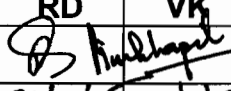




BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-368-510-016	Rev 00	Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	RD	VK	RS
TITLE 33KV POTENTIAL TRANSFORMER		SIGN			
		DATE	31/03/16	31/3/15	
		GROUP	TBEM	W.O. No	83012
CUSTOMER	MADHYA PRADESH POWER TRANSMISSION CO. LTD.				
CONSULTANT	-----				
PROJECT	400KV SUBSTATION PACKAGE AT BALAGHAT, BADNAWAR, BHOPAL, CHHEGAON AND NAGDA				

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2.	Equipment Specification	23
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4.	Guaranteed Technical Particulars (To be furnished at Contract Stage)	03
5.	Checklist (To be furnished at Tender Stage)	02

Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS			
Distribution			To Copies	TBTS	O/C	TBMM	TBQM	TBCM
				-	1	-	-	1

Project: 400kV Substation Package at
Balaghat, Badnawar, Bhopal,
Chhegaon and Nagda
Customer: Madhya Pradesh Power Transmission Co. Ltd.
Consultant: -----
Technical Specification: 33kV Potential Transformer

Bharat Heavy Electricals Limited
Document No. TB-368-510-016

SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & QUANTITIES

1.0 SCOPE

This specification covers requirements of design, engineering, manufacture, assembly, testing at works, inspection, packing and dispatch of 33kV Potential/Voltage Transformers along with its accessories as mentioned in this section and in various other sections of this specification.

Section-1: Scope, Specific Technical Requirements and Quantities
Section-2: Equipment Specification
Section-3: Project Details & General Technical Requirements
Section-4: Guaranteed Technical particulars (GTP)
Section-5: Checklist

In case of any conflict between various sections, **order of precedence** shall be in the same order as listed above.

Note: The term 'Owner' appearing in this specification shall refer to MPPTCL, the term 'Purchaser' shall refer to BHEL and the term 'Contractor' shall refer to the successful Bidder.

1.1 CUSTOMER / PROJECT DETAIL

Name of customer: Madhya Pradesh Power Transmission Co. Ltd. (MPPTCL)

Name of consultant: -----

Name of Projects: 400kV Substation Package at Balaghat, Badnawar, Bhopal, Chhegaon and Nagda

Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

a. As per Section-2.

b. Core Parameters :

Core No.	Ratio	Accuracy Class	Burden
1	$\frac{33/\sqrt{3} \text{ kV}}{110/\sqrt{3} \text{ V}}$	3P	100 VA
2	$\frac{33/\sqrt{3} \text{ kV}}{110/\sqrt{3} \text{ V}}$	0.2	100 VA

Project: 400kV Substation Package at
Balaghat, Badnawar, Bhopal,
Chhegaon and Nagda

Bharat Heavy Electricals Limited
Document No. TB-368-510-016

Customer: Madhya Pradesh Power Transmission Co. Ltd.

Consultant: ———

Technical Specification: 33kV Potential Transformer

(55)

1.3 BILL OF QUANTITY:

Item No.	Description	Quantity				
		Balaghat	Badnawar	Bhopal	Chhegaon	Total
01	33KV, Single Phase Potential Transformer	1 No.	60 No.	30 No.	30 No.	15 No.

Note :- The PT's shall be complete with Hardware (Nut, Bolts and Washers) for Mounting on structure – 1set for each PT.

1.4 TESTS

At contract stage, the reports for all type tests as per relevant IS/IEC and additional type tests as per technical specification shall be submitted for end customer (MPPTCL) approval. The test reports submitted shall be of the tests conducted within last **five years from 20.11.13**. In case the test reports are of the test conducted earlier than five years prior to **20.11.13**, the bidder shall repeat these test(s) at no extra cost to the BHEL.

In the event of any discrepancy in the test reports i.e. any test report not acceptable to customer due to any design / manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all additional type tests not carried out, same shall be carried out without any additional cost implication to BHEL.

1.5 DEVIATIONS :

The bidder shall list all the deviation from the specification separately. Offers without specific deviation will be deemed to be totally in compliance with the specification and NO DEVIATION on any account will be entertained at a later date.

