



BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

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TITLE 245kV CAPACITIVE VOLTAGE TRANSFORMER (245kV CVT)		SIGN			
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		GROUP	TBEM	W.O. No	I19TB000 03
CUSTOMER	Indian Oil Corporation Limited (IOCL)				
CONSULTANT	TATA Consulting Engineers Limited (TCE)				
PROJECT	LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery				

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**Project: LSTK job for ISBL work of 220KV Grid
Power Import at IOCL, Panipat Refinery
Customer: Indian Oil Corporation Limited (IOCL)
Consultant: TATA Consulting Engineers Limited (TCE)
Technical Specification: 245kV Capacitive Voltage Transformer**

**Bharat Heavy Electricals Limited
Document No. TB-411-510-103**

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 245kV Capacitive Voltage Transformers (245kV CVT) complete with accessories as listed in this specification.

The fitment and equipments offered shall be of approved make of IOCL/ HVPNL or its subsequent approval from IOCL/ HVPNL 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 IOCL/ HVPNL, the bidder has to supply alternate IOCL/ HVPNL 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: Checklist

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

Note: The terms used in this specification namely, "Employer/Purchaser/Owner" refers to IOCL/ HVPNL & "Contractor/ LSTK Contractor /Sub-contractor/Manufacturer" refers to successful bidder.

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of customer: **Indian Oil Corporation Limited (IOCL)**

Name of consultant: **TATA Consulting Engineers Limited (TCE)**

Name of Project: **LSTK job for ISBL work of 220KV Grid Power Import at IOCL,
Panipat Refinery**

Refer Section - 3 for Project Details and General Specifications.

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1.2 SPECIFIC TECHNICAL REQUIREMENTS

1.2.1 245 kV CVT PARAMETERS:

Sl No.	Parameters	245 kV CVT
1	Nominal voltage (Phase to Phase) [kVrms]	220
2	Max. Continuous voltage Um (Phase to Phase) [kVrms]	245
3	Rated frequency [Hz]	50
4	Rated Short Time current for 1 sec [kA]	50
5	Minimum creepage Distance (phase to ground) [mm/kV]	25
6	Max temperature rise over design ambient temp	As per Section-3
7	Type of Insulation	Class A
8	Number of Terminals	All terminals of control circuits are to be wired upto terminal box plus 20% spare terminals evenly distributed on all TBs.
9	Terminal Box - Ingress Protection	IP 55

1.2.2 CVT WINDING PARAMETERS:

Ratio	$\frac{220KV}{\sqrt{3}} / \frac{110V}{\sqrt{3}} / \frac{110V}{\sqrt{3}} / \frac{110V}{\sqrt{3}}$
Sec-I	Class – 3P, 50VA
Sec-II	Class – 3P, 50VA
Sec-III	Class – 0.2, 50VA
	Capacitance: 8800 pF (+10% , -5%)

1.2.3 Offered CVT shall be as per IOCL/HVPNL specification (Section-2, 11 pages).

1.2.4 The successful bidder shall have to extend all possible supports like timely submission/re-submission of drawings, visit to end customer IOCL/ HVPNL to facilitate documents approval without any commercial implications to BHEL. Acceptance of bidder's documents shall be subject to end customer (IOCL/ HVPNL) approval. Testing as per HVPNL guidelines, at third party lab, if any, shall be carried out by successful bidder without any commercial implications to BHEL/ IOCL. Arranging and coordinating with HVPNL

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engineers for witnessing routine/ acceptance/ type tests at manufacturer's works or at third party lab is in the scope of bidder, without any commercial implications to BHEL/ IOCL.

1.3 TECHNICAL PRE QUALIFYING REQUIREMENTS

245kV Capacitive Voltage Transformers being offered should be from manufacturer who have manufactured and supplied at least fifteen (15) nos. of single phase Capacitive Voltage Transformers suitable for Air Insulated Substation/ Switchyard of 245kV or above class which should have been in successful operation for minimum two (2) years prior to the date of techno-commercial bid opening.

1.4 BILL OF QUANTITY

Item No.	Item Description as per Tender BOQ	Detailed Description	Quantity (Main)	Quantity (Spare)	Total Quantity
01	Supply- Capacitive Voltage Transformer : 245kV, 3 Secondary, Single Phase Capacitive Voltage Transformer	245kV, Single Phase, 3 Secondary, 8800pF Capacitive Voltage Transformer	6 Nos.	2 No.	8 No.

Note:

1. Junction Box for a set of three (3) CVTs shall be provided by BHEL.
2. The above quantities are subject to change by $\pm 20\%$ at contract stage.
3. Hardware (Nut, Bolts and Washers) for Mounting CVT on structure – 1set for each CVT to be included by bidder in their offer.

1.5 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 not prior to **five years from the date of techno-commercial bid opening**. 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.

1.6 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. Date of Submission of first lot of drawings will be counted only from the date of submission of reasonably correct drawings.

1.7 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

1.8 WARRANTY

Refer relevant clauses mentioned elsewhere.

1.9 DRAWINGS / DOCUMENTS REQUIRED FOR ENGINEERING MANUFACTURING CLEARANCE

The minimum drawings/ documents, as follows shall be required for providing engineering manufacturing clearance of the equipment (245kV CVTs) and furthermore, it shall be used for delay analysis, if any, on account of the bidder. The schedule for submission and resubmission shall be in line with details provided in section-3.

1	OGA & Section Drawing, R&D Plate Drawings, BOM/ Component List with Guaranteed Technical Particulars
2	Type Test Reports
3	Quality Assurance Plan & Inspection Test Schedule

1.10 PACKING AND DISPATCH

The equipment shall be properly packed for selected mode of transportation i.e. sea, rail and road in such a manner that it is protected against the climatic conditions and for any damage during transportation, transit and storage. The equipments shall be wrapped in polyethylene sheets before being placed in wooden crates/cases to prevent damage to the finish. Crates/cases shall have skid bottoms for handling. Special notations such as 'Fragile', 'This side up', 'Weight', 'Owner's particulars\ 'PO nos.' etc., shall be clearly marked on the package together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing should also be suitable for outdoor storage areas with heavy rains/ high ambient temperature unless otherwise agreed and hence, packing shall be suitable for long duration storage (minimum 1 year).

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1.11 QUALITY PLAN

The successful bidder shall submit Quality Assurance Plan for the equipment with in-process inspection methods, tests, records, etc. for BHEL/ Customer/ HVPNL approval. Customer hold points will also be included in the plan, which shall be mutually agreed by BHEL/ Customer. In case bidder has reference Quality Assurance Plan agreed with BHEL/ Customer/ HVPNL, same shall be submitted for specific project to BHEL/ Customer approval. There shall be no commercial implication to BHEL/ Customer on account of Quality Plan approval.

Superior quality control system shall be adopted to assure high product quality. Raw materials of the best commercial grade quality and high reliability shall be used in the manufacture of the equipment. All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan. The supplier shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and comply with the requirements of the specification. Charges for all tests for the equipment shall be deemed to be included in bidder's scope.

