BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

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TYPE OF DOC.	**TECHNICAL SPECIFICATION**	**NAME**	**RD**	**VK**	**RS**
TITLE		**SIGN**	Sd/-	Sd/-	Sd/-
400kV CURRENT TRANSFORMER		**DATE**	25/10/13	25/10/13	28/10/13
		GROUP	**TBEM**	**W.O. No**	**83001**

CUSTOMER	**RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD**
CONSULTANT	**TATA CONSULTING ENGINEERS LTD (TCE)**
PROJECT	**400kV SWITCHYARD AT 2 X 660 MW SURATGARH SUPER-CRITICAL THERMAL POWER STATION, STAGE-V, UNIT-7 & 8**

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01	20/06/14	**RD**	**VK**	**RS**	Only Section-1 Revised; All other sections remaining un-changed.
Rev No.	**Date**	**Altered**	**Checked**	**Approved**	**REVISION DETAILS**

Distribution		*TBTS*	*O/C*	*TBMM*	*TBQM*	*TBCM*
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SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of 400kV Current Transformer complete with accessories as listed in this specification.

The fitment and equipments offered shall be of approved make of RRVUNL or its subsequent approval from RRVUNL shall be bidder's responsibility with no commercial implications to BHEL. If any of the make offered by the bidder is not acceptable to M/s RRVUNL, the bidder has to supply alternate RRVUNL approved make, meeting the specification, with no commercial implications to BHEL.

The specification comprise of following sections:

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.

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of customer: Rajasthan Rajya Vidyut Utpadan Nigam Ltd (RRVUNL)

Name of consultant: Tata Consulting Engineers Ltd (TCE)

Name of Projects: 400kV Switchyard at 2x660 MW Suratgarh Super-Critical Thermal Power Station, Stage-V, Unit-7 & 8

Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

1.2.1 System parameters and technical requirements

Sl No.	Parameters	**400kV CT** (Outdoor, Oil-filled, live tank, hermetically sealed)
1	Nominal voltage (Phase to Phase) [kVrms]	400
2	Max. Continuous voltage *Um* (Phase to Phase) [kVrms]	420
3a	1.2/ 50 micro sec Impulse withstand voltage [kVp]	±1425
3b	250/2500 micro sec Switching Impulse withstand voltage (Dry and Wet) [kVp]	±1050
4	One min. dry and wet power frequency withstand voltage [kVrms]	630
5	One minute power frequency withstand voltage between secondary terminal & earth [kV]	3
6	Rated frequency [Hz]	50
7	Rated Short Time current for **3 sec** [kA]	**50**
8	Rated Dynamic current withstand [**kA (peak)**]	**127.5**
9	Rated Primary Current [A]	3000
10	Rated Extended Primary Current	120%
11	Rated secondary current [A]	1
12	Minimum creepage Distance (phase to ground) [mm/kV]	31
13	Max temperature rise over design ambient temp	As per IEC 60044-1
14	Type of Insulation	Oil Immersed Class A
15	Radio Interference voltage at 266kV (rms) for frequency range 0.5 to 2Mhz [micro volts]	<1000
16	Corona Extinction voltage [kV]	320
17	Partial Discharge level [pC max]	10
18	Number of Terminals	All terminals of control circuits are to be wired upto terminal box plus 20% spare terminals evenly distributed on all TBs.
19	Cantilever strength of CT at the terminal [kg]	600

Each CT shall be equipped with an over voltage protective device to limit the voltage developed across the secondary terminals to a safe value not exceeding 3 kV.

1.2.2 Core Parameters for 3000A Current Transformer (6 core)

Core No	Current Ratio (A)	Output Burden at lowest tap (VA)	Accuracy class as per IEC : 60044-1	Min. Knee Point Voltage Vk (Volts)	Max. CT Secondary winding resistance (ohms)	Max. exciting current at KPV (mA)
1	3000-2000-500/1	-	PS	3000-2000-500	15-10-2.5	20mA on 3000/1 Tap 30mA on 2000/1 Tap 120mA on 500/1 Tap
2	3000-2000-500/1	-	PS	3000-2000-500	15-10-2.5	20mA on 3000/1 Tap 30mA on 2000/1 Tap 120mA on 500/1 Tap
3	3000-2000-500/1	20	0.2s, ISF $\leq$ 5	-	-	-
4	3000-2000-500/1	20	0.2s, ISF $\leq$ 5	-	-	-
5	3000-2000-500/1	-	PS	3000-2000-500	15-10-2.5	20mA on 3000/1 Tap 30mA on 2000/1 Tap 120mA on 500/1 Tap
6	3000-2000-500/1-	-	PS	3000-2000-500	15-10-2.5	20mA on 3000/1 Tap 30mA on 2000/1 Tap 120mA on 500/1 Tap

Intermediate tapping at 3000-2000A shall be suitable for use as 1000/1A.