SECTION-2

Vol.II Part-8/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~~ APPENDIX-1, SECTION-2.

3.0 CLIMATIC CONDITIONS :

Applicable climatic conditions shall be as per Section -3

4.0 SYSTEM PARTICULARS :

Applicable System Particulars shall be as per Section -3.

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 withstands 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 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 : (NOT IN SCOPE OF BIDDER)

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.

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 P.T. secondary terminals shall be brought out in a weather proof terminal box. Firstly the connections will be terminated on a internal board and then the same shall be brought out in the Secondary terminal box. The secondary terminals termination should be bolted type with wire size 4 sq.mm copper for connections. 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.

The terminal box shall be dust and vermin proof. Suitable arrangement shall be made for drying of air inside the secondary terminal box. The dimensions of the terminal box and its openings shall be adequate to enable easy access and working space with use of normal tools. 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 along with 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 contains our purchase order no. and date.

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 emide 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 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 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 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. 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 - ~~Volume 4~~, APPENDIX-2 .

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, Volume-II shall be applicable.

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)	3		
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 coulombs)	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

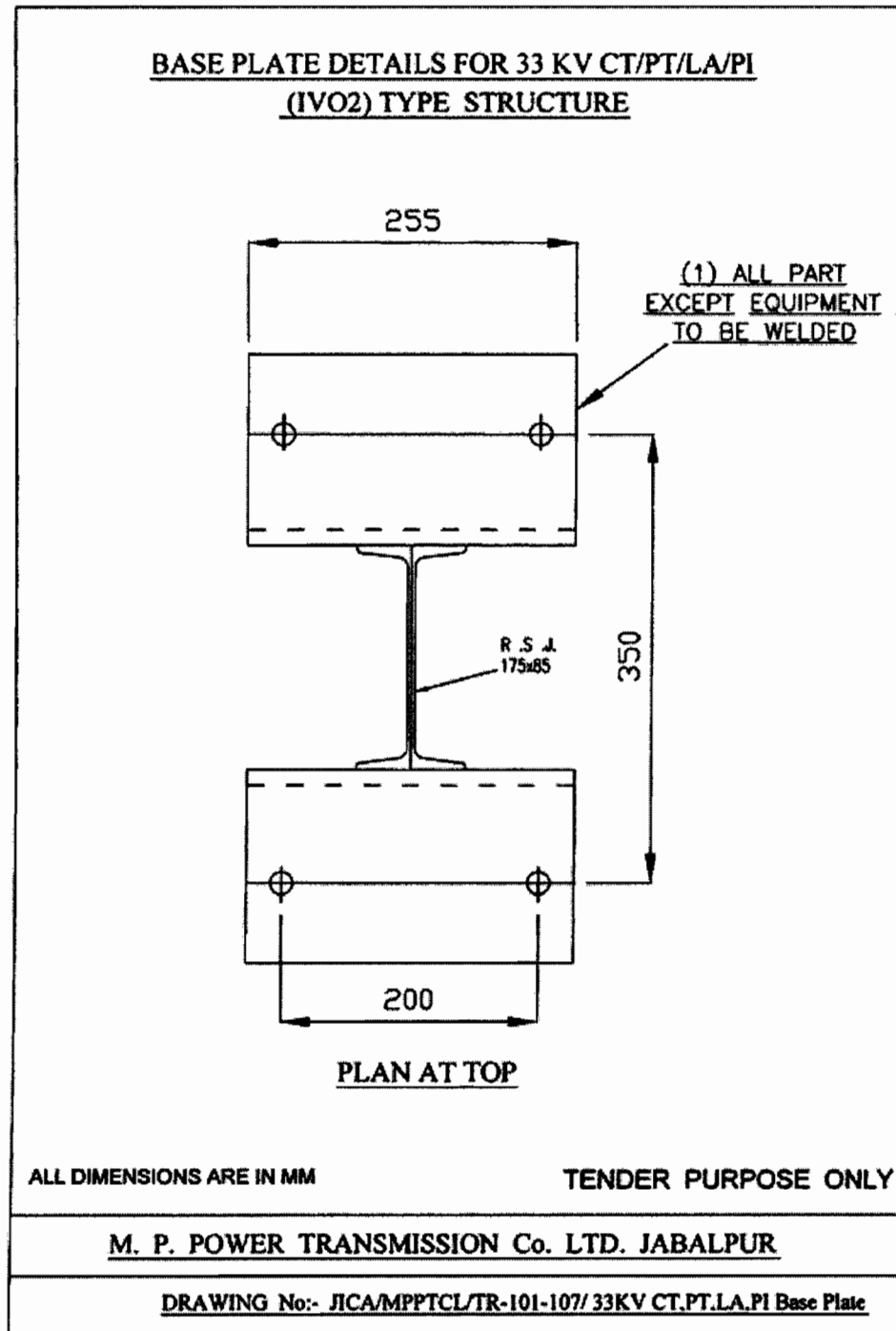
