)	¾ load	
c)	Full load	
3.0	Performance Guarantee :	
3.1	Net electrical output at site after engine derating factors and auxiliary power requirements have been taken into account	
3.2	Fuel oil consumption (actual) :	
a)	½ load	

S.No.	Particulars	
b)	¾ load	
c)	Full load	
3.3	Lubricating oil consumption at rated load (actual) per engine hour operation	
3.4	Jacket water temperature `IN' to engine.	
3.5	Jacket water temperature `OUT' from engine.	
3.6	Lubricating oil temperature `IN' to engine.	
3.7	Lubricating oil temperature `OUT' from engine.	
3.8	Vibration and noise at rated output.	
3.9	Generator efficiency :	
a)	½ load	
b)	¾ load	
c)	Full load	
3.10	AMF compatibility	
3.11	Generation cost per unit	
3.12	Engine life in hours	
4.0	WEIGHT SCHEDULE :	
4.1	Weight of engine with fly wheel including standard accessories	
4.2	Weight of generator with exciter	
4.3	Weight of common base frame	
4.4	Heaviest single piece to be handled during erection and maintenance and its weight	
5.0	DIMENSIONS :	
5.1	After engine and generator are assembled	
5.2	Maximum dimensions of the single item to be transported	

(Signature of the Tenderer)

Name

Designation

Seal of the company

SCHEDULE -III

TECHNICAL QUESTIONNAIRE

ALL POINTS MENTIONED BELOW SHOULD BE REPLIED IN THESE SHEETS ONLY WITHOUT MAKING ANY REFERENCE TO ANY CLAUSE IN THE BID. IF REPLIES ARE INCOMPLETE OR REPLY TO ANY CLAUSE IS NOT FURNISHED, BID MAY BE TREATED AS INCOMPLETE AND NON RESPONSIVE FROM TECHNICAL ANGLE.

S No.	Particulars	Tenderer's Confirmation
1	Name of manufacturer and country of Origin	
2	Address of manufacturing works	
3	What is the type and designation of DG set offered	
4	Please confirm that for DG set offered necessary galvanized mounting structures complete with foundation bolts have been included in the offered price	
5	Please refer clause no. 1.4.1.1 & 1.4.6.1 of Section II & confirm that offered DG set shall comply with the standards specified	
6	Please refer clause 1.9 of Section II & confirm that type test certificates of all relevant test of offered DG set furnished with the Tender	
7	Please confirm that offered DG set shall work satisfactorily under climatic conditions as per clause 1.1.1	
8	Our important technical requirements have been detailed out in clause no. 1.3 of Section II of technical specification which may be noted carefully. Please confirm that various technical requirements should be met with. In case of deviation same has been clearly brought out in schedule VI of technical deviation please confirm	
9	Please refer clause 1.3.4 of Section II & confirm that noise level and emission parameters shall be as per latest notification of MOEF.	
10	Please confirm that Design of Diesel Engine shall be as per clause 1.4.1.	
11	Please confirm that the filter shall be dry type air filter as per clause 1.4.2.2.	
12	Please confirm that closed loop lubricant system is offered as per clause 1.4.3	
13	Please confirm that automatic electric starting is offered as per clause 1.4.4	
14	Please refer clause 1.4.5 of Section II & specify the type of fuel injection and regulator	

S No.	Particulars	Tenderer's Confirmation
15	Please confirm that Design of alternator shall be as per clause 1.4.6	
16	Please confirm that the Design of terminal box is in line with clause no. 1.4.6.8	
17	Please specify the type of coupling offered.	
18	Please specifically confirm that all required details as called under various clauses of specification have been furnished or not	
19	Please confirm that detailed drawing for offered DG set and also detailed write-up regarding constructional details of equipments have been furnished	
20	Please confirm that the mounting arrangement shall be as per clause no.1.4.7	
21	Please confirm that the peripherals to be provided are in line with clause 1.4.9.	
22	Please confirm that the control and instrumentation provided with the DG set shall comply clause 1.5. In case of deviation same has been clearly brought out in schedule VI of technical deviation please confirm?	
23	Please confirm that the DG set enclosures to be provided are in line with clause 1.6.	
24	Please confirm that a condensed engraved type electrical wiring diagram & schematic diagram drawing shall be fixed on the rear door of control cubicle from inside	
25	Please confirm that copy of bill of material including all accessories & fittings is submitted with the offer	
26	Please confirm that you have furnished copy of orders recently executed/under execution	
27	Please indicate Quantity of DG set of 200KVA or higher rating of DG sets manufactured and supplied during the last three year and current financial year	
	Financial Year 2009-2010	
	Financial Year 2010-2011	
	Financial Year 2011-2012	
	During Current Financial Year	

(Signature of the Tenderer)

Name

Designation

Seal of the company

SECTION-II

TECHNICAL SPECIFICATION FOR 500 AMP. PRIMARY INJECTION KIT

GENERAL

The instrument should check all parts of protection system by injecting current drawn by system the cable/busbars. The instrument should ascertain the current carrying capacity of any conductor, connector or calibration of CTs/bimetallic relays.