Core Parameters for 3000A Current Transformer (3 core)

Core No	Current Ratio (A)	Output Burden at lowest tap (VA)	Accuracy class as per IEC : 60044-1	Min. Knee Point Voltage Vk (Volts)	Max. CT Secondary winding resistance (ohms)	Max. exciting current at KPV (mA)
1	3000-2000-500/1	-	PS	3000-2000-500	15-10-2.5	20mA on 3000/1 Tap 30mA on 2000/1 Tap 120mA on 500/1 Tap
2	3000-2000-500/1	-	PS	3000-2000-500	15-10-2.5	20mA on 3000/1 Tap 30mA on 2000/1 Tap 120mA on 500/1 Tap
3	3000-2000-500/1	20	0.2s ISF $\leq$ 5	-	-	-

Intermediate tapping at 3000-2000A shall be suitable for use as 1000/1A.

1.3 BILL OF QUANTITY

Item No.	Description	Quantity (Main)	Quantity (Spare)
01	Single Phase, 400kV, 3000A, 50kA for 3s, 6 core Current Transformer	54 Nos.	1 No.
02	Single Phase, 400kV, 3000A, 50kA for 3s, 3 core Current Transformer	36 Nos.	1 No.
03	Spares - Gaskets of each type	-	1 Set
04	Spares - Oil level gauge of each type	-	1 Set

Hardware (Nut, Bolts and Washers) for Mounting CT on structure – 1set for each CT to be included by bidder in their offer.

Note- 1. Marshalling Box for a set of three (3) CTs shall be provided by BHEL.
2. The above quantities are subject to change by ±20% at contract stage.

1.4 TYPE TEST

All equipments to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last **five years from 03.12.2012**. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Client.

However if contractor is not able to submit report of the type test(s) conducted within last 5 years from the date mentioned above, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/ owners representative and submit the reports for approval.

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

1.5 DRAWINGS

The documentation requirements detailed under Section-3 shall be submitted to BHEL at various stages of contract. Softcopy of the drawings are to be submitted at contract stage.

1.6 DOCUMENTS REQUIRED WITH OFFER

a) "No Technical Deviation" Certificate
b) Un-priced schedule
c) Filled up Checklist
d) Catalogue and Technical Leaflets for the offered Equipments

SECTION-2

EQUIPMENT SPECIFCATION

2.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of Current Transformer (CT). In case of any discrepancies between requirements mentioned in this section and those mentioned in Section-3 of this specification, this specification shall prevail and shall be treated as binding requirement.

2.1 GENERAL

The AC Instrument Transformers and accessories shall conform to the latest version of IEC60044/ IS: 2705. The instrument transformers provided for control, metering and protective relaying functions shall have accuracy ratings and burden capabilities adequate to provide their designated functions within the overall accuracy requirements of the systems. The CT shall be designed for use in geographical and meteorological condition as specified for the project.

The specification given below relatesto oil filled instrument transformers.

2.2 TECHNICAL AND CONSTRUCTIONAL REQUIREMENTS

The features and constructional details of current transformers shall be in accordance with requirements stipulated hereunder:

2.2.1 Bushing/Insulators:

a) Current Transformer shall be of 420kV class, oil filled, with shedded porcelain bushings/ Insulators suitable for outdoor service and upright mounting on steel structures.

b) Bushings/Insulators shall conform to requirements of relevant IS.

c) CT tank shall be provided with oil filling and drain plugs, oil sight glass.

d) Instruments transformers shall be hermetically sealed units. Manufacturer shall furnish details of the arrangements made for the sealing of instrument transformers.

e) Polarity marks shall indelibly be marked on each instrument transformer and at the lead terminals at the associated terminal block.

2.2.2 Terminal box:

Each single phase instrument transformers shall be complete with its terminal box. The terminal box shall meet the requirements of IP55 as per IS-13947 Part-I.