✓ (iii) 33 KV PT

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

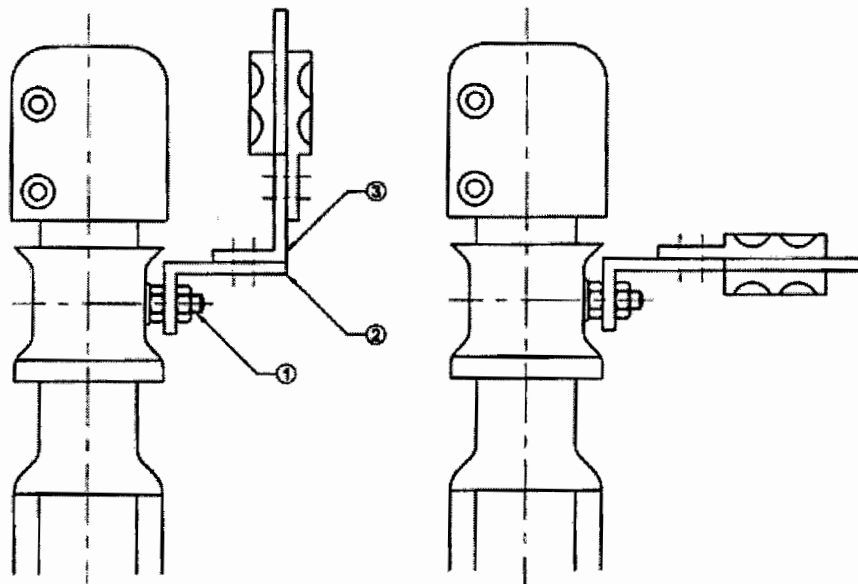
APPENDIX - B

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**



VERTICAL TAKE OFF

HORIZONTAL TAKE OFF

1. COPPER STUD OF 32MM/ 40MM DIA.
2. COPPER 1" CLAMP OF 8 MM THICKNESS
3. ALUMINIUM ALLOY 1" CLAMP OF 12 MM THICKNESS

NOTES

1. BOTH THE NUTS IN THE COPPER STUD SHOULD BE FACTORY TIGHTENED & LOCKED
2. ALL 1" 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

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

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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

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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
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	-

APPENDIX - 2

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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

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SECTION-3 Project Details and General Technical Requirements

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under other respective sections and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

a)	Customer/ Purchaser/ Owner	Madhya Pradesh Power Transmission Company Ltd.				
b)	Project Title	Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work on total turn-key basis (Lot no. 1) – Balaghat, Badnawar, Bhopal, Chhegaon and Nagda substation				
c)	Location	Balaghat	Badnawar	Bhopal	Chhegaon	Nagada
		Balaghat is Located in district of Balaghat of Madhya Pradesh. Distance between Jabalpur to Balaghat is 232 km by Road and 130 km by Rails.	Badnawar is Located in district of Dhar of Madhya Pradesh. Distance between Badnawar to Ujain is 70 km by Road.	Bhopal site is located 20 km away from Bhopal city.	Chhegaon is located in Khandwa district of Madhya Pradesh. Distance between Chhegaon to Khandwa is 15 km by Road.	Nagda is located in Ujjain district of Madhya Pradesh. The road distance between Nagda to Ujjain is 47 km.
d)	Transport Facilities	Road/Rail				