SECTION-2

IOCL, PANIPAT REFINERY

220kV OUTDOOR SWITCHYARD

CHAPTER-03G

Annex S-3/C-4/6

CAPACITOR VOLTAGE TRANSFORMER:

The specification provided below are for reference purpose. The complete design, engineering and supply of the equipments shall be in line with HVPNL guidelines, applicable standards and as per tender requirements and shall be responsibility of ~~ESTK~~ contractors including all liasoning requirements with HVPNL authorities.

1.0 SCOPE :

- 1.1 This specification provides for design, engineering, manufacture, testing of outdoor TYPE capacitor voltage transformers ~~along with terminal connectors~~ for protection and metering services in 220/33kV S/Stn at IOCL Panipat. At least one core to be provided with 0.2 class accuracy, ~~and as per IOCL-PR specification~~
- 1.2 It is not the intent to specify completely herein all details of the design and construction of equipments. However the equipment shall conform in all respects to high standards of engineering design and workmanship and shall be acceptable to the purchaser, who will interpret in a manner the meanings of drawings and specifications and shall have the power to reject any work or material, which in his judgment is not in accordance therewith. The equipment offered shall be complete with all components necessary for its effective and trouble free operation. Such components shall be deemed to be within the scope of supply irrespective of whether those are specifically brought out in this specification and or the commercial order or not.

2.0 STANDARDS:

Sl.No.	Standard No.	Title.
1.	IS : 3156 (Part-I to Part-III)	Voltage transformer
2.	IS : 3156 (Part-IV)	Capacitor Voltage Transformer
3.	IS : 2099	High Voltage porcelain bushing.
4.	IS : 3347	Dimensions of porcelain transformer bushings
5.	IS : 2071	Method of High Voltage Testing
6.	IS : 335	Insulating oil for transformers and switchgears
7.	IS : 2165	Insulation Co-ordination for equipments of 100 kV and above.
8.	IS : 2147	Degree of protection provided by enclosures for low voltage switchgear and control.
9.	IEC- 186	Voltage Transformers
10.	IEC - 186A	First supplement to IEC publication 186
11.	IEC - 270	Partial discharge Measurement
12.	IS - 5561	Terminal Connectors
13.	IS -4800	Enameled round winding wires
14.	IEC- 44 (4)	Instrument Transformer measurement of PDs
15.	IEC-171	Insulation Co-Ordination
16.	IEC - 358	Coupling capacitor divider.

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17.	IEC-60	High Voltage testing techniques.
18.	IEC-8263	Method for RIV test on high voltage insulators.
19.	IS: 9348	Coupling capacitors and capacitor dividers
20.	IS: 2633	Methods of testing hot dipped galvanized articles
21.	IS: 11065	Drawings.
22.		Indian Electricity Rules 1956
23.	IS: 5621	Hollow porcelain insulators.

2.2 Equipment meeting with the requirements of other authoritative standards, which ensure equal or better performance than the standards mentioned above, shall also be considered. When the equipment offered by the ~~L1~~ contractor conforms to other standards salient points of difference between standards adopted and the standards specified in this specification shall be clearly brought out in the relevant schedule.

3.0 SERVICE CONDITION: The service condition shall be as per ~~Annex-S-2/C-1/8~~ **SECTION-3**.

Note: Moderately hot and humid tropical climate conducive to rust and fungus growth. The climatic conditions are also prone to wide variations in ambient conditions. Smoke is also present in the atmosphere. Heavy lightening also occur during June to October.

4.0 PRINCIPAL PARAMETERS:

The capacitor voltage transformers covered in this specification shall meet the technical requirements listed hereunder.

PRINCIPAL TECHNICAL PARAMETERS (Use data of relevant voltages- as per project scope):

Sl. No.	Item	Specification				
		420kV	245kV	145kV	72.5kV	36kV
1.	Type/Installation	Single Phase, Oil filled, Self cooled, Hermetically sealed Outdoor type				
2.	Type of mounting	-----Steel structure-----				
3.	Highest system voltage (kV rms)	420	245	145	72.5	36
4.	Suitable for system frequency	50 Hz				
5.	Rated primary voltage (kV rms)	400/√3	220/√3	132/√3	66/√3	33/√3
6.	Method of earthing the system	Solidly earthed				
7.	1.2/50 microsecond lightning impulse withstand voltage (kVp)	1425	1050	650	325	170

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8.	1 Minute dry & wet power frequency withstand voltage primary (kV rms)	630	460	275	140	70
9.	Min. Creepage distance (mm)	10500	6125	3625	1815	900
10.	Creepage factor (max.)	4.0				
11.	Rated voltage factor	1.2 continuous and 1.5 for 30 seconds				
12.	Equivalent capacitance at power frequency for carrier coupling for CVT (PF)	8800+10%-5%				N.A
13.	Resultant high frequency capacitance for CVT (PF)	8800 in carrier frequency range of 40 KHz N/A to 500 KHz with variation in capacitance as contained in IEC-358 (i.e- 20% & +50%)				
14.	One minute power frequency withstand voltage for secondary winding (kV rms)	3.0				
15.	Max. temperature rise over ambient of 50°C	As per IS:3156 or equivalent IEC				

5.0 GENERAL TECHNICAL REQUIREMENTS:

5.1 General:

5.1.1 The insulation of the instrument transformers shall be so designed that the internal insulation shall have higher electrical withstand capability than the external insulation. The designed dielectric withstand values of external and internal insulations shall be clearly withstand values specified in this guaranteed technical particulars. The dielectric withstand values specified in this specification are meant for fully assembled instrument transformers. The insulating material shall be preferably silicon polymer rubber/composite type until unless the product is not available in the market.

5.1.2 Porcelain Housing (if applicable):

5.1.2.1 The details of location and type of joint, if provided on the porcelain, shall be furnished by the ~~LSH~~ contractor during the detailed engineering stage. The housing shall be made of homogeneous, vitreous porcelain of high mechanical and dielectric strength, glazing of porcelain shall be of uniform brown or dark brown colour with a smooth surface arranged to shed away rain water or condensed water particles (fog).

5.1.2.2 Details of attachment of metallic flanges to the porcelain shall be brought out during detailed engineering stage. Nuts and bolts or screws used for fixation of the interfacing porcelain bushings for taking out terminals, shall be provided on flanges cemented to the bushings and not on the porcelain.

5.1.3 Metal tank:

The metal tanks shall have bare minimum number of welded joints so as to minimise possible locations of oil leakage. The metal tanks shall be made out of mild steel/Stainless steel/aluminium alloy, depending on the requirement. Welding in horizontal plane is to be avoided as welding at this location may give way due to vibrations during transport resulting in oil leakage. ~~ESTK~~ contractor has to obtain specific approval from purchaser for any horizontal welding used in the bottom tank.

