BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

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TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	RKP	SKS	AS
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SPECIFICATION FOR 400kV CURRENT TRANSFORMER		DATE	22.05.13		
		GROUP	TBEM	W.O. No	80010

CUSTOMER/ CONSULTANT	**The West Bengal Power Development Corporation Ltd. / Development Consultants Private Ltd. Kolkata**
PROJECT	**2X500MW thermal power extension project Unit-3 & 4 at Sagardighi- 400KV Switchyard**

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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 Current transformers with spares as listed in clause 1.3 below. This section covers the specific technical requirements of Current transformers . This constitutes minimum technical parameters for the above item as specified by the customer (WBPDCL). The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

The specification comprise of following sections:
Section-1: Scope, specific technical requirements & Bill of Quantities.
Section-2: Equipment specification under scope of supplies.
Section-3: General technical requirements for all equipments under the project.
Section-4: Equipment Data Sheet
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 : The West Bengal Power Development Corporation Ltd.
Name of Consultant : Development Consultants Private Ltd. Kolkata

Name of the project : 2X500MW thermal power extension project Unit-3 & 4 at Sagardighi-400KV Switchyard

1.2 SPECIFIC TECHNICAL PARAMETERS

i) Number of cores Five (5) ; Details as follows

Core No.	RATIO	Output Burden at lowest Tap (VA)	Min KPV (V)	Max. Ie	Max Rct	Acc Class	Purpose
1	**2000-1000-500/1**	-	2000-1000-500V	30-60-120 mA at KPV	10 -5 -2.5 Ohms	PS	Protection
2	**2000-1000-500/1**	-	2000-1000-500V	30-60-120 mA at KPV	10 -5 -2.5 Ohms	PS	Protection
3	**2000-1000-500/1**	40 VA	-	-	-	0.2S (ISF≤5)	Metering

4	**2000-1000-500/1**	-	4000-2000-1000V	30-60-120 mA at KPV	10 -5 -2.5 Ohms	PS	Protection
5	**2000-1000-500/1**	-	4000-2000-1000V	30-60-120 mA at KPV	10 -5 -2.5 Ohms	PS	Protection

ii)	Rated voltage kV (rms)	420
iii)	Rated primary current	2000 A
iv)	Rated short time withstand Current (1 sec.)	40 kA
v)	Rated dynamic current	100 kAp
vi)	One minute Power Frequency withstand voltage between secondary terminal and earth	5 kV
vii)	Extended current rating =	120% of Rated Current.
viii)	Maximum temperature rise over design ambient temperature	As per IEC 60044-1
ix)	Type of insulation	A
x)	Rated Insulation Level	
a)	Full wave Impulse withstand voltage (1.2/50 micro sec) Between line terminals and ground	± 1425 kVp
b)	Switching Impulse withstand voltage(250/2500 micro-sec) dry and wet Between line terminals and ground	± 1050 kVp
c)	One minute Power Frequency dry and wet withstand voltage Between terminal and ground	630 kV(rms)
x)	Minimum Creepage distance Phase to ground (mm)	10500 mm
xi)	Design ambient Temperature (^{O}C)	50
xii)	System neutral earthing	Effectively Earthed
xiii)	Seismic acceleration	0.3 g Horizontal
xiv)	Partial discharge	Not exceeding 10 pc
xv)	Corona Extinction voltage (kVrms)	320 (min)

xvi) Max. radio interference Voltage for frequency between 0.5 MHz and 2 MHz at 266 kVrms (Micro Volts) — 1000

1.3 QUANTITIES

S.No.	Description	Quantity
1	**420 KV, 2000 A, Current Transformer complete with accessories**	**33 Nos. (Main) + 1 No. (Spare)**

Accessories:

Each Current Transformer shall be furnished complete with the accessories as listed below:

1. Base frame with anchoring bolts nuts etc. for fixing the equipment on to structure.
2. Two grounding pads with bolts and spring washers.
3. Lifting Lugs.
4. Weather-proof secondary terminal box with set of terminals.
5. Grading ring, if necessary.
6. Oil level gauge and pressure relief device.
7. Other standard accessories which are not specifically mentioned but are usually provided with current transformers of such type and rating for efficient and trouble-free operation.