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e)	Postal Address	To follow
SITE CONDITIONS		
a)	Maximum ambient air temperature	50°C
b)	Minimum ambient air temperature	1°C
c)	Average daily ambient temperature	35°C
d)	Maximum Relative humidity	95 % (sometimes approach saturation)
e)	Pollution Severity	Heavily Polluted
f)	Seismic level (horizontal acceleration)	0.3g
g)	Wind zone as per IS 802 (PART 1) - 1995 velocity	4
h)	maximum wind pressure	150kg/sq.mts
i)	Average annual rainfall	1250 mm
j)	Maximum altitude above mean sea level	1000m
k)	Isoceraunic level	90 days per year
l)	Climate	Moderately hot & humid tropical climate, conducive to rust & fungus growth

AUXILIARY POWER SUPPLY

3 phase A.C power supply	415V 50 Hz, 3-phase 4 wire, solidly earthed
1 phase A.C power supply	240V, 50 Hz, 1-phase, 2 wire
D.C. power supply	220V, 2-wire ungrounded, for all equipments and panels except PLCC of 400kV /220kV /132kV /33kV substation
D.C. power supply	48V, 2 wire system positively earthed for PLCC

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

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

SYSTEM PARAMETERS

Description parameters	400kV System	220kV System	132kV System	33kV System
System operating voltage	400 kV	220kV	132kV	33kV
Maximum operating voltage(rms)	420 kV	220kV	145kV	36 kV
Rated frequency	50Hz			
Full wave impulse withstand voltage (1.2/50 micro second)	1425kVP	1050kVP	650kVP	250kVP/ 170kVP
One minute Power frequency dry/wet withstand voltage (rms)	630kV/ 520kV	460kV	275kV	95kV/70kV
Switching Impulse withstand voltage (250/2500 micro sec.) dry and wet	1050kVP	-	-	-
Corona extinction voltage	320kV	156kV	105kV	-
Maximum radio interference voltage for frequency between 0.5MHz and 2 MHz at 320kV rms phase for 400kV system , 156kVrms for 220kV system & 92 kV rms for 132kV system	1000 Micro volt	1000 Micro volt	500 Micro volt	-
Rated short time current	40 kA for three seconds/one second as applicable			25 kA for three seconds/2 6.2kA for two second
Creepage distance @25mm/kV	10500mm	6125mm	3625m m	900mm
System Earthing	Effectively Earthed			

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3.2 GENERAL TECHNICAL REQUIREMENT

3.2.1 TYPE TESTS

All equipment/systems to be supplied shall conform to type tests as per relevant standards and proven type. The Bidder / Contractor shall furnish the reports of all the type tests carried out in within last **five years from the date of bid opening (i.e. 20.11.13)** as listed in relevant clauses in respective electrical specification and relevant standards for all components / equipment / systems. These reports should be for the tests conducted on identical/similar components/equipment/systems to those offered/proposed to be supplied under this contract.

Type tests done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type test reports of the same shall be submitted for scrutiny /approval. If these are found suitable and technically acceptable, conducting of type tests shall be waived off.

In case Contractor is not able to submit report of type test(s) conducted in last five years, or in case type test report(s) are not found to be meeting the specification/relevant standard requirements, then all such tests shall be conducted under this contract by the Bidder free of cost to Employer/Purchaser, and reports shall be submitted for approval. No charges shall be paid under this contract. All acceptance and routine tests as per relevant standards and specification shall be deemed to be included in the bid price.

3.2.2 CODES AND STANDARDS

All materials and equipment shall generally comply in all respect with the latest edition of relevant international electro-technical commission (IEC) or any other internationally accepted standard which ensure equal or better quality or relevant Indian standard(IS) mentioned against each equipment and this specification.

3.3 MATERIAL/WORKMANSHIP

3.3.1 General Requirement

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment it is understood that the same must be new, of highest grade of the best quality of their kind conforming to best engineering practice and suitable for the purpose for which they are intended.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In

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general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from purchaser.