TECHNICAL REQUIREMENT

1. The instrument should be built in Digital ammeters for display of test current of accuracy better than 1%
2. The instrument should be able to measure time interval from 0.0001 Sec to 999 Sec.
3. The supply voltage should be 230 V AC, 50Hz.
4. The output voltage should be 0-20V at 500A
5. The output current ranges should be 0 to 500A
6. The instrument should be natural air cooled type
7. The instrument should have minimum 20 min. duty cycle higher duty cycle kits shall also be acceptable
8. Supplier must have adequate "after sales service" facility in India.
9. The Kit shall be supplied alongwith all accessories including oil and copper cable set (2x15 meter length), clamps & connectors, spare fuses, indication lamp, power supply cable etc. all that required for carrying measurement for one unit.
10. The copper cable shall be of adequate size to deliver the rated current of 600 Amp. for minimum 20 minutes.

SCHEDULE-I

DETAILS OF EQUIPMENTS & QUANTITY FOR PRIMARY INJECTION KIT

Tenderers may please note that the prices are to be offered exactly as per the format given below. Description of equipment/material and quantity indicated here under should exactly be used for the purpose of offering the prices.

S.No.	Particulars of equipment/ Item	Qty.
1	500 Amp. Primary Injection Kit complete with copper cable and all accessories as described in the specification complying to all technical requirement mentioned in the tender specification	As per Price Schedule

SECTION II(E)

TECHNICAL SPECIFICATION OF LEVEL METER AND LEVEL OSCILLATOR

The equipment should be suitable for measurements in H.F. range and shall be utilized for selective and wide band measurement including impedance and return loss measuring attachment. The equipment shall be hand held battery operated, multifunction measuring instrument, intended for the test of Carrier Frequency Systems up to 600 channel capacity, Power Line Carrier, Audio Tone, and FSK Communications Systems. The equipment should be compatible with level generator. The major requirements of the equipment shall have following -:

- a. **100Hz to 2400 kHz Level Generator** - For the generation of measuring voltage for the test of FDM transmission systems up to 600 channels
- b. **100Hz to 2400 kHz Level Meter** - For selective and wideband level measurements with auto ranging.

The combined unit of Selective Level Meter and Level oscillator should have following features:

1. Level Meter & Level Oscillator in one instrument.
2. Storage facility for 100 sets of testing.
3. Rechargeable battery for 8 Hrs.
4. Transmitter
5. Selective Receiver
6. Transmitter & Receiver
7. Wideband Receiver
8. Balance (LCL) Measurement
9. Return Loss Measurement
10. Impedance Measurement
11. Wideband Noise Measurement
12. Spectrum Analyzer
13. Impulse Noise Measurement
14. Next/Loss Measurement
15. Interruption Measurement
16. Spectrogram
17. Group delay distortion Measurement
18. Phase Jitter & Frequency Measurement
19. Digital Level Display with 0.1 dB resolution
20. AFC for 10 Hz bandwidth
21. PC data transfer etc.

Each Level Meter and Level Oscillator shall consist of following :

- a. Level Meter and Level Oscillator
- b. 2 Nos. Balanced Measuring Cables
- c. 2 Nos. Coaxial Measuring Cables
- d. 1 No.USB cable
- e. 1 No. USB stick
- f. 1 No. Mains adapter
- g. Carrying case
- h. Operating Manual
- i. Calibration Certificate
- j. Software CDs

4.0 TRAINING: Subsequent to delivery of Level Meter and Level Oscillator, demonstration & Training for 1 to 2 days period to a batch of our engineers shall be provided by the supplier on “free of cost” basis for each Equipment supplied by the supplier. The training shall cover operation, evaluation/analysis of test results and general trouble shooting about the equipment.

5.0 Any other item or accessories, which are essentially required for satisfactory operation of equipment & for meeting requirements of this specification shall be deemed to be within scope of the Tenderer irrespective of whether these are specifically indicated here or not.