1.4 TYPE TESTS

Bidder shall submit valid type test reports (as per relevant IEC/IS standard) for the tests carried out within last five years from the date of LOA **(i.e. 22.02.2011)** . The reports should have been conducted on identical or similar equipment/components to those offered. In case type test reports are more than 5 years old (from the date of LOA) or the reports of type tests are found to be technically unacceptable , the type test shall be conducted by the vendor without cost and delivery implication to BHEL.

SECTION 2

Equipment Specification

1.0 GENERAL

a) The current transformers and accessories shall conform to the latest versions of the standards IEC-60044-1/IS: 2705 or latest applicable standard of IEC/IS except to the extent explicitly modified in the modified in the specification.

b) The current transformer shall be complete with its terminal box.

c) The tank alongwith top metallics shall be painted as per IS-5 shade or hot dip galvanizing shall be specified by the customer during detailed engineering.

d) The impregnation details alongwith tests/ checks to ensure successful completion of impregnation cycle shall be furnished for approval

e) The current transformers shall be designed for use in geographical and meteorological condition as specified in section-3.

f) The equipment will be installed outdoor in a hot, humid and tropical atmosphere with heavy chemical pollution.

g) All equipment accessories and wiring shall have tropical protection, involving special treatment of metal and insulation against fungus, insects and corrosion.

h) The maximum temperature in any part of the equipment at specified rating shall not exceed the permissible limits as stipulated in the relevant standards.

i) The equipment shall be capable of withstanding the dynamic and thermal stresses of listed short circuit current without any damage or deterioration.

j) The safety clearance of all live parts of the equipment shall be as per relevant standards.

2.0 CONSTRUCTION FEATURES

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

2.1 Busing/Insulators:

a) Instrument transformers shall be of 420 kV 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 stipulated in relevant IS/IEC. The bushing/insulator for CT shall be one piece without any metallic flange joint.

c) Bushings shall be provided with oil filling and drain plugs, oil sight glass of CT. The bushing/insulator of instrument transformer shall have a cantilever strength of not less than 500 kg for 420kV Instrument transformers respectively.

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

Manufacturer shall also furnish the details of site tests to check the effectiveness of hermetic scaling for approval.

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

f) Insulator shall be of wet process porcelain, brown glazed and free from imperfections. All metal parts and hardwares shall be hot dip galvanized.

g) The creepage distance shall correspond to heavily polluted atmosphere. Grading ring, if required, shall be furnished to maintain voltage gradient with permissible limit.

2.2 Terminal box/Marshalling box:

The terminal box shall be provided with a removable cable gland plate at the bottom for mounting five shall conform to the requirements furnished separately in section-3 of specification.

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).

2.4 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.

3.0 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. In case "Bar primary" inverted type current transformers are offered, the manufacturer will meet following additional requirements:

(i) The secondaries shall be totally encased in metallic shielding providing a uniform equipotential surface for even electric field distribution.
(ii) The lowest part of the insulation assembly shall be properly secured to avoid any risk of damage due to transportation stresses.
(iii) The upper part of insulation assembly resting on primary bar shall be properly secured to avoid any damage during transportation due to relative movement between insulation assembly & top dome.
(iv) Nitrogen if used for hermetic sealing (in case of live tank design) should not come in direct contact with oil.
(v) Manufacturer shall recommend whether any special storage facility is required for spare CT.

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) Current transformer's guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

g) For 420 kV class CTs, the rated extended primary current of the CTs shall be 200% of rated primary on all except 2000/1 tap ratio. On 2000/1 tap ratio the rated extended primary current shall be 120%. However, at 2000/1, ratio the CT shall be thermally rated for 200% for 15 minutes and 120% continuous.

h) 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.

i) 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. The manufacturer shall submit the details of packing design to the Purchaser for review.

j) For CTs the instrument security factor at ratios shall be less than five (5) for metering core. 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 current transformers should be suitable for mounting on lattice support structure to be provided by the contractor.

l) The CT shall be designed as to achieve the minimum risks of explosion in service. Manufacturer shall bring out the measures taken to achieve this.

m) 420 kV current transformers shall be suitable for high speed auto reclosing.

n) Super Enameled wire shall preferably be used for secondary windings. Copper conductor shall be used for all windings.

o) The current transformer shall be filled up under vacuum with insulating oil and be hermetically sealed. The current transformer shall be provided with oil level gauge, drain and pressure relief device. An inert gas cushion shall be provided on the top of the oil.