2.2.3 Insulating Oil:

Insulating oil to be used for instrument transformers shall be of EHV grade and shall conform to IS: 335 (required for first filling) and IEC60296.

2.2.4 Tank

The tank alongwith top metallics shall be hot dip galvanised or painted.

2.2.5 Lifting arrangement

Current transformers shall be provided with suitable lifting arrangement, to lift the entire unit. The lifting arrangement shall be clearly shown in the general arrangement drawing.

2.2.6 Name Plate:

Nameplate shall conform to the requirements of IEC incorporating the year of manufacture. The rated current, extended current rating in case of current transformers shall be clearly indicated on the nameplate. The rated thermal current of CT shall also be marked on the name plate.

2.3 SPECIFIC TECHNICAL REQUIREMENT

a) Current transformers shall have single primary either ring type, or hair pin type and suitably designed for bringing out the secondary terminals in a weather proof (IP 55) terminal box at the bottom. These secondary terminals shall be terminated to stud type non disconnecting terminal blocks inside the terminal box.

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

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

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

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

f) The guaranteed burdens and accuracy class are to be simultaneous for all cores. The accuracy class for measuring cores shall be met upto the rated extended primary current.

g) For 400 kV class CTs, the rated extended primary current of the CTs shall be 120% of rated primary on all cores of CTs.

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

i) For current transformer, characteristics shall be such as to provide satisfactory performance of burdens ranging from 25% to 100% of rated burden over a range of 5% to 120% of rated current in case of metering CTs and up to the accuracy limit factor/knee point voltage in case of relaying CTs.

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

k) The CT shall be designed as to achieve the minimum risks of explosion in service.

l) The current transformers shall be suitable for high speed auto reclosing, if required.

2.4 TYPE & ROUTINE TESTS

2.4.1 The CTs shall conform to Type Tests as per relevant IS and IEC

2.4.2 The CTs shall be subjected to routine tests as per IS and IEC

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	Rajasthan Rajya Vidyut Utpadan Nigam Ltd, Jaipur
b)	Consultant	Tata consulting Engineer Ltd, Bangalore
c)	Project Title	2X660MW Super –Critical Thermal Power Station, Stage –V, Unit 7 & 8 - 400kV Switchyard at Suratgarh
d)	Location	Prabat Nagar, Suratgarh Sriganganagar district, Rajasthan
e)	Altitude and longitude	Lattitude:29 deg. 10 min. N Longitude: 74 deg. 01 min. E
f)	Elevation above mean sea level	186 m(approximately)
g)	Transport Facilities	Suratgarh project is located 27 km from Suratgarh , 15 km from Suratgarh to Biradhwal on NH15, 12km in east from NH15.
h)	Postal Address	To follow
SITE CONDITIONS		
a)	Mean of daily maximum temperature	32.3 deg. C
b)	Mean of daily minimum temperature	19.6 deg. C
c)	Highest temperature recorded	50 deg. C
d)	Lowest temperature recorded	-2.8 deg. C
e)	Design ambient temperature for electrical equipment design	50 deg. C
f)	Relative humidity	Varies between 21 % and 81%
g)	Pollution Severity	Heavily Polluted
h)	Seismic zone	II
i)	Basic Wind speed	47 m/sec

j)	Annual mean wind speed	4km/hr
k)	Terrain category	2
l)	Annual average rain fall	312 mm

SYSTEM PARAMETERS

Nominal system voltage	**400 kV**	**11kV**
Highest system voltage	420 kV	12kV
Basic Impulse level(dry /wet)	1425kVP	75kVP
Power frequency withstand voltage	630kVrms	28kVrms
Switching Impulse withstand voltage	1050 kVP	NA
Rated short time current	50 kA for 3 sec	40 kA for 1 sec
Frequency	50 Hz	50 Hz
Creepage distance	31mm/kV	31mm/kV
System Earthing	Effectively Earthed	Effectively Earthed

AUXILIARY POWER SUPPLY

3 phase A.C power supply	415V ± 10%, 50 Hz, 3-phase 4 wire, solidly earthed with variation in frequency of ± 5%
1 phase A.C power supply	240V ± 10%, 50 Hz, 1-phase , 2 wire , AC supply with variation in frequency of ± 5%
D.C. power supply	220V ±15%, 2-wire ungrounded 48V ±10%, 2 wire system positively earthed

Combined variation of voltage and frequency shall be +/- 10%

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 within last **five years from the date of opening of the tender** (i.e. 03.12.2012) 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.