ANNEXURE I

TECHNICAL REQUIREMENTS OF SELECTIVE LEVEL METER
AND OSCILLATOR

Particulars	Technical Requirements
Transmitter	
Frequency Range	100 Hz to 2400 kHz in 1 Hz steps
Frequency Accuracy	$2 \times 10^6 \pm 1$ Hz
Balanced Outputs	
10 to 2400 kHz	0, 75, 135 (125), 150 Ω
100 Hz to 10 kHz	0, 600 Ω
Level Range of Balanced Output	
For all impedances	+10 to -40 dBm, dB
Level Range of Coaxial Output	
0-75 Ω	+10 to -40 dBm, dB
75, 135(125), 150 Ω	+10 to -40 dBm
600 Ω	+4 to -40 dBm
Level Resolution	0.1 dB
Level Accuracy at 0 dBm Freq.>200Hz	$\pm 0,3$ dB
Selective receiver	
Frequency Range	100 Hz to 2400 kHz
Frequency Accuracy	$2 \times 10^6 \pm 1$ Hz
Direct Frequency Setting	in 1 Hz steps
Frequency Setting in Carrier \pm Tone Format	
Carrier Frequency	4 to 2396 kHz in 1 kHz steps
Tone Frequency	100 Hz to 3,9 kHz in 1 Hz steps
Band width	
200 Hz to 10 kHz.	.20 Hz
10 to 2400 kHz	20, 200 Hz, 1.74, 1.95, 3.1 kHz
Balanced Inputs	
10 to 2400 kHz	75, 135 (125), 150 Ω or high
100 Hz to 10 kHz	600 Ω or high
Measuring Range	
With 20 Hz band width	120 to +10 dB
Level Resolution	0.1 dB
Level Accuracy at 0 dBm, Freq.>200Hz	$\pm 0,3$ dB
Wideband Receiver	
Balanced Inputs	
10 to 2400 kHz	75, 135 (125), 150 Ω or high
100 Hz to 10 kHz	600 Ω or high
Selectable 3 dB Band Filters Measuring Ranges	
100 Hz to 4kHz	-100 to +10 dB
1200 Hz to 120 kHz	-90 to +10 dB
3 kHz to 300 kHz.	-90 to +10 dB
6 kHz to 600 kHz	-80 to +10 dB
12 kHz to 1200 kHz	-70 to +10 dB
24 kHz to 2400 kHz.	-70 to +10 dB
Level Resolution	0.1 dB
Level Accuracy at 0 dBm, Freq.>200Hz	$\pm 0,3$ dB
Power supply	Internal rechargeable NIMH battery pack
Operation time	approx. 8 hours

Particulars	Technical Requirements
Charging	From 230V mains From 12V car battery Fast charging time less than 3 hours
Display	320 x 240 LCD with backlight
Over voltage protection	Between a and b or ground - 200V DC
Ambient temperature ranges	23±5°C
Rel. humidity	45% to 75%

SCHEDULE - I**DETAILS OF EQUIPMENTS & QUANTITY FOR SELECTIVE LEVEL METER
AND LEVEL OSCILLATOR**

NOTE : The prices against the specification should be Offered exactly as mentioned in the following table.

S.No.	Particulars of equipment/ Item	Qty.
1	Selective Level Meter and Level Oscillator, Operating instruction manual in hard and soft copy, Test Certificate complete with all accessories as stipulated in the tender specification	As per Price Schedule

SECTION II (A)

TECHNICAL SPECIFICATION FOR 5 KV INSULATION RESISTANCE TESTERS

1.0 **SCOPE:** This specification covers the manufacture, testing and supply of 5 KV Digital Insulation Testers. The offers shall include all accessories even though not specifically mentioned in this specification, but which are essential for satisfactory operation of the equipment offered as a whole.

2.0 **MATERIAL AND WORKMANSHIP:** All the materials used for the manufacture of the equipment shall be of the best quality and the design and workmanship shall be of the highest order, so as to ensure satisfactory operation at full capacity over its full life.

3.0 **5 KV DIGITAL INSULATION TESTERS :** The Insulation Testers shall be compact, light weight, 3 digit digital insulation tester. The 5 KV digital insulation tester shall be compact, light weight, 3 digit digital insulation tester. The Insulation Tester shall be supplied with suitable software to allow for further analysis of tests results, including features such as graphical representation and automatic report generation. The Insulation Tester shall provide safe, reliable and accurate measurements of insulation resistances up to 10 T Ω , with selectable test voltages, 250 V - 5 kV in steps of 50V.

The operation of Insulation Tester shall be microprocessor controlled and it shall have features such as auto-range selection, memory for 1000 readings, AC/DC voltmeter, automatic measurement of Insulation Resistance, Dielectric Absorption Index, Polarization Index, Dielectric discharge test, Breakdown Voltage Test, Step voltage test, leakage current and capacitance measurement. Timer enabling programming of test duration, & real time clock shall be provided. Built-in chronometer, indicating remaining time in minutes and seconds, since the test started, up to 99 minutes.

It shall be possible to transmit Measured values through the isolated serial output (RS-232). Storage of about 1000 measured values in a non-volatile internal memory which can be transferred to a PC and the supplied software by Insulation Tester shall allow further analysis of the test results, including a graphical representation & automatic report generation. The real time clock, and the sequential test number, shall facilitate the identification of each test, and the organization of a predictive maintenance system by trend analysis.