5.1.4 Surface Finish:

The ferrous parts exposed to atmosphere shall be hot dip galvanised or shall be coated with atleast two coats of zinc rich epoxy painting. All nuts, bolts and washers shall be made out of stainless steel.

5.1.5 Insulating Oil:

Insulating oil required for first filling of the instrument transformer shall be covered in ~~ESTK~~ contractor's scope of supply. The oil shall meet the requirements of latest edition IS:335 or equivalent IEC.

5.1.6 Prevention of Oil leakages and Entry of Moisture:

The ~~ESTK~~ contractor shall ensure that the sealing of instrument transformer is properly achieved. In this

connection the arrangement provided by the ~~ESTK~~ contractor at various locations including the following ones shall be described, supported by sectional drawings.

- i) Locations of emergence of primary and secondary terminals.
- ii) Interface between porcelain housing and metal tanks.
- iii) Cover of the secondary terminal box.

5.1.7 Gaskets:

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

5.1.8 Oil level indicators:

Instrument transformers shall be provided with oil sight window (Prismatic Type) at suitable location so that the oil level is clearly visible with naked eye to an observer standing at ground level.

5.1.9 Earthing:

Metal tank of the instrument transformer shall be provided with two separate earthing terminals for bolted connection to 50X8mm MS flat to be provided by the Purchaser for connection to station earth-mate.

5.1.10 Lifting & Transportation Arrangements:

Instrument transformer shall be provided with suitable lifting arrangement, to lift the entire unit. The lifting arrangement shall be clearly shown in the general arrangement drawings. Lifting arrangement (lifting eye) shall be positioned in such a way so as to avoid any damage to the porcelain housing or the tanks during lifting for installation/transport. If necessary, string

guides shall be offered which shall be of removable type. The instrument transformers shall be so constructed that it can be easily transported to site within the allowable transport limitation and in horizontal position, if the transport limitations so demand.

5.1.11 Name Plate:

The instrument transformer shall be provided with non-corrosive, legible name plate with the information specified in relevant standards, duly engraved/punched on it. In addition to these P.O. NO. & Connection diagram shall also be marked in rating plate.

5.1.12 Terminal Connectors: (NOT IN BIDDER'S SCOPE)

Suitable terminal connectors for OSBL conductor as suitable for 220kV CVTs/PTs.

Suitable terminal earth connectors for earthing connections shall also be provided.

The terminal connectors shall meet the following requirements:

- a. Terminal connectors shall be manufactured and tested as per IS:5561 or equivalent IEC.
- b. All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- c. No part of a clamp shall be less than 10mm thick.
- d. All ferrous parts shall be hot dip galvanized conforming to IS:2633 or equivalent IEC.
- e. For bimetallic connectors, copper alloy liner of minimum 2mm thickness shall be cast integral with aluminium body.
- f. Flexible connectors shall be made from tinned copper/aluminium sheets.
- g. All currents carrying parts shall be designed and manufactured to have minimum contact resistance.
- h. Connectors shall be designed to be corona free in accordance with the requirements stipulated in IS: 5561 or equivalent IEC.

5.1.13 Insulation:

Enamel, if used for conductor insulation, shall be polyvinyl acetate type or amide emide type and shall meet the requirements of IS:4800 or equivalent IEC. Polyester enamel shall not be used. Double cotton cover, if used, shall be suitably covered to ensure that it does not come in contact with oil.

5.1.14 Temperature Rise:

The temperature rise on any part of equipment shall not exceed maximum temperature rise specified in IS:3156 or equivalent IEC. However, the permissible temperature rise indicated is for a maximum ambient temperature of 50°C.

5.1.15 Oil Filling & Drain Valves:

The instrument transformers shall be vacuum filled with oil after processing and thereafter hermetically sealed to eliminate breathing and to prevent air and moisture from entering the tanks, sealing type oil filling with/without oil sampling cocks shall be provided with facility to reseal the same. The method adopted for hermetic sealing shall be described during the detailed engineering stage.

5.1.16 Pressure Relief Device:

Suitable arrangement shall be made to accommodate the expansion and contraction of oil

due to temperature variation. The pressure variation shall be kept within limits which do not impair the tightness of the instrument transformer. A pressure relief device capable of releasing abnormal internal pressure shall be provided.

5.2 Capacitor Voltage Transformer (CVT):

- 5.2.1 The CVTs comprising of a capacitor divider unit and electromagnetic unit shall be single phase, oil filled hermetically sealed, self cooled, outdoor type and suitable for direct line connection without any fuse and isolating switches. These CVTs are required to be used on interlinking substations between IOCL Panipat & IOCL PR Source Substation for the purpose of protection, synchronising, interlocking, carrier coupling and metering. CVTs shall be suitable for connecting the carrier terminals to single circuit and double circuit transmission lines for phase to phase coupling for power line carrier, voice communication, tele-metering & tele-printing services.
- 5.2.2 The secondary terminals of potential unit, high frequency coupling terminal and the earthing terminals shall be brought out separately and housed in a water proof cabinet outside the main steel chamber.
- 5.2.3 The capacitor voltage transformer shall be suitable for simultaneous use as measuring unit, for feeding voltage supply to protective relays and as coupling capacitor for carrier transmission i.e. for voice communication, carrier protective relays, tele-metering, tele-printing services over one or more carrier channels in the frequency range of 40 to 500KHz.
- 5.2.4 The capacitors shall be designed for wide frequency band and low dielectric loss. Their natural frequency shall be considerably higher than the carrier frequency range of 40 KHz to 500 kHz.
- 5.2.5 The unit capacitors shall be so designed that no damage to internal elements or change in electrostatic capacitance is resulted by the application of impulse voltage.
- 5.2.6 Each CVT including its emvt unit shall be filled with insulating oil conforming to IS:335 or equivalent IEC and shall be hermetically sealed against moisture and dust.
- 5.2.7 The electromagnetic voltage transformer unit of CVT intended for out-door installation whose primary is to be fed by the inter-mediate tapping of capacitor divider shall be of oil immersed, self cooled design and shall be suitable for metering, relaying & synchronising services. The core of this transformer shall be of high accuracy at normal & high voltages. The primary winding shall be connected through a compensating reactor to compensate the voltage increase at inter-mediate tapping, whatever is the load within range of rated burden.
- 5.2.8 The design shall be free from corona effect to keep noise level of carrier frequency link very low. Use may be made of grading rings or Electrostatic screen for this purpose if required.
- 5.2.9 The design shall be suitable for rapid reclosing of the circuit and shall be capable of accurate and proportionate transmission of sudden variation in the primary voltage.
- 5.2.10 Each CVT shall be provided with a suitable damping device so that ferro-resonance oscillation due to saturation of iron core of transformer or any inductance connected in parallel with it and

initiated by either over voltages on the net work side or by opening of the short circuited primary or secondaries, shall be practically zero. Oscillations of the secondary voltages which may arise as a result of breakdown of primary voltages due to short circuits shall not affect the proper working of protective relays.