3.2.3 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 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 manufacture'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. If 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.

All the steel works shall be thoroughly cleaned of rust , scale , oil , grease, dirt and scarf by pickling , emulsion cleaning , etc. The sheet steel shall be phosphated /oven dried and then painted with two coats of zinc rich primer paints . After application of the primer, two coats of

finished synthetic enamel paint shall be applied. The colour of the finished coats inside shall be **glossy white** and exterior of the treated sheet steel shall be **shade 631 of IS 5 /RAL 7032** for all switchboard /MCC/distribution board, control panels etc.

Sufficient quantities of touch paint shall be furnished for application at site. All the indoor cubicles shall be the same as exterior surface 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.

3.8 GALVANIZING

All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support channels, structures, shall be hot dip galvanized conforming to latest version of IS:2629 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. Average weight of zinc coating shall be **750gm/sq.m.**

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.

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-42

c) Installed in covered area IP:52

d) 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 be 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.

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 **650 V** grade 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 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 sheet steel . Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled . The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and 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 atleast 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 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, RRVUNL 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 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 3 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

3.18.5 **DOCUMENTATION SCHEDULE**

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
			Prints	Prints	CDs
1	Drawings and Data Sheets	1	7	8	-
2	Drawings "As Built "	-	-	8	05
3	Type Test Reports	1	3	4	-
4	Erection Manuals	-	7	8	-
5	Operation and Maintenance Manuals	-	7	8	-
6	Manufacturing Quality Plan	1	7	8	-
7	Field Quality Plan	1	7	8	-
8	Inspection Test Reports	-	-	8	-

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

Drawings will also be submitted in CD in AUTOCAD package 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.	Name and address of manufacturer
2.	Manufacturer's type designation
3.	Standards applicable
4.	Rated frequency (Hz)
5.	Rated voltage (kV)
6.	Rated current
	i. Rated continuous normal current (A)
	ii. Rated extended primary current (A)
7.	Short time thermal current withstand for 3 second (KA).
8.	Dynamic current withstand (kA peak).
9.	1.2/50 micro second impulse withstand voltage (kV peak)
10.	250/2500 micro seconds switching surge withstand voltage (kV peak dry and wet)
11.	One minute dry and wet power frequency withstand voltage (kV rms)
12.	No. of cores per CT
13.	Transformation ratio
14.	No. of secondary turns (Nominal)
15.	Rated output (VA) at different taps
16.	Accuracy class
17.	Knee-point voltage (V) at different taps

18. Secondary data
    a. Secondary resistance at different taps.
    b. Oversize factor and transient error under CO-t-CO duty condition with t=400 ms and duration of fault(100 ms)
19. Maximum exciting current
    a. 100% kpv (mA)
    b. 25% kpv (mA)
    c. 20% kpv (mA)
    d. 10% kpv (mA)
20. Instrument security factor at different ratios.
21. Radio interference voltage at $1.1Ur/\sqrt{3}$ kV (rms) at 0.5 to 2.0 MHz (micro volts)
22. Whether auxiliary CT/reactors provided for metering winding.
23. Corona extinction voltage (kV rms)
24. Partial discharge level (pico coulombs)
25. Total creepage distance (mm)
26. Primary
    a) No. of primary turns
    b) Material and cross section of primary(cm^2)
    c) Whether bar type or ring type primary
27. Whether CT is suitable for transportation horizontally

28.	Composite error at rated burden and at
	a) 20% rated current
	b) 120% rated current
29.	Composite error at 25% rated burden and at
	a) 20% rated current
	b) 120% rated current
30.	Quantity of oil per CT (kg)
31.	Whether spark gap/surge arrester provided at the primary
32.	Standard to which oil conforms generally
33.	Characteristics of Oil (Prior to filling)
	a) Breakdown voltage (kV)
	b) Dielectric dissipation constant at 90°C
	C) Water content(ppm)
	d) Gas content (ppm)
	e) Interfacial tension at 27°C (N/m)
	f) Specific resistance
	i) at 90°C (ohm-cm)
	ii) at 27°C (ohm-cm)
34.	Whether current transformers are hermetically sealed. If so, how.
35.	Total weight (kg)
36.	Transport weight (kg)