The Insulation Tester shall be powered using a rechargeable battery and supplied with an automatic inbuilt charger operating on 240 V +/- 10% , 50Hz mains supply. The battery backup shall not be less than 5Hours of typical use with fully charged battery. The cabinet of Insulation Tester shall be IP 65 rated, strong, lightweight, easy to carry, impact-resistant and suitable to be used under severe weather conditions.

The instrument must be IEC 61010-1 to 600V phase to earth, Category IV and IP54 Protected.

3.1 FEATURES:

- Microprocessor-controlled
- Insulation resistances up to 10 T Ω
- Auto-range
- Digital & bar-graph reading

- Tests Regimes:
 - Absorption index
 - Polarization index
 - Dielectric Discharge
 - Step Voltage Test
 - Breakdown Voltage Test
 - Capacitance
 - Leakage current
 - AC/DC voltmeter
- Chronometer up to 99 minutes
- Real time clock
- 1000 readings memory
- Isolated RS-232 data port
- Software for data management
- Rechargeable battery Selectable
- Selectable test voltage of 250 & 5000 V DC in steps of 50V.
- The Insulation Tester should have self calibration checkup at every startup.
- The Insulation Tester shall be equipped with High Voltage terminal, Measurement & Guard terminal. These terminals shall be suitably marked for easy identification.
- The Insulation Tester shall be equipped with audio & visual indication for the test ON condition.
- The Insulation Tester shall discharge the test object after every test.
- The Insulation Tester should have three programmable timers for conducting diagnostic tests.

3.2 Accessories to be supplied with each 5 KV Insulation Tester:

- a. 2 x Measuring test leads (IEC 61010-031)
- b. 1x GUARD test lead
- c. Charger power cord
- d. Software CD
- e. RS-232 cable
- f. Protective bag
- g. Operating instructions
- h. software
- i. Test & calibration sheet.
- j. Fuses

4.0 The Insulation Testers shall be suitable for insulation measurements during installation, servicing and maintenance work in charged substations. The instrument shall be suitable for testing Transformers, Switch Gears, relays, switches and contactors.

5.0 Technical Particulars:

No.	Particulars	Requirement of 5 KV Insulation Tester
1	Resistance	Max 10 TΩ @ 5 kV ± 5 % of reading up to 1 TΩ @ 5 kV ± 20 % of reading up to 10 TΩ @ 5 kV
2	Out put Voltages	Selectable test voltage of 250 & 5000 V DC in steps of 50V.
3	Current	3mA
4	Input Power	230V AC±10%, 50Hz±10%
5	Response Time	< 15 seconds

No.	Particulars	Requirement of 5 KV Insulation Tester
6	Display Display Update Over Range Indication	3 digit LCD, 1000 counts Current battery status 2.5 readings/sec ">" is displayed in most significant digit
7	Environment	(a) Operating Temperature Range : 0 °C to 50 °C (b) Storage Temperature Range -10 °C to 60 °C (c) Humidity Range 95% RH (non condensing) (d) Environmental Protection: IP 65 (with closed lid) (e) Safety Class Meets the requirements of IEC 61010-1 (f) E.M.C: In accordance with IEC 61326-1 (g) Type tested as per IS 11994 (h) CE marking
8	Physical	5 kg(Approx)

7.0 TRAINING: Subsequent to delivery of 5KV Insulation Testers, demonstration & Training for 1 to 2 days period to a batch of our engineers shall be provided by the supplier on "free of cost" basis for each Equipment supplied by the supplier. The training shall cover operation, evaluation/analysis of test results and general trouble shooting about the equipment.

8.0 SCOPE OF SUPPLY : Each 5KV Insulation Testers shall consist of following

- 5KV Insulation Tester in rugged case
- Accessories - Kit should be supplied with IEC 61010-031 complied 10 meter long testing leads. With maximum jaw opening span of 40mm, software CD, RS232 Cable,
- Operating instruction & Test Certificate

9.0 Any other item or accessories, which are essentially required for satisfactory operation of equipment & for meeting requirements of this specification shall be deemed to be within scope of the Tenderer irrespective of whether these are specifically indicated here or not.

ANNEXURE I

TECHNICAL REQUIREMENT OF 5 KV INSULATION TESTER

No.	Particulars	Requirement of 5 KV Insulation Tester
1	Resistance	Max 10 TΩ @ 5 kV ± 5 % of reading up to 1 TΩ @ 5 kV ± 20 % of reading up to 10 TΩ (for lower test voltages, the upper limit will be reduced proportionally)
2	Output Voltages	250V to 5000V in steps of 50V
3	Current	3mA
4	Input Power	230V AC±10%, 50Hz±10%

No.	Particulars	Requirement of 5 KV Insulation Tester
5	Response Time	< 15 Seconds
6	Display Display Update Over Range Indication	3 digit LCD, 1000 counts Current battery status 2.5 readings/sec “>” is displayed in most significant digit
7	Environment	(a) Operating Temperature Range : 0 °C to 50 °C (b) Storage Temperature Range -10 °C to 60 °C (c) Humidity Range 95% RH (non condensing) (d) Environmental Protection: IP 65 (with closed lid) (e) Safety Class Meets the requirements of IEC 61010-1 (f) E.M.C: In accordance with IEC 61326-1 (g) Type tested as per IS 11994 (h) CE marking
8	Physical	5 kg (Approx)

SCHEDULE-I**DETAILS OF EQUIPMENTS & QUANTITY FOR
5 KV INSULATION TESTER**

NOTE : The prices against the specification should be Offered exactly as mentioned in the following table.