5.2.11 Design of the potential units of the CVT shall be based on the following requirements in connection with protective relaying:

- They must transmit accurately sudden drops of primary voltage.
- The CVTs must not enter into sub-harmonic resonance and transient oscillations during energisation. They must be damped out with sufficient rapidness.
- They must have sufficiently low short circuit impedance as seen from secondary.

5.2.12 A device shall be incorporated in a capacitor voltage transformer for the purpose of limiting over voltages which may appear across one or more of its components with/without to prevent sustained ferro-resonance.

5.2.13 The device may include a spark gap and may be located in several different ways according to its nature. (Clause 2.12 of IS:3156 (Part-IV)-1978 or IEC-186A Clause 37.12)

5.2.14 SECONDARY TERMINAL BOXES.

5.2.14.1 Suitable terminal boxes with removable gland plate for facilitating the entry of H.F. Cable & VT control cables shall be provided at an accessible position.

5.2.14.2 The secondary terminals of 245kV CVTs shall be brought out in two separate weather proof terminal boxes and it shall be provided with a removable gland plates. In case of 245kV CVTs, in the first box, secondary terminals of Protection and measurement cores shall be brought out.

5.2.14.3 In the second box the secondary terminals metering Core lead shall be brought out. The Metering secondary terminal box shall be provided with proper sealing facility.

6.0 INSPECTION & TESTS:

Following type test reports, as specified in IEC standard (amended up to date) shall be submitted for the offered type, rating of equipments invariably at the time of inspection for verification by TPI with/without owner's representatives. The type test reports shall not be older than ~~Seven~~ ^{FIVE} years and shall be valid up to expiry of validity of offer. The type test must have been carried out at any ISO/IEC/NABL accredited laboratories.

6.1 TYPE TESTS OF CAPACITIVE VOLTAGE TRANSFORMERS (CVT's):

The equipment offered should be fully type tested. Following tests are compulsory and must be submitted during detailed engineering stage. The type test reports should not be more than ~~seven~~ ^{FIVE} years old, reckoned from the date of bid opening and the type test should have been carried out in accordance with IEC-358(1992) and IEC-186 (1987) from any ISO/IEC accredited laboratories.

- Tests as per clause No.: 12.1, 12.2 & 14 of IEC-358 (1990) and clause 10.1 (b), 10.1 (d), 10.1(e), 10.1(f), 49, 51, 52 & 53 of IEC-186 (1987) latest addition of IEC's to be

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considered.

6.2 ACCEPTANCE

However, temperature rise test although covered under type tests will be get conducted during factory inspection in the presence TPI. The arrangement of required test is the responsibility of the contractor including all associated costs. The purchaser reserves the right to demand repetition of some or all the type tests in the presence of purchaser's representative.

6.3 ROUTINE TESTS:

All acceptance and routine tests as stipulated in the relevant IEC standards and based on approved QAP and shall be carried out by the ~~LSTK~~ contractor/~~LSTK~~ contractor in presence of authorised Third Party Agency (TPI) with/without Owner's representatives.

7.0 DOCUMENTATION:

The drawing and documentation shall follow following vendor data requirement schedule

Sr. No	Description with bids	With Bids	Post order		Final documents with equipments	
			For review	For records	soft copy	Prints
1.	Completely filled, datasheet(GTP) duly filled. technical catalogue, literature and manual.	x	x		x	x
2.	General outline and assembly drawings of the equipment.		x	x	x	x
	a.GA drawings (Elevation and Plan)		x	x	x	x
	b. Cross Sectional View		x	x	x	x
	c. Detailed drawing of pressure release device with detailed literature. Terminal connector drawing.		x	x		x
	d. Schematic drawing.		x	x		x
	e. Arrangement of terminals and details of connection studs provided.		x	x		x
	f. Porcelain used (if applicable) and its dimensions.		x	x		x
	g. The insulation & the winding arrangements, method of connection of the primary / secondary winding to the primary/ secondary terminals etc.		x	x	x	x

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	h. General Constructional Features. Materials/Gaskets/Sealing used		x	x	x	x
	i. Graphs showing the performance of equipment's in regard to magnetisation characteristics;		x		x	x
	j. Ratio & phase angle curves, ratio correction factor curves		x	x		x
3.	Inspection Plan and testing procedure (For review by inspection) & QAP		x			x
4.	Type Test Certificate		x	x		x
5.	List of Commissioning spares		x		x	x
6.	a. Installation and Maintenance manual			x		x
	b. Operating/Maintenance manual			x		x
	c. Catalogues/ Brochures			x		x
7.	Equipment storage procedure at site					x

GUARANTEED TECHNICAL

PARTICULARS CAPACITIVE VOLTAGE TRANSFORMER

1. Name of ~~ESTK~~ contractor
2. Type and model
3. Rated voltage (kV)
4. Capacitance:
 - a) Primary capacitance C1 (pf)
 - b) Secondary capacitance C2 (pf)
 - c) Equivalent capacitance C (pf)
5. Number of secondary windings
6. Rated secondary windings:
 - a) Winding-I (volts)
 - b) Winding -II (volts)
7. Rated secondary burden:
 - a) Winding - I (VA)
 - b) Winding - II (VA)
8. Accuracy class of each secondary:
 - a) Winding -I (VA)
 - b) Winding - II (VA)
9. Rated voltage factor with rated burden.
10. One minute power frequency withstand: Test (Dry) voltage (kV rms)
11. One minute power frequency withstand test (wet) voltage (kV rms)
12. 1.2/50 micro second impulse wave withstand test voltage (kV rms)
13. One minute power frequency withstand voltage on secondaries (kV rms)
14. Total creepage distance (mm)
15. Creepage factor
16. Is CVT suitable for carrier frequency in the range of 40 to 500 KHz? (Yes/No)
17. Natural frequency of coupling capacitors
18. Rated Primary burden of potential devices (VA)

IOCL, PANIPAT REFINERY	220kV OUTDOOR SWITCHYARD	CHAPTER 03
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19. Temperature rise at 1.2 times rated voltage with rated burden ($^{\circ}\text{C}$)
20. Guaranteed value of temp. coefficient. (percent per $^{\circ}\text{C}$)
21. Guaranteed value of radio interference voltage in micro-volts at different voltages.
22. Guaranteed sealing test.
The pressure at which sealing test is to be carried out.
23. Guaranteed value of the H.F capacitances and equivalent series resistance at different.
24. Value of stray capacitance and stray conductance in the carrier frequency range of 40 to 500 KHz.
25. Weight of oil and the standard to which it conforms
 - i) In capacitor unit (Kg/IS)
 - ii) In measuring unit. (Kg/IS)
26. Total weight (Kg)
27. Over-all dimensions (mm)
28. Mounting flange dimensional details
29. Whether CVT are suitable for Carrier communication, carrier protection, carrier tele-metering and carrier tele-printing services, metering, relaying protection, synchronising and interlocking purposes.
30. Do the CVTs contain built in compensating reactors and damping device in P.T. portion

Project: LSTK job for ISBL work of 220KV Grid

Bharat Heavy Electricals Limited

Power Import at IOCL, Panipat Refinery

Project Details & General Technical Requirements

Customer: Indian Oil Corporation Limited (IOCL)

Section-3

Consultant: TATA Consulting Engineers Limited (TCE)

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SECTION 3
PROJECT DETAILS & GENERAL TECHNICAL REQUIREMENTS

1. General

1. This section stipulates the general technical requirements under the contract and will form integral part of the technical specification.
2. The provisions under this specification are intended to supplement requirement for the materials, equipment and services covered under this specification and is not exclusive. However, in case of conflict between requirements specified in this section and requirements specified in other sections the requirements specified under respective sections shall hold good.