37. Dimensional details

    i) Overall height from mounting plane

    ii) Height up to terminals from mounting plane

    iii) Mounting dimensions & diameter of mounting holes

    Iv) Terminal pad diameter and length

        i) Material of terminal pad

        ii) Diameter of insulator at

            a) top end

            b) bottom end

38. Temperature rise over an ambient temp. of 50° C (° C)

39. Transient over voltage withstand for

    a) 30 seconds (kV peak)

    b) 1 minute (kV peak)

40. Whether CT characteristic curves enclosed

41. Details of recommended support structure enclosed

42. Drawing showing clearance from earthed objects enclosed

43. Type test reports enclosed

44. OGA drawing enclosed

45. Details of spark gap provided at the primary enclosed

SECTION 5

CHECK LIST FOR 400kV CURRENT TRANSFORMER

Put a tick mark (√) on 'YES' if the specified requirement is met, or put a tick mark on 'NO', if the specified requirement is not met and give comments in the "Remarks" column.

Sl. No.	Parameters	Data	YES/NO	Remarks
1	Manufacturer's type designation	Bidder to furnish in Remarks Col.		
2	Type of CT			
	a) Insulating medium	Oil	YES/NO	
	b) Installation	Outdoor	YES/NO	
	c) Mounting	Upright	YES/NO	
	d) Tank design	i. Live tank	YES/NO	
		~~ii. Dead tank~~	~~YES/NO~~	
3	Standards Applicable	IEC 60044-1, IEC-60044-4 , IS-2705-(P1 to P4), ANSI-C5713	YES/NO	
4	Rated Voltage (kV rms)	400KV	YES/NO	
5	Rated Primary Current	3000A	Yes/No	
6	Rated short time thermal current	50 KA for 3 (three) Sec	YES/NO	

7	Rated dynamic current	127.5 kA	YES/NO	
8	Max. Temperature rise over design ambient temperature	As per IEC:60044-1	YES/NO	
9	One minute power frequency withstand voltage - Secondary Terminal and Earth	3KV	YES/NO	
10	Cantilever Strength of CT at the terminal	Not less than 600Kg	YES/NO	
11	Class of Insulation	Oil Immersed Class A	YES/NO	
12	Core parameters	As per table at clause 1.2.2 of Section-1	YES/NO	
13	Technical parameters	As per table at clause 1.2.1 of Section-1	YES/NO	
14	**External Surface**			
	Tank and Top Metallics	Hot dip galvanized	YES/NO	
16	**Specific requirements for Oil CT's**			
	a. Oil filled CT's:			
	i. Grade of oil	EHV grade	YES/NO	
	ii. Standard to which oil conforms	IS-335 / IEC-60296	YES/NO	
	iii. Oil filling and drain plug provided.		YES/NO	
	iv. Oil sight glass provided		YES/NO	

17	**Hermetic Sealing**			
	a. Hermetically Sealed		YES/NO	
	b. Details of arrangement made for Hermetical sealing of the CT's are available and shall be furnished at contract stage.		YES/NO	
	c. Details of Site test to check the effectiveness of the hermetic sealing are available and shall be furnished at contract stage.		YES/NO	
18	Polarity of CT permanently marked		YES/NO	
19	Name Plate			
	As per IEC standards, and shall clearly indicate Year of manufacture, Rated current , Extended current rating & rated thermal current		YES/NO	
20	Terminal Box - Ingress Protection	IP 55	YES/NO	
21	Rated extended current	120%	YES/NO	
22	Packing & Transportation			
	a. CT suitable for horizontal transportation.		YES/NO	
	b. Details of packing design shall be furnished for review at contract stage.		YES/NO	
23	CT suitable for High speed auto-reclosing.		YES/NO	
24	Valid Type test reports are available and attached along with this offer.		YES/NO	

25.	Following Documents are attached along with the offer:			
	a. Filled Checklist		YES/NO	
	b. Filled GTP		YES/NO	
	c. Catalogue/ leaflets		YES/NO	
	d. Drawings		YES/NO	
26.	**a.** Bidder to confirm that there are no deviations and the offer is in full compliance with the Specification. **b.** Bidder to confirm that there are no deviations in any other form such as comments, variations and / or exceptions. **c.** Bidder to confirm that all drawings / data sheets/ QP / valid type tests reports / all relevant information shall be submitted to BHEL for organizing approval of ultimate customer.		YES/NO YES/NO YES/NO	
27.	Bidder to confirm Qualifying requirements, if any, mentioned in the tender document are being met.		YES/NO	