S.No.	Particulars of equipment/ Item	Qty.
1	5 KV Insulation Tester complete with all accessories viz. 3 m lead set insulated clips , RS232 cable, USB cable , 3 x 3 m lead set insulated clips , Screened HV test leads 1 x 15 m, 5 kV screened un-insulated compact clips, spare lead set with clamp, Operating instruction; Test Certificate, User guide on CD-ROM , Rugged Case etc and meeting all technical requirements as stipulated in the tender specification TR-06/2011.	As per Price Schedule

SECTION II (F)

TECHNICAL SPECIFICATION FOR EARTH TESTER

1.0 The Earth Tester shall allow measurement of Earth Resistances (three pole) and Ground Resistivity by the Wenner's (four pole) method, It shall have a built-in voltmeter that shall enable measurement of spurious voltages of the soil, caused by surface leakage currents. The Earth Tester shall be suitable for measurements of earth resistances of lightning-conductors, substations yard etc. The internal generator of Earth Tester shall inject alternated current on the soil through an auxiliary rod. The voltage generated over the earth resistance shall be measured by the Tester. Results shall be shown in a digital display with up to 3 ½ digits resolution. The test current shall be automatically regulated. A sharp and intermittent audible signal shall be provided to indicate anomalies in the circuit if, for any reason, the current is lower than the value required to perform the measurement, the alarm circuit that produces the intermittent "beep", shall be activated.

2.0 BASIC FEATURES

The earth tester shall be of the four pole type for measuring earth electrode resistance and soil receptivity. It shall be of the battery operated digital type. Hand-crank type shall not be accepted.

The equipment shall be of rugged construction, suitable for field use and complete with 04 Nos. ground probes, necessary length of test leads, terminal shorting bars and robust carrying case. (Length of test leads shall be sufficient to carry out the tests according to BS 7430).

The equipment shall be powered by an Internal re-chargeable battery, charged by built in battery charging unit. The battery charging unit shall be suitable for operation on 230 V/ 50HZ AC supply.

3.0 TECHNICAL PARTICULARS:

- DIGITAL AND AUTOMATIC
- 3 ½ DIGITS DISPLAY
- GROUND RESISTIVITY (WENNER'S METHOD)
- SPURIOUS VOLTAGE MEASUREMENT
- HIGH SPURIOUS VOLTAGE REJECTION
- UP TO 20 K RESISTANCE RANGE
- RESISTANCE RANGE : 0 to 2 ohm
- RESOLUTION : 0.01
- ACCURACY : Earth resistance measuring : 2% of reading 1% of full scale
- POWER SUPPLY : Built-in rechargeable battery
- WEIGHT : Equipment: ≤ 2 kg
- BATTERY STATUS CHECK : Push-button to measure the batteries charge status.
- TEMPERATURE : Working / Storage 0 to + 50°C
- HUMIDITY : Up to 95% RH, non condensing

4.0 ACCESSORIES TO BE SUPPLIED WITH EARTH TESTER

- I. steel rods, copper, 45cm long.

- II. 4 rod extractors and wind-up handle.
- III. Battery charger.
- IV. Complete test leads set, containing 4 test cables
- V. User's manual and CD.

5.0 TRAINING: Subsequent to delivery of DCRM Set, demonstration & Training for 1 to 2 days period to a batch of our engineers shall be provided by the supplier on "free of cost" basis for each Equipment supplied by the supplier. The training shall cover operation, evaluation/analysis of test results and general trouble shooting about the equipment.

6.0 Any other item or accessories ,which are essentially required for satisfactory operation of equipment & for meeting requirements of this specification shall be deemed to be within scope of the tenderer irrespective of whether these are specifically indicated here or not.

SCHEDULE-I**DETAILS OF EQUIPMENTS & QUANTITY FOR EARTH TESTER**

NOTE : The prices against the specification should be Offered exactly as mentioned in the following table.