2. Project Details

Panipat Refinery is a PSU Refinery and is having capacity of 15 MMTPA, catering the customers of northern India and is strategically important as per national interest. The refinery is located at Panipat, Haryana and was commissioned in the year 1998.

Presently 132KV supply to Panipat Refinery is provided from 2 sections of grid (one from PTPS and one from Munak) and point of supply is at Panipat Refinery 132KV switchyard Panipat Refinery complex is consisting of Refinery (will be marked as PR here onwards) and Naphtha cracker complex (will be marked as PNCP here onwards). As a strategic initiative, Panipat Refinery is planning for Bulk power import from HVPNL (Haryana Vidyut Prasaran Nigam Limited) at 220 KV level of 70 MW.

In view of this, Indian Oil Corporation Ltd. (IOCL) - Panipat Refinery is in the process of developing infrastructure to import 70 MW power from grid at 220 KV. Infrastructure development for grid power import at 220KV jobs consists of Inside Battery Limit (ISBL) jobs, Outside Battery Limit (OSBL) jobs.

Sl. No.	Description	Particulars
1	Customer	Indian Oil Corporation Ltd.
2	Consultant	TATA Consulting Engineers Ltd.
3	Project	LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery
4	Project location	Panipat (City): 16 Km (approx.) Chandigarh Highway: 11 Km (approx.) Noida (Advant)/ Delhi: 150 Km/ 80 Km (approx.)
5	Transport facilities	Well connected by road, rail & air with other parts of the country.

3. Meteorological Data

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions,

Sl. No.	Technical Parameters	Unit	Particulars
1	Location	Panipat, Haryana, India	
1.1	Maximum ambient temperature	°C	50
1.2	Minimum ambient temperature	°C	-5
1.3	Average ambient temperature	°C	35
1.4	Design ambient temperature	°C	45
2	Average no. of thunder storm days	Days	45
3.1	Maximum Relative humidity	%	95
3.2	Maximum Relative humidity	%	26
4	Average Annual Rain Fall	Mm	900
5	Maximum Wind Pressure	Kg/ sqm	195
6	Maximum Altitude above Mean Sea Level	M	1000
7	Isoceraunic Level	Days/ Year	45
8	Seismic Level (Horizontal Acceleration)	Zone	4
9	Average no. of rainy day per Year	Days/ Year	120

NOTE: Moderately hot and humid tropical climate conducive to rust and fungus growth. The climate conditions are also prone to wide variations in ambient condition. Smoke is also present in the atmosphere. Heavy lightening also occurs during June to October. Switchyard is inside the refinery premise which is also prone to other corrosive gases like sulphur, H₂S, Chlorine etc.

4. Instruction to Bidders

1. The bidders shall submit the technical requirements, data and information as per the technical specifications provided in the bid documents.
2. The bidders shall furnish catalogues, engineering data, technical information, design document, drawings etc fully in conformity with the technical specification.
3. It is recognised that the Manufacturer may have standardised on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the owner. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously; All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.

4. Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the technical specifications unless include in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard shall be deemed to be included in the scope of the specification. All similar standard components/parts of similar standard equipment provided, shall be interchangeable with one another.
5. Unless brought out clearly in the respective schedule of deviations, it will be considered that, the bid proposal scrupulously confirms compliance to the specification. The bidder must bring out all the deviations in the bid proposal.
6. In case there is a discrepancy between the data offered equipment and catalogue furnished, and unless the deviations are brought out clearly in the Technical Deviation Schedule, the equipment will be deemed to conform compliance to the specification scrupulously.

5. Standards

1. The works covered by the specification shall be designed, engineered, manufactured, built tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.
2. The equipment to be furnished under this specification shall conform to latest issue with all amendments of standard specified of this section as well as under respective Sections/Chapters of the specification.
3. In addition to meeting the specific requirement called for in the respective sections of the Technical Specification, the equipment shall also conform to the general requirement of the relevant standards and shall form an internal part of the specification.
4. The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intend to complement each other.
5. The Manufacturer shall also note that list of standards presented in this specification is not complete. Wherever necessary the list of standards shall of the specification shall take precedence.
6. When the specific requirements stipulated in the specification exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.
7. Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards referred shall also be accepted.
8. In case governing standards for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in deviation sheets along with English language version of standard or relevant shall be subject to Owner's approval.

9. Indicative List of Standards and Specifications General Standards Indian Electricity Rules shall be as per **Annexure- A**.

6. Services to be performed by the Equipment being furnished

1. The 220/33 kV system is being designed to limit the switching surge over voltage and the power frequency over voltage within limits of IEC. The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, re-strike etc. under such over voltage conditions and in system where line lengths would extend up to 200 km.
2. All equipment shall also perform satisfactorily under various Electro-mechanical and meteorological conditions of the site of installation.
3. All the Equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, short circuit etc. for the equipment.
4. The bidder shall design the various forces for terminal connectors of the equipment are required to withstand.
5. The equipment shall also comply to the following:
 - All outdoor EHV equipment shall be suitable for hot line washing.
 - To facilitate erection of equipment, all items to be assembled as site shall be "match marked". All piping, if any between equipment control cabinet operating mechanism to marshalling box of the equipment shall bear proper identification to facilitate the connection at site.

7. Engineering Data

1. The furnishing of engineering data by the Manufacturer shall be in accordance with the schedule for each set of equipment as specified in the technical specifications.
2. The review of these data by the owner will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the owner may not indicate a thorough review of all dimensions, quantities and accuracy of the information submitted. This review and/or approval by the owner shall not be considered by the Manufacturer, as limiting any of his responsibilities and liabilities for mistakes and deviation from the requirements, specified under these specifications and documents.
3. All engineering data submitted by the Manufacturer after final process including review and approval by the owner shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the owner in Writing.
4. LIST OF DOCUMENTS
 - 4.1 The bidder must furnish a detailed list of drawings/documents along with the bid proposal which he intends to submit to the owner after awarded of the contract.

4.2 The supplier shall necessarily submit all the drawings/ documents unless anything is waived. The supplier shall submit required sets of drawings/design documents/test reports as may be required for the approval of the owner.

4.3 All engineering data submitted by the Manufacturer after final process including review and approval by the Owner shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the owner in Writing.