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall be interchangeable with, and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

3.3.2 Provisions For Exposure to Hot and Humid climate

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

3.4 COLOUR SCHEME AND CODES FOR PIPE SERVICE/PANELS

The contractor shall propose a color scheme for those equipment/items for which the colour scheme has not been specified in the specification for the approval of purchaser. The decision of purchaser shall be final. The scheme shall include:

Finishing colour of Indoor equipment

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.

Finishing colour of various auxiliary system equipment including piping

Finishing colour of various building items.

Painting process shall be of powder coating type. All surface shall be cleaned, phosphated and given two coats of rust-resistant primer followed by two coats of finish paints. The interior of all panels cabinets and enclosures shall be finished with gloss white enamel. Two final powder coats of synthetic enamel paint of light grey shade (697 of IS-5) shall be given to exterior surface of all the panels. Sufficient quantities of touch paint shall be furnished for application at site. All The indoor cubicles shall be of same colour scheme and for other miscellaneous items, colour scheme will be approved by the purchaser.

3.5 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion. The parts which *are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.* Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.6 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.

3.7 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles 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 paints.

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. 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 other wise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external painting shall be as per shade no. 697 of IS:5.

3.8 GALVANIZING

All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support channels, structures, shall be hot dip galvanised conforming to latest version of IS:2629 & or 4759 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvanized. Minimum weight of zinc coating shall be 610 gm/sq.m and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM.

3.9 PACKING

The following details are to be clearly indicated in the material forwarding documents:

- a) Name and address of the consignee.
- b) Purchase order number.
- c) Name of supplier/s.
- d) Description of equipment / material.
- e) Net weight.
- f) Gross weight.

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the purchaser, the Contractor shall also submit packing details/associated drawing for any equipment material under his scope of supply, to facilitate the purchaser to repack any equipment/ material at a later date, in case the need arises. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost. The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbol i.e. fragile, handle with care, use no Hooks etc.

Mandatory spares shall be packed in separate packing with clear identification.

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3.10 HANDLING, STORING AND INSTALLATION

Contractor may engage manufacturer's Engineers to supervise if required for unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than one section, contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning.

Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. Any demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. The Contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

3.11 DEGREE OF PROTECTION

The enclosures of the Control Cabinets, Junction boxes and Marshalling boxes panels etc to be installed shall be provided with degree of protection as detailed here under:

- a) Installed out door: IP-55
- b) Installed indoor in air conditioned area: IP-31
- c) Installed in covered area IP:52
- d) Installed indoor-in non air-conditioned area where possibilities of entry of water is limited:IP-41

e) For LT switchgear (AC & DC distribution Boards): IP-54

The degree of protection shall be in accordance with IS:13947, (Part-1)/IEC-947(Part-1). Type test report/or degree of protection test on each type of the box shall be submitted for approval.

3.12 RATING PLATES, NAME PLATES AND LABELS

Type or serial number together with details of the loading conditions under which the item of the substation in question has designed to operate and such diagram plates as may required by the Purchaser. The rating plate of each equipment shall be according to IEC requirements.

All such nameplate instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternately two separate plates one with Hindi and other with English inscriptions may be provided. All measurements shall be in M.K.S units.

3.13 EARTHING

Circuit breakers, LA, Isolator, CVT , CT , BPI shall be provided with two grounding pads suitable for connection to galvanized steel flat. Control panels, Relay panel, outdoor marshalling boxes, Junction boxes, Lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

3.14 TERMINAL BLOCKS AND WIRING

Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All Inter-phase and external connections to equipment or to control cubicles will be made through terminal blocks.

Terminal blocks shall be **1100 V grade box –clamp type** and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece complete with insulated barriers stud type terminals, washers nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be **non-disconnecting stud type equivalent to Elmex type CATM4**, Phoenix cage clamp type of Wedge or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

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

The terminal shall be that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the

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terminal clamp unless it is done intentionally. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable. The terminal blocks shall be of extensible design. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal blocks shall be fully enclosed with removable covers of transparent, non deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

All circuits except CT circuits : Minimum of 2 nos. of 2.5 sq.mm, copper flexible.