S.No.	Particulars of equipment/ Item	Qty.
1	Four Pole Digital Earth Tester to measure the soil resistivities and earth electrode resistances and meeting all technical requirements	As per Price Schedule

TECHNICAL SPECIFICATION FOR MULTIMETER

1. The hand held Digital multimeter shall be suitable for measurement of RMS AC voltages & currents, DC voltages & current, capacitance, frequency, wattage, inductance, continuity. The four & half digit DMM shall be suitable for operating temp of 0 to 40 degree C.

2. The auto ranging DMM shall have following resolution

AC Current	100 mA/1mA
DC voltage	10 micro volt/100 milli volt
AC voltage	10 micro volt/100 milli volt
Resistance	0.01 Ohm / 1 K Ohm
Time	1 sec / 9999 min
Frequency	1 Hz / 1 Khz
Capacitance	20 nF/200 Micro Farad
Wattage	0.1W/1W
Inductance	200 mH

3. The DMM shall have built in features such as safety shutter, high energy fuse, over load alert, and shall have 3 year warranty. The DMM shall be supplied with standard accessories such as pair of test leads, operating & calibration manual, spare fuse.

4. The equipment offered shall be of reputed make.

SCHEDULE-I**DETAILS OF EQUIPMENTS & QUANTITY FOR MULTIMETER**

NOTE : The prices against the specification should be Offered exactly as mentioned in the following table.

S.No.	Particulars of equipment/ Item	Qty.
1	hand held Digital multimeter	As per Price Schedule

Technical Specification of DC Earth Fault Locator

The instrument should be compact ,light weight and easy to use.The instrument should be able to carry out the test in online condition ,i.e. no isolation /shut down of battery system required .It should be able to detect ,track and locate grounding faults developed in floating DC system thereby increasing the reliability of system.

Technical Requirements.

- 1.The instrument should be in two part viz.signal generator and signal receiver.
- 2.The signal generator should have selectable output voltage ranges of 12 to 50 Volts with a selectable low frequency range to avoid interference of the system and carry out test accuracy.
- 3.The instrument should be able to detect the high resistance fault upto 400 Kilo ohms and the corresponding measurement range should be 1 ohm to 400 Kilo ohm.
- 4.The Receiver unit should provide audible alarm.
5. The instrument should have adjustable output frequency on signal receiver to avoid interference from DC system itself.
- 6.The signal receiver should have adjustable sensitivity allowing the user to locate the earth leakage quickly in different location of circuit.

SCHEDULE-I**DETAILS OF EQUIPMENTS & QUANTITY FOR MULTIMETER**

NOTE : The prices against the specification should be Offered exactly as mentioned in the following table.

S.No.	Particulars of equipment/ Item	Qty.
1	DC Earth Fault Locator with all accessories	As per Price Schedule

SECTION-II

2.11P.T. Distribution Box

Scope : In normal practice PT secondary terminals are wired directly to the control and relay panel and these wires are looped in all adjacent panels .To avoid such practice contractor should supply two nos 64 bays (32 terminals) ,one for Metering core and other for Protection core, Junction box with proper looping arrangement so that wiring of PT secondary terminal in each panel shall be done through these boxes. These P.T. Distribution Board shall be erected in yard just outside of control room at suitable place in consultation with Project Manager. PT distribution boxes should be erected at suitable height with angle size of 65x65x8 mm . No extra charge shall be payable for the arrangements of grouting and providing angles.

- 1.1. The technical specification of PT Distribution box shall be same as 64bay (32 Terminal block) as mentioned 2.3.3 (B) "Technical specification for Junction Boxes".

SCHEDULE – I (A)

**DESCRIPTION OF MATERIAL FOR SCHEDULE OF RATES AND PRICES TO BE
FURNISHED IN VOLUME – VI**

S.No.	Particulars	Qty
1.	P.T. Distribution Box	As per Price Schedule

Note :

1. The above description of material is given for the purpose of offering the prices and to mention description of material in Invoice for claiming payment.
2. The quantity of above material has been mentioned in Volume VI.

SECTION-II

2.12 ICTP (AC Distribution Board for Yard)

Scope : For A.C Distribution for various equipments situated at yard A.C. Distribution Board are to be supplied by Contractor .This Board should be suitable for outdoor installation .This Board should have one no 32 Amp s three phase AC MCCB with neutral , Two nos 10 Amps Three phase MCCB with neutral and two nos 10 AMP single phase MCCB .Bottom of this box should have arrangement to accommodate one no eight core 2.5 sq.mm control canle and four nos 4 core 2.5 Sq.mm control cable.For connection of these control cable necessary cable Gland with terminal bloks are to be provided.

- 1.1 It is not the intent to supply all details of design and construction of 32 Amps A.C.Distribution Box .However 32 Amps AC distribution Box shall conform in all respect to the high standard of engineering ,Design and Workmanship.
- 1.2 32 Amps Ac Distribution board shall be complete with all component necessary for their effective and trouble free operation.
- 1.3 . All above accessories should be mounted in a metal sheet box. Thickness of sheet metal should not be less than 2.5 mm.Installtion of box should be water proof.
1. 4 . These Ac Distribution Boards are to be mounted on angles of size 65x65x8 . No extra charge shall be payable for the arrangements of grouting and providing angles .