4.0 TYPE, ROUTINE & SITE TESTS

4.1 All current transformers should have been type tested as per IEC/ IS and shall be subjected to routine tests in accordance with IEC60044-1/ IS 2705. Only type-tested equipments only shall be offered. Manufacturer shall submit valid reports of type tests carried out within five years of bid opening. These reports should have been conducted on identical / similar equipment to those offered, in case less than five years old type test reports OR valid type tests are not furnished, the tests shall be conducted free of charge. No separate type test charges shall be paid.

4.2 For CT, test reports of the following additional type tests shall be submitted for the purchasers review in addition to the other type tests as per IS & IEC

a) Radio Interference test as per IEC 60044-1 or latest applicable IEC standard.
b)
c) Seismic withstand test (as per annexure-A).

d) Thermal stability Test i.e application of rated voltage and rated current simultaneously by synthetic test circuit.

e) Corona test (for 400KV only)

f) IP:55 test on control cabinet and secondary terminal box

g) Thermal coefficient test i.e. measurement of tan delta as a function of temperature (at ambient and between 80°C and 90°C) and voltage (at 0.3, 0.7, 1.0 and 1.1 Um/3)

h) The current transformers shall be subjected to Fast Transient test by any one of the following two methods given below to assess the CT performance in service to withstand the high frequency over voltage generated due to closing and opening operation of isolators. Alternatively, method as per IEC: 60044-1 may be followed.

Method I: 600 negative polarity lightning impulses chopped on crest will be applied to current transformer. The opposite polarity amplitude must be limited to 50% of crest value when the wave is chopped. Impulse crest values will be 1000 kVp for 420 kV CTs. One impulse per minute shall be applied and every 50 impulse high frequency currents form the windings and total current to earth will be recorded and be compared with reference currents recorded applying one or more (max 20) reduced chopped impulses of 50% of test value.

Oil samples will be taken before and 3 days after the test. Gas analysis must not show appreciable rate of increase in various gases related with the results of the analysis performed before test.

Total sum of crest values of current through secondaries must not exceed 5% of the crest value of total current to earth.

CT must withstand dielectric tests after this test to pass the test.

Method II: 100 negative polarity impulses with a rise and gall time of less than 0.25 microsecond having 950 kV for 420 kV CT corrected to atmospheric condition shall be applied at one minute interval and total current through insulation of earth will be recorded. The amplitude of first opposite polarity should be limited to 50% of the chopped impulse crest value. Voltage and total current wave shapes shall be recorded after every 10 impulses, and will be compared with reference wave shapes recorded before test at 50% of test values.

Oil sample shall be taken before and 3 days after the test and CT shall be deemed to have passed the test if the increase in gas content before and after test is not appreciable.

4.3 The CTs shall be subjected to following routine tests in addition to routine tests as per IS/ IEC

a) Measurement of Capacitance

b) High Voltage power frequency withstand test on secondary winding

c) Over voltage inter turn test as per BS 3938

d) Oil leakage test

e) Measurement of tan delta at 0.3, 0.7, 1.0 and 1.1 Um/3

f) Measurement of partial discharge as per IEC 60044-1

4.4 **Site test** -- Dissolved gas analysis to be carried out by purchaser at the time of commissioning, CTs shall have adequate provision for taking oil samples from the bottom of the CT without exposure to atmosphere. Manufacturer shall recommend the frequency at which oil samples should be taken and norms for various gases in oil after being in operation for different durations. Manufacturer should also indicate the total quantity of oil which can be withdrawn from CT for gas analysis before filling or further treatment of CT becomes necessary.

ANNEXURE –A

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstand test on the complete equipment shall be carried out along with supporting structure.