All CT circuits : Minimum of 4 nos. of 2.5 sq.mm, copper flexible.

The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live. **At least 20 % spare** terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

There shall be a minimum clearance of 250mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm. The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets.

All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The supplier shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

3.15 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable and the clause given below.

Control cabinet, Junction boxes, Marshalling boxes & Terminal boxes shall be made of CRCA sheet steel of minimum 2.5 mm thickness. The thickness of door s/covers shall not be less than 2.5 mm. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and

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rigidity during transportation and installation. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

Cabinet /boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of gaskets shall be such that it does not get damaged/cracked during the operation of the equipment.

All door, removable covers and plates shall be gasketed all around with suitably profiled **Neoprene gaskets**. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged /cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting atleast 150 mm above from the base of the Marshalling Kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required

3.16 SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater.

One or more adequately rated, thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heater shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heater to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and air and shall consist of coiled resistance wire centered in metal sheath and completely encased in a highly compacted powder of Magnesium Oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of a resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and air. Alternatively, they shall consist of resistance wire mounted into a tubular ceramic body built into an envelop of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in glaze the surface temperature of the heaters shall be restricted to a value

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which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

3.17 QUALITY

BHEL quality plan to be followed subject to TBEM / customer's approval.

3.18 DOCUMENTATION

3.18.1 LIST OF DOCUMENTS

The bidder shall submit a detailed list of drawings / documents along with the bid proposal which he intends to submit to the Employer after award of the contract.

The supplier shall necessarily submit all the drawings / documents unless any thing is waived.

All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under this specification shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

3.18.2 DRAWINGS

All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearances and spaces required for installation and interconnection between various portions of equipments and any other information specifically requested in the specifications.

Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, name of consultant, the unit designation, contract no. , and the name of the Project .If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Employer if so required.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to

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approval by the Employer. Approval of Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

3.18.3 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Employer would be discussed and finalised at the time of award. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer. The following schedule shall be followed generally for approval.

i.	Approval/comments/by employer on Initial submission	Within 2 weeks of receipt
ii.	Resubmission	Within 2 (two) weeks (whenever from date of comments required) Including both ways postal time.
iii.	Approval or comments	Within 2 weeks of receipt of resubmission
iv.	Furnishing of distribution copies	2 weeks from the date of last approval.

Note: The contractor may please note that all resubmissions must incorporate, all comments given in the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

The title block of drawings shall contain the following information incorporated in all contract drawings. Please refer enclosed sheet for details of Title block.

3.18.4 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

- 1) Drawings
- 2) Guaranteed Technical Particulars
- 3) Type Test Reports
- 4) Manufacturing Quality Plan

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3.18.5 DOCUMENTATION SCHEDULE

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
				Prints	CDs
1.	Drawings and Data Sheets	1	6	21	7 nos of all drawings/documents
2.	Drawings "As Built "	-	-	21	
3.	Type Test Reports	1	6	21	
4.	Erection Manuals	-	6	21	
5.	Operation and Maintenance Manuals	-	6	21	
6.	Manufacturing Quality Plan	1	6	21	
7.	Field Quality Plan	1	6	21	
8.	Inspection Test Reports	-	-	21	

Soft copies of drawings at contract stage shall also be submitted in PDF format.

Drawings will also be submitted in mini cartridges in AUTOCAD Release -14 package or any other CAD package along with conversion files for all major items.

Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top.