5. DRAWINGS

5.1 All drawing submitted by the Manufacturer 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 equipment and materials, clearances and spaces required for installation and interconnection between various portions of equipment and any other information specifically requested in the specifications.

5.2 Each drawing submitted by the Manufacturer shall be clearly marked with the name of the Owner, the unit designation, the specifications title, the specification number 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.

5.3 Further work by the Manufacturer shall be in strict accordance with these drawing and no deviation shall be permitted without the written approval of the Owner if so required.

5.4 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Manufacturer's risk. The Manufacturer 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 Owner. Approval of Manufacturer's drawing or work by the Owner shall not relieve the Manufacturer of any of his responsibilities and liabilities under the Contract.

5.5 OTHER REQUIREMENTS OF DOCUMENTATION

5.5.1 One set of soft copy of all drawings, manual, catalogues to be submitted along with 6 sets of hardcopies during submission of as built documents.

5.5.2 6 copies of instruction/operation manuals for complete project shall also be furnished. The instruction Manuals shall contain full details of drawing of all equipment being supplied under this contract, their exploded diagrams with complete instruction for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.

5.5.3 If after the commissioning and initial operation of the substation, the

instruction manuals require any modifications/additions/changes, the same shall be incorporated and the updated final instruction manual in the form of one (1) reproducible original and twelve (12) copies shall be submitted by the Manufacturer to the Owner.

The Manufacturer shall furnish to the Owners, twelve (12) sets of spare part catalogue.

5.6 TITLE BLOCK

Title block for project shall be as follows,

Customer:	Indian Oil Corporation Ltd.
Consultant:	TATA Consulting Engineers Ltd.
LSTK Manufacturer:	Bharat Heavy Electricals Ltd.
Project:	LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery

8. Colour Scheme and Codes

1. The Manufacturer shall propose parts a colour scheme for those equipment/ Items for which the colour scheme has not been specified in the specification, for the approval of Owner. The decision of Owner shall be final. The scheme shall include,
 - Finishing colour of Indoor equipment.
 - Finishing colour of Outdoor equipment.
 - Finishing colour of all cubicles.
 - Finishing colour of various auxiliary system equipment including piping.
 - Finishing colour of various building items.
2. All steel structures, plates etc. shall be hot dip galvanised or painted with noncorrosive paint on a suitable primer as per the provisions of the respective Section. It may be noted that normally all Owner's electrical equipment in Owner's switchyard are painted with shade 631 of IS-5 and Owner will prefer to follow the same for this project also. All the indoor cubicles shall be of same colour scheme and for other miscellaneous items colour scheme will be approved by the Owner.

9. Material/ Workmanship

1. GENERAL REQUIREMENTS

- 1.1 Where the specification does not contain characteristics with reference to workmanship, equipment, materials and component 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 the best engineering practice and suitable for the purpose for which they are intended.
- 1.2 The equipment must be new, of highest grade, the best quality of their kind, to best engineering practice and latest state of art in accordance with purpose for which they are intended and to ensure satisfactory performance throughout the service life.

- 1.3 In case where the equipment, material or components are indicated in the specification as "similar" to any special standard, the Owner shall decide upon the question of similarly. When required by the specification or required by the Owner the supplier shall submit, for approval, all the information concerning the material or components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Supplier.
- 1.4 The design of the work shall be such that installation, future expansions, replacement 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 part shall be accurately positioned and retained to fulfil 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 the Owner.
- 1.5 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 material and workmanship as the corresponding parts of the equipment supplied under specification. Where feasible, common component units shall be Employed in different pieces of the equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.
- 1.6 All material and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). The erection procedure must be approved by the OEM and erection completion shall be certified by OEM for satisfactory completion. The commissioning of all major equipment as recommended by Engineer in-charge.
- 1.7 Only first-class work in accordance with the best modern practice 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, grouping, levelling, aligning, coupling of or bolting down to previously installed equipment bases/ foundation, performing the alignment check and final adjusting prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instruction and the specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel 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 location and tested for healthiness.

1.8 The Supplier 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 purpose shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Supplier shall apply all operational lubricants to the equipment installed by him.

1.9 All oil, grease and other consumable used in the Works/Equipment shall be purchased in India unless the Supplier 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 Owner in establishing equivalent India make and Indian supplier. The same shall be applicable to other consumable too.

1.10 A cast iron or welded steel base plate shall be provided for all rotating equipment which are to be installed on a concrete base unless otherwise agreed to by the Owner. Each base plate shall support the units and its drive assembly, shall be of design with pads for anchoring the units and shall have a raised up all around and shall have threaded in air connections, if so required.

2. PROVISION FOR EXPOSURE TO HOT 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 favourable to the growth of fungi and mildew. The indoor equipment located in non- air conditioned areas shall also be same type.

2.1 SPACE HEATERS

2.1.1 The heater shall be suitable for continuous operation at 240 V as supply voltage. On-off switch and fuse shall be provided.

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

2.1.3 The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centred in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties, or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternately, they shall consist of a resistance wire mounted into a tubular ceramic body and embedded in vitreous gale. The surface temperature of the heater shall be restricted wire is wound on a tubular ceramic body and embedded in vitreous 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.

2.2 FUNGISTATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied to 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 interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

2.3 VENTILATION OPENING

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass or galvanized steel to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

2.4 DEGREE OF PROTECTION

The enclosures of the control cabinets, junction boxes and marshalling boxes to be installed shall provide degree of protection as detailed here under:

- a) Installed outdoor: IP 55
- b) Installed indoor in air conditioned area: IP31
- c) Installed in covered area: IP 52
- d) Installed indoor in non-air-conditioned area where possibility of entry of water is limited: IP 41

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

The above requirement is indicative only. Requirements as provided in respective technical specification shall prevail.

10. Rating Plates, Name Plates and Labels

1. Each main and auxiliary item of substation is to be permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading condition under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Owner. The rating plates of each equipment shall be according to IEC requirement.
2. All such nameplates instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternatively, two separate plates one with Hindi and the other English Instruction may be provided.

11. First Fill of Consumable, Oil and Lubricant

All the first fill consumable such as SF6, AC refrigerant, oil, lubricant, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications, into successful operation, shall be supplied by the Manufacturer unless specification excluded under the exclusions in these specifications and documents.

12. Design Improvements

1. The bidder may note that the equipment offered by him in the bid only shall be acceptable, however, the Purchaser or the Supplier may propose changes in the specification of the equipment or quality thereof and if the parties agreed upon any such changes, the specification shall be modified accordingly.
2. If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of the completion before the Manufacturer proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

13. Quality Assurance Programme

1. To ensure that the equipment and services under the scope of this contract whether manufactured or performed within the Manufacturer's Work or at his SubManufacturer's premises or at the Owner's site or at any other place of work are in accordance with the specification, the Manufacturer shall adopt suitable quality assurance programme to control such activities at all points necessary.