SCHEDULE – I (A)

**DESCRIPTION OF MATERIAL FOR SCHEDULE OF RATES AND PRICES TO BE
FURNISHED IN VOLUME – VI**

S.No.	Particulars	Qty
1.	ICTP (AC Distribution Board for Yard)	As per Price Schedule

Note :

1. The above description of material is given for the purpose of offering the prices and to mention description of material in Invoice for claiming payment.
2. The quantity of above material has been mentioned in Volume VI.

2.13 TECHNICAL SPECIFICATIONS OF GLOBAL POSITIONING SYSTEM BASED TIME SYNCHRONIZATION EQUIPMENT (GPS-TSE)

INTRODUCTION:

The Global Positioning System (GPS) is constellation of 24 satellites and ground control by system operated by United States of America. It provides precision position and time with worldwide accessibility. Satellite coverage is sufficient to provide continuous time data with sub-microseconds absolute accuracy.

In power utilities with the geographically dispersed network of sub-station and transmission line, it is essential that all events from the generation to the end-user are recorded with respect to a common clock datum, to facilitate the fault analysis. Since most of the events occur as transients of few milliseconds duration, the clock signals will have to be very precise, with order of higher accuracy. The time-tagged event is then sent to a remote computer, which analyzes the cause of the fault. The higher the accuracy of the time data, the easier it is to reconstruct the fault by cross comparing data from all pieces of equipment and thus detecting the fault. With this process, the GPS based time synchronization will help the utilities to gradually reduce the fault frequency in substations. In addition, GPS based clocks are required to synchronize the embedded clocks in the revenue metering systems, to estimate the technical losses in the network, by taking snapshots of energy values at different intervals of time.

SCOPE:

MPPTCL proposes to install GPS based Time Synchronization Equipment (GPS-TSE) in 400 KV, 220 KV. The scope covers design, engineering, quality surveillance, manufacture, testing at works, packing and delivery to site of for time synchronizing various equipments like Event Loggers, Disturbance Recorders, Numerical Relays, SCADA System, Electronic tri-vector meter, Distributed Control System and Distribution Automation System.

CLIMATIC CONDITIONS:

The GPS-TSE shall be guaranteed to operate satisfactorily for Indian tropical climates conditions at site as given here under:

No.	Particulars	Conditions.
1	Location	Indoor
2	Maximum ambient air temp.	50° Centigrade
3	Minimum ambient air temp.	1° Centigrade
4	Average daily ambient air temp.	35° Centigrade
5	Maximum Relative humidity	95% (sometime approaches saturation)
6	Maximum altitude above mean sea level	1000 (Meters)
7	Average Annual rainfall	1250 (mm)
8	Maximum wind pressure	150 Kg/m ²
9	Isoceraunic level	90 days per year
10	Seismic level (Horizontal acceleration)	0.3

Moderately hot and humid tropical climate, conducive to rust and fungus growth. The climate condition is also prone to wide variation in ambient conditions. Smoke is also present in the atmosphere. Heavy lightning also occurs between June and August.

In general, equipments in power utilities accept the following formatted signals.

- (a) Inter Range Instrumentation Group (IRIG) B and E modes.
- (b) RS-232 & RS-485 output in ASCII as per NENA standard & Extended ASCII format in Broadcast mode.
- (c) Pulse outputs at desired time intervals ranging from 1 minute to 1 day.

In most of the substations of MPPTCL, the equipments accept IGIG-B input and hence the basis GPS-TSE model should generate IRIG-B and RS-232/RS-485 outputs only. However, for substations requiring other inputs, the GPS-TSE shall provide all other outputs as optional modules. Most of the substations have PC based energy management system, interfaced to energy meters and SCADA systems. It is essential that these PCs are also synchronized using the RS-232/RS-485 output of GPS-TSE, so that all recordings are time stamped accurately for data analysis.

It is not the intent of this specification to specify completely herein all the details and construction of GPS-TSE. However, the GPS-TSE shall conform to the latest standards of engineering, design and workmanship in all respects and be capable of performing in commercial operation up stipulated guarantee period, to complete satisfaction of purchaser.

SCOPE OF SUPPLY:

The GPS-TSE shall be supplied in total, having the following sub systems:

- (a) GPS-TSE Antenna
- (b) GPS Receiver unit
- (c) Time Code Generator Unit
- (d) Distant View Display Unit
- (e) Software to Synchronize Computers.
- (f) RS-232 to USB Converter for connecting to computer.