The bidder shall arrange to transport the structure from BHEL premises/ customer sites for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometer shall be provided as the terminal pad of the equipment and any other point as agreed by the purchaser. The seismic withstand test shall be carried out in all possible combinations of the equipment. The seismic withstand test procedure shall be furnished for approval of the purchaser.

SECTION-3

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	The West Bengal Power Development Corporation Ltd.
b)	Consultant/Owner's Engineer	Development Consultants Private Ltd. Kolkata
c)	Project Title	2X500MW thermal power extension project Unit-3 & 4 at Sagardighi- 400KV Switchyard
d)	Location	Site is located at Manigram village of Murshidabad district in West Bengal and around 240kM from Kolkata. 13kM north of Sagardighi town by the side of the SMGR(Sagardighi Manigram –Gankar –Raghunathganj) road at a distance of 20kM from National Highway 34 . Nearest railway station is Manigram adjacent to the site on Bandel-Barhawara branch line and 6.5kM from Sagardighi railway station on Sainthia-Azimhunj line of eastern railway. Nearest Airport –Kolkata. Nearest Seaport-Kolkata/Haldia
e)	Altitude	34 m above MSL
f)	Transport Facilities	Road/Rail
g)	Postal Address	To follow
SITE CONDITIONS		
a)	Maximum Design ambient dry bulb temperature	50°C
b)	Minimum Design ambient dry bulb temperature	5°C
c)	Average Relative humidity (for design)	73 %
d)	Maximum relative humidity	84%

e)	Pollution Severity	Heavily Polluted
f)	Seismic zone	III
g)	Wind velocity	47m/sec.
h)	Wind pressure	150kg/sq.mts
i)	Terrain category	2
j)	Risk coefficient (K1)	1.07
k)		
l)	Average rainfall	1389mm

SYSTEM PARAMETERS

Nominal system voltage	**400 kV**
Highest system voltage	420 kV
Basic Impulse level(dry /wet)	1425kVP
Power frequency withstand voltage dry/wet	630kVrms
Switching Impulse withstand voltage Phase to Earth	1050kVP
Switching Impulse withstand voltage Phase to Phase	1575kVP
Maximum radio interference voltage at 1MHz & 266kV rms phase to ground voltage	1000 Micro volt
Rated short time current	40 kA for 1 sec
Frequency	50 Hz
Creepage distance	25mm/kV
System Earthing	Effectively Earthed

AUXILIARY POWER SUPPLY

3 phase A.C power supply	415V ±10%, 50 Hz±5%, 3-phase 4 wire,50kA, solidly earthed, combined voltage and frequency variation ±10%
1 phase A.C power supply	240V±10%, 50 Hz±5%, 1-phase AC supply
D.C. power supply	220V ±10%, 2-wire , 25kA, ungrounded 48V ±10%, 2 wire system positively earthed

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 LOA (i.e. 22.02.2011)** 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 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 modem 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. 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(631 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 FUNGISTATIC 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 throughly 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 paintaing shall

be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitabley 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. 631 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 any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvasized. 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.

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 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 Publictions, 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 mm thickness. The thickness of door s/covers shall not be less than 1.6 mm. 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 S PACE 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, 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 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

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	6	7	4 nos of all drawings/ documents
2	Drawings "As Built "	-	-	7	
3	Type Test Reports	1	6	7	
4	Erection Manuals	-	6	7	
5	Operation and Maintenance Manuals	-	6	7	
6	Manufacturing Quality Plan	1	6	7	
7	Field Quality Plan	1	6	7	

8	Inspection Test Reports	-	-	7	

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

CURRENT TRANSFORMER

1.		Name and address of manufacturer
2.		Manufacture's type designation
3.		Standards applicable
4		Type of CT (Live or Dead Tank)
5		Rated frequency (Hertz)
6		Rated voltage Ur (KV_{rms})
7		Rated current
	I)	Rated continuous normal current (A)
	ii)	Rated extended primary Current (A)
8		Short time thermal current withstand for 1 sec. (KA).
9		Dynamic current withstand (KA_{peak}).
10		1.2/50 micro second impulse withstand voltage (KV_{peak})
11		250/2500 micro second switching surge withstand voltage (dry & wet) (kVp)
12		One minute dry and wet power frequency withstand voltage (kVrms)
13		No. of Primary winding
14		No. of cores per CT
15		Current Ratio (for all cores)