Such programme shall be outlined by the Manufacturer and shall be finally accepted by the Owner after discussions before award of contract. A quality assurance programme of the Manufacturer shall be generally covered the following,

- a) His Organization structure for the management and implementation of the proposed quality assurance programme.
- b) Qualification data for bidder's key personnel.
- c) Documentation control System.
- d) The procedure for purchases of material, parts components and selection of subManufacturer's services including vendor analysis, source, inspection, incoming raw material inspection, verification of material purchases etc.
- e) System for shop manufacturing and, site erection control including process controls and fabrication and assembly control.
- f) Control and non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and field activities.
- h) Control of calibration and testing of measuring instruments and field activities.

- i) System for indication and appraisal of inspection status.
- j) System for quality audits.
- k) System for authorising release of manufactured product to the Purchaser.
- l) System for maintenance of records.
- m) System for handling storage and delivery. and
- n) A quality plan detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services ordered.

The Owner or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Manufacturer/his vendor's quality management and control activities.

2. QUALITY ASSURANCE DOCUMENTS

The Manufacturer shall be required to submit the following quality Assurance Documents within three weeks after despatch of the equipment.

All Non-destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication and report including radiography interpretation reports.

Welder identification list, listing welder's and welding operator qualification procedure and welding identification symbols.

Welder and Welding operator qualification certificate.

Raw material test reports on components as specified by the specification and for agreed to in the quality plan.

Stress relief time temperature chart/oil impregnation tile temperature chart.

Factory test results for testing required as per applicable codes/ mutually agreed quality plan/standards referred in the technical specification.

The quality plan with verification of various customer inspection points(CAP) as mutually agreed and methods used to verify the inspection and testing points in the quality plan were performed satisfactory.

14. Inspection, Testing and Inspection Certificate

1. The Owner/ his duly authorised representative and/or outside inspection agency acting on behalf of the Owner shall have at all reasonable times free access to the Manufacturer's premises or Works and shall have the power at all reasonable times to inspect and examine the material and the Workmanship of the Works during its manufacture or erection and if part of the works during its manufacturing or erection and if the part of works being manufactured or assembled at other premises or works, the Manufacturer shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the work

were manufactured or assembled on the Manufacturer own premises or works, Inspection may be made at any stage of manufacture, despatch or at site at the option of the Owner and equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

2. All equipment being supplied shall conform to type tests and shall be subject to routine tests in accordance with relevant standards.
3. The Manufacturer shall give the Owner/Inspector thirty (30) days written notice of any material being ready for testing along with work test certificate. Such tests shall be to the Manufacturer's account. The Owner unless witnessing of the tests is virtually waived, will attend such tests with thirty (30) days of the date of which the equipment is notified as being ready for tests/inspection, the Manufacturer must ensure TPI for all inspections in line with tender documents.
4. The Owner or Inspector shall, within fifteen (15) days from the date of inspection as defined here in give notice in writing to the Manufacturer, of any objection to any drawings and all any equipment and workmanship which in his opinion is not in accordance with the contract. The Manufacturer shall give due consideration to such objections and shall either made the modifications that may be necessary to meet the said objections or shall confirm in writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.
5. When the, factory tests have been completed at the Manufacturer's or Sub-Manufacturer's Works the Owner/Inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests. The completion of these tests or the issue of the certificate shall not bind the Owner to accept the equipment should, it, on further tests after erection be found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of dispatch clearances in approved by the Owner.
6. In all cases where the Manufacturer provides for tests whether at the premises or at the works of the Manufacturer or of any Sub-Manufacturer. The Manufacturer except where otherwise specified shall provide free of charge such items as labour, material electrically, field water, stores, apparatus and instruments as may be reasonably demanded by the Owner/Inspector or his authorized representative to carry out effectively such tests of the equipment in accordance with the Manufacturer and shall give facilities to the Owner/inspector or to his authorised representative to accomplish testing.
7. The inspection by Owner and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Manufacturer in respect of the agreed quality assurance programme forming a part of the Manufacturers.
8. The Owner will have the right of having at his own expenses any other test(s) of Reasonable nature carried out at Manufacturer premises or at site of in any other place in addition of aforesaid type and routine tests, to satisfy that the materials comply with the specification.

9. The Owner reserves the right for getting any field tests conducted on the completely assembled equipment at site.

15. Tests

1. CHARGING

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Owner and the Manufacturer for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at site. The list of pre-commissioning tests to be performed are given in section-7 and shall be included in the Manufacturer's quality assurance programme.

2. COMMISSIONING TESTS

2.1 The available instrumentation and control equipment will be used during such tests shall calibrated. However un-measurable parameters shall be taken into account in a reasonable manner by the Owner for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The Owner will apply proper corrections in calculation, to take into account conditions which do not correspond to the specified condition.

2.2 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Manufacturer, free of cost.

2.3 The specified tests to be conducted on equipment have been brought out in the respective chapters of the technical specification.

2.4 The Manufacturer shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However, necessary fee shall be paid by Owner.

16. Packing and Shipping

All the equipment shall be suitably protected, coated, covered or boxes and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken account. The Manufacturer shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Owner takes no responsibility of the wagons.

17. 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 and pilings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

18. Painting and Finishing of Metal Surfaces

1. GENERAL

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use shall be hot-dip galvanized after fabrication. High tensile steel nuts and bolts and spring washers shall be electro-galvanized to service condition. All steel conductors including those used for earthing/grounding (above ground level) shall also be galvanized according to IS: 2629.

2. HOT DIP GALVANIZING

2.1 The minimum weight of the zinc coating shall be 610g/sq.m and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM.

2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel; The finished surfaces shall be clean and smooth and shall be free from defects like colour patches, are spots, unevenness of coating, plate which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

2.3 After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

2.4 The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.

2.5 Sharp edges with radii less than 2.5mm shall be able to withstand four immersions of the standard price test. All other coating shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating
- Uniformity of zinc
- Adhesion test
- Mass of Zinc

2.6 Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

3. PAINTING

3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 "code of practice for phosphating iron and sheet". All surfaces which will not be easily accessible after shop assembly shall beforehand be treated and protected for

the life of the equipment. The surface which are to be finished painted after installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swart shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

- 3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and over drying. The phosphate coating shall be sealed with application of two coats may be "flash dried" while the second coat shall be stoved.
- 3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.
- 3.4 The exterior colour of the paint shall be as per shade No.:631 of IS-5 and inside shall be glossy white. Each coat of primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipment.
- 3.5 In case the bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc. the procedure shall be submitted along with the bids for Owner's review & approval.