Fully wired module accommodating subsystems (b) & (c) shall be preferable. The scope of supply includes required coaxial & twisted pair cables & their termination and miscellaneous accessories required for completing work of Erection, Testing and Commissioning of GPS based TSE. All such accessories, which are required for erection of TSE and for synchronization of desktop computers (available in Substations) through TSE, are deemed to be included in offered prices. The GPS based TSE complete with its subsystems shall be supplied to three transmission stores located at Jabalpur, Indore and Itarsi. From these stores, TSE with all its subsystems shall be transported by the MPPTCL offices to designated substation sites located in MP.

SCOPE OF ERECTIONS, TESTING & COMMISSIONING:

The successful Tenderer shall have to provide services for complete Erection, Testing and Commissioning of TSE at designated substation locations. The work shall include laying of coaxial & twisted pair cables including their terminations at substations and synchronization of desktop computers (available in Substations) through TSE. Local transportation facility for going to Substation site shall be provided by concerned Testing Officials of MPPTCL.

GPS-TSE ANTENNA:

The Antenna shall be an active antenna to provide the timing signals even under weak signal conditions. In addition, antenna shall be waterproof to operate satisfactorily in an open environment under all weather conditions. The basic specification of this Antenna are:

Environmental Specifications:

- a. Operating Temp. - 40° C to + 85° C
- b. Storage Temp. - 40° C to + 100° C
- c. Humidity MIL STD-810E
- d. Waterproof Submersion to 1 meter
- e. Vibration 10-200 Hz Log Sweep, 3g(sweep time 30 min) 3 axes
- f. Shock 50g vertical, 30g all axes
- g. Corrosion 5% Salt spray

Technical Specifications:

- a. Power consumption - 30mA Maximum at 5Vdc, 3 watts
- b. Output Impedance - 50 Ohms
- c. Frequency L1 band (1575 MHz)
- d. Gain minimum 30 dB
- e. Azimuth Coverage Omni Directional – 360°
- f. Elevation Coverage Hemispherical (0 to 90°)
- g. Noise 3.3 dB maximum (25° to +/- 5°)

PHYSICAL CHARACTERISTICS:

All mounting poles, fixtures and cables required to commission the antenna on rooftop or at any other location, as specified by the purchaser, shall be supplied by the supplier:

- a. Antenna Weight Low weight complete with supporting arrangements
- b. Mounting pole height Minimum of 1 meter
- c. Dimension of antenna Suitable for mounting in Verandah or rooftop.

CABLE SPECIFICATION:

- a. Type RG-59
- b. Impedance 75 Ohms
- c. Shielding Foil and copper braid 100% coverage
- d. Connectors Waterproof F-type
- e. Single Attenuation Less than 10 dB for cable & Connectors.

POWER SUPPLY: The GPS-TSE shall operate at either of the following power supply levels:

- a. Minimum of 100 V to Maximum of 250 V AC as available from AC mains supply. OR
- b. Minimum of 100 KV to Maximum of 300 V DC, as available from Substation batteries.

No separate power supply will be provided in case GPS receiver is located outside Time Code Generator. The power requirements will have to be met from the Time Code Generator, through the cables by the supplier.

SYNCHORNIZATION SOFTWARE: The software supplied with the GPS-TSE should be capable of synchronizing the computer / Server located within the substation, through USB port. For this purpose a RS 232 to USB converter shall be supplied with each GPS based TSE. The software shall be compatible with Windows based computer systems. The necessary converter shall be supplied by the tenderer.

DRAWING AND LITRATURE: The supplier shall provide a copy of the drawings indicating general arrangement of the system equipments, technical literature, user manual, wiring drawings, dimensions and mounting details, along with the offer. The dimensional drawings of all the assemblies and sub-assemblies, conforming to engineering standards.

TYPE TESTS:

Mechanical requirements: The GPS-TSE shall be tested for the following Type Tests for meeting Mechanical requirements.

(A) Bump Test

- (a) Number of bumps 1000 / axis
- (b) Acceleration 40g
- (c) Height of drop 25 mm
- (d) No. of axis 1
- (e) Rate 2 Bumps / Sec.

(B) Vibration Test : The GPS-TSE shall be subjected to vibration test as follows in un-energized and unpacked condition:

- (a) Range and Sweep frequency 10 -150-10 Hz
- (b) Cut off frequency 16.7 Hz
- (c) Acceleration 2.2 g
- (d) Sweep rate One octave per minute.

SCHEDULE-I (A)**DESCRIPTION OF EQUIPMENT FOR SCHEDULE FOR RATES & PRICES TO
BE FURNISHED IN VOLUME-VI**

S.No.	Particulars of equipment/ Item	Qty.
1	Global positioning system based time synchronization equipment (gps-TSE) With all accessories for time Synchronisation of Neumerical Relays and Computers	per Price sched

1. The above description of the equipment is given for the purpose of offering the prices and to mention description of equipment in invoice for claiming payment.
2. The quantity of above equipments has been mentioned in Volume VI