SECTION-4
GUARANTEED TECHNICAL PARTICULARS

1 GENERAL

- a) Name and address of manufacturer :
 - b) Manufacturer's type designation :
 - c) Standard applicable :
 - d) Rated voltage U_r (KV) :
 - e) Number of secondaries :
 - f) Rated frequency (Hz) :
 - g) Type of installation :
- 2 Guaranteed ratings** :
- a) Rated output of each secondary winding (VA) :
 - b) Total Simultaneous burden (VA) :
 - c) Accuracy class :
 - d) Rated voltage factor :
 - i) Continuous :
 - ii) 30 Seconds :
 - iii) 5 seconds :
 - e) Temperature rise over ambient temperature at 50 deg. centigrade :
 - f) One minute power frequency test voltage of secondary winding :

SECTION-4
GUARANTEED TECHNICAL PARTICULARS

**3 CONSTRUCTIONAL
DETAILS**

- a) Overall dimensions :
- i) Overall height (mm) :
- ii) Height upto top of terminal pad from mounting plane :
- iii) Diameter and length of terminal pad :
- iv) Material of terminal pad :
- v) Mounting dimensions and diameter of mounting holes :
- vi) Diameter of insulator :
- B) Total weight (kg) :
- C) Quantity of oil (litre) :
- D) Whether PTs are hermetically sealed :
- E) Details of dielectric :
- F) Standard to which oil conforms generally :
- G) Characteristics of Oil (Prior to filling) :
- A) Breakdown voltage (kV) :
- B) Dielectric dissipation constant :
- C) Water content :
- D) Gas content (ppm) :
- E) Interfacial tension at 27 degree C(117 m) :
- F) Specific resistance :

SECTION-4
GUARANTEED TECHNICAL PARTICULARS

- I) At 90 degree C (ohm-cm) :
- II) At 27 degree C (ohm-cm) :
- H) Minimum clearance between :
phases recommended (mm)
- I) Minimum centre to centre :
spacing recommended (mm) :
- J) Minimum distance from :
nearby earthed objects (mm)

4. LITERATURE

Whether the following are
enclosed

- A) Type test reports :
- B) OGA drawing of PT & :
terminal connector :
- C) Characteristic curve :
- D) Drawing showing clearance :
from earthed object
- E) Details of surge arrester :
connected at secondary
winding of PT

SECTION 5

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

BHEL ENQUIRY. NO:

BIDDER:OFFER REFERENCE:

A)

S.No	Parameters	Data	Yes / No	Remarks
1.	<i>Applicable Standard</i>	<i>IEC: 60044-2, IS-3156</i>		
2.	<i>Type</i>	<i>Outdoor</i>		
3.1	<i>Earthing Conditions</i>	<i>Solidly Earthed</i>		
3.2	<i>Rated Frequency</i>	<i>50 Hz</i>		
3.3	<i>System Voltage</i>	<i>33 kV</i>		
3.4	<i>Highest System Voltage</i>	<i>36 kV</i>		
3.5	<i>Rated Voltage</i>	<i>33/√3 kV</i>		
3.6	<i>Rated Secondary Voltage</i>	<i>110/√3 V</i>		
3.7	<i>Voltage Factor</i> - Continuous - 30s	<i>1.25</i> <i>1.5</i>		
3.8	<i>One minute power frequency withstand voltage secondary terminal & earth</i>	<i>3 kV</i>		
3.9	<i>Creepage Distance</i>	<i>900 mm</i>		
3.10	<i>a) One min dry and wet power frequency withstand voltage</i> <i>b) Lightning Impulse withstand voltage (Peak Value)</i>	<i>70 kVrms</i> <i>170 kV p</i>		
4	<i>PT Secondary Winding Parameters</i>	<i>As per Tables given in Clause 1.2 b of Section 1</i>		
5	<i>PT supplied Suitable for operation in the Climatic and High Altitude conditions.</i>	<i>Suitable for Climatic and Meteorological Data Specified in Section 3</i>		
6	<i>Oil filling & Drain Plug and Oil Sight glass</i>	<i>Provided</i>		

7	<i>Max. Temperature rise over design ambient temperature</i>	<i>As per Section-2</i>		
8	<i>External Surface</i>	<i>As per Section-2</i>		

B) TYPE TESTS

i) Whether type test reports of all the tests as per Section-2 and conducted earlier on identical or similar material are available (test reports are of the tests conducted not earlier than **five years from 20.11.13**). **(YES)**

ii) If type test reports are not acceptable to BHEL/Customer then above tests shall be conducted by the bidder free of cost. **(YES)**

Date:

Signature of the authorized representative of Bidder

Company Seal