19. Handling, Storing and Installation

1. In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Owner or his representative, the Manufacturer shall unload, store, erect, install, wire test and place into commercial use all the electrical equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energization at rated voltage.
2. Manufacturer may engage manufacturer's engineer to supervise the unloading, transportation to site, storing and erection. The Manufacturer shall engage the manufacturer's Engineer's for testing and commissioning of the various equipment being procured by them separately. Manufacturer shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's supervisory Engineer(s)/ as per Manufacturer's approved process and shall extend full cooperation to them.
3. In case of any doubt or misunderstanding as to the correct interpretation of manufacture's drawing or instruction, necessary clarifications shall be obtained from the Owner/ Manufacturer. Manufacturer shall be held responsible for any damage to the equipment

consequent to not following manufacturer's drawing/instructions correctly.

4. Where assemblies are supplied in more than one section, Manufacturer shall make all necessary mechanical and electrical connections between section including the connection between buses. Manufacturer shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected during testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Manufacturer at his own expense.
5. Supplier shall be responsible for examining all the shipment and notify the Owner immediately of any damage, shortage, discrepancy etc. for the purpose of Owner's information only. The supplier shall submit to the Owner every week a report detailing all the receipts for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharf age and other such charges claimed by the transporters, railways etc. shall be to the account of the Supplier.
6. The Manufacturer shall be fully responsible for the equipment material unit the same is handed over to the Owner in an operating condition after commissioning. Manufacturer shall be responsible for the maintenance of the equipment material while in storage as well as after erection unit taken over by Owner, as well as protection of the same against theft, element of nature, corrosion, damages etc.
7. Where material/equipment is unloaded by Owner before the Manufacturer arrives at site or even when he is at site. Owner by right can hand over the same to Manufacturer and there upon it will be the responsibility of Manufacturer to store the material in an orderly and proper manner.
8. The Supplier shall be responsible for making suitable indoor storage facilities, to store all equipment which require indoor storage.
9. The words 'erection' and 'installation' used in the specification are synonymous.
10. Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.
11. The minimum phase to earth, phase to phase and section clearance for the various 132 kV, 66 kV and 33 kV sections of the switchyard are given below,

Voltage Grade	220kV	132kV	33kV
Phase to earth (mm)	2100	1300	320
Phase to Phase (mm)	2100	1600	350
Section clearance (mm)	5000	4000	2800

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life.

20. Protective Guard

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

21. Design Co-ordination

1. The Manufacturer shall be responsible for the selection and design of appropriate equipment to provide the best co-ordinate performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done so that it facilitates easy field assembly and maintenance.
2. The Manufacturer has to coordinate designs and termination with the agencies (If any) who are LSTK vendors/ Manufacturer for the Owner if applicable. The names of agencies shall be intimated to the successful bidders.

22. Design Co-Ordination Meeting

The Manufacturer will be called upon to attend design co-ordination meeting with the Engineer, other Manufacturer's and the LSTK vendors of Owner (If any) during the period of Contract. The Manufacturer shall attend such meeting at his own cost as and when required and fully cooperate with such person and agencies involved during those discussions.

23. Tools and Tackles

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

24. Equipment Bases

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base unless otherwise agreed to by the Owner. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

25. Support Structure (*NOT IN BIDDER'S SCOPE*)

1. The support structures should be hot dip galvanised with minimum 610 gram/m² net of Zinc.
2. In case of any deviation in this regard the bid is liable to be rejected.
3. Support structure shall meet the following mandatory requirements.
4. The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 meters or as per applicable standard.
5. The design calculations taking into account the environmental conditions of the substations shall be furnished for sizing of the structures.

26. Clamps and Connectors including Terminal Connectors (NOT IN BIDDER'S SCOPE)

1. All power clamps and connectors shall conform to IS:5561 & NEMA CC1 and shall be made of materials listed below,

a)	For connecting ACSR Conductors	Aluminium alloy casting conforming to designation A6 of IS:617 and shall be tested for all test as per IS:617
b)	For connecting equipment terminals made of copper with ACSR conductors	Bimetallic connectors made from aluminium alloy casting, conforming to designation A6 of IS 617 with 2mm thick bimetallic liner and shall tested as per IS:617
c)	For connecting GI shield wire	Galvanised mild steel
d)	Bolts, nuts & plain washer galvanised Spring washers for items 'a' to 'c'	Electro galvanisation for sizes Plain, washers below M12, for others hot dip galvanised. Electro-galvanised mild steel suitable for at least service condition-3 as per IS:1573

2. Each equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation. The conductor termination of equipment shall be suitable for Moose ACSR Conductor. The requirement regarding external RIV as specified for any equipment shall include its terminal fittings and the equipment shall be factory tested with the connectors in position.
3. Where copper to aluminium connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress. The design details of the joint shall be furnished to the Owner by the supplier.
4. Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of work.
5. No current carrying part of any of any clamp shall be less than 12 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminium body for Bi-metallic clamps.
6. Lateral load deflection test shall be carried out as an acceptance test. The test procedure and accepted norms shall be mutually discussed and agreed to.
7. All casting shall be free blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
8. Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.
9. All current carrying parts shall be designed and manufactured to have minimum contact resistance.
10. Clamps and connectors shall be designed to be corona controlled. RIV level for 220 kV system shall not be more than 1000/ micro volts respectively at the specified test voltage

as per IS/NEMA.

11. TESTS

Clamps and connectors shall conform to type tests and shall be subjected to routine tests as per IS:5561.

27. Control Cabinets, Junction Boxes, Terminal Boxes & Marshalling Boxes for Outdoor Equipment

1. All type of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS5039/IS-8623, IEC-439, as applicable, and the clauses given below.
2. Control cabinet, junction boxes, marshalling boxes & terminal boxes shall be made of sheet steel or aluminium and shall be dust, water and vermin proof. Sheet used shall be least 2.0 mm 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. In case of aluminium enclosed box the thickness of aluminium shall be such that it provides adequate rigidity and long life as comparable with sheet of specified thickness.
3. The enclosures of the control cabinets, junction boxes, terminal boxes & marshalling boxes shall provide a degree of protection of not less than IP 55 as per IS: 2147. The bidder shall offer type tested (IP:55) Marshalling kiosk and type test report for degree of protection test each type of box shall be furnished for arrival. After protection degree test of marshalling kiosk, 2.0 kVrms for 1 (one) minute, insulation resistance and functional test should have been conducted. In case these tests have not been carried out during IP55 test, then the Manufacturer shall carry out the IP-55 test along with these tests, at his cost.
4. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.
5. All door, removable covers and plates shall be gasketed all around with suitably profiled EPDM gaskets. The gasket shall be tested in the presence of Owners representative. 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 of 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 or GI wires.
6. All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connection. Boxes and cabinet shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within 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 plate. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel

plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.

7. A 240V, single phase, 50Hz, 15amp AC plug and socket shall be provided the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.
8. For illumination of control cabinet, a 7 Watt LED shall be provided.
9. All control switches shall be of rotary switch type and Toggle/piano switches shall not be provided.
10. EARTHING

Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of star of self-etching washer. Earthing of hinged door shall be done by using a separate earth wire.

11. TESTS

The marshalling kiosks shall be subject to routine tests as per 18:5039. The following routine tests shall also