SECTION -4
GUARANTEED TECHNICAL PARTICULARS

CURRENT TRANSFORMER

16	Output Burden for all cores
17	Accuracy class
18	Knee point voltage (V) at different taps
19	Secondry winding resistance at different ratios (for all cores)
20	Maximum exciting current at knee point voltage at different ratios (for all cores) (mA)
21	Instrument security factor at different ratios for metering cores
22	Radio interference voltage at 1.1 Ur/($\sqrt{3}$) at 1.0 MHz (μVolts)
23	Conona extinction voltage (KVrms)
24	Partial discharge level (pico coulumbs)
25	Standard to which oil conforms generally
26	Total weight (kg)
27	Confirm whether similar equipment are type tested and in successful operation for at least 2 years
28	Maximum exciting current at knee point voltage at different ratios (for all cores) (mA)

SECTION 5

ENCLOSURES TO SPECIFICATIONS

ANNEXURE 1	CHECK LIST FOR INFORMATION TO BE FURNISHED WITH THE OFFER
ANNEXURE 2	FORMAT FOR QUALITY PLAN
ANNEXURE 3	SCHEDULE OF DEVIATION

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER

BIDDER SHALL PUT A TICK '✓' **IF THE INFORMATION IS ENCLOSED** WITH THE OFFER, PUT A CROSS **'X' IF THE INFORMATION IS NOT ENCLOSED** OR WRITE **'NOT APPLICABLE' IF THE QUERY/ SCHEDULE IS NOT RELEVANT AND 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.
BIDDER:
OFFER REFERENCE:

1.	Technical offer with detailed schedules of equipment/ material and spares	_____
2.	Guaranteed Technical Particulars as per Section - 4	_____
3.	Schedule of Deviations listing deviations, if any, clause-wise with respect to technical specification	_____
4.	List of past supplies complete with Purchase Order & Project name, quantity, order reference, etc., where identical equipment have been supplied.	_____
5.	Manufacturer's Quality Plans for approval	_____
6.	Field Quality Plan for approval	_____
7.	General Arrangement drawings with dimensions and weights and foundation/ fixing details	_____
8.	Drawing/ data submission Schedule	_____
9.	Type test reports. The type test reports shall be accompanied with a list listing all the relevant clauses of the applicable standard and the corresponding type test report. The manufacturer shall also furnish a certificate certifying that the test reports have been carried out on equipment identical in all respects to the one offered. In case the reports are for a different equipment and the applicability of the report is permitted as per applicable standards, the justification shall be enclosed to the list of type test reports.	_____
10.	Bar Chart showing time schedule showing time required for design, manufacture, test and inspection, transport, erection, site testing and commissioning	_____
11.	Makes of all important components, like motors, operating switches, fuses, etc.	_____
12.	Any additional information called for in any part of the technical specification.	_____

Date:

Signature of the authorized representative of Bidder

Company Seal

	MANUFACTURER'S NAME & ADDRESS	**MANUFACTURING QUALITY PLAN**	PROJECT:
BHEL		**ITEM:** **SUBSYSTEM:**	QP No. _____ Rev No. _____ Date _____ PAGE __ OF __	PACKAGE: CONTRACT NO.: CONTRACTOR: BHEL/ TBD/ NEW DELHI

SL. No.	COMPONENT AND OPERATION	CHARACTERISTIC	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE OF NORMS	FORMAT OF RECORD		AGENCY			REMARKS
										P	W	V	
1	2	3	4	5	6	7	8	9	D*	10			11

		LEGEND:			
		* RECORDS IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.			
MANUFACTURER/ SUB-CONTRACTOR	CONTRACTOR	Indicate 'P' 'PERFORM, 'W' WITNESS and 'V' VERIFICATION			
SIGNATURES			REVIEWED BY	Name & Sign of Approving Authority & Seal	

SCHEDULE OF DEVIATIONS

Certified that the following are only deviations from the specification (for the equipment and systems being offered)

S.No.	Page No.	Clause No.	Deviation	Reason / Justification

Date :

Signature :

Name:

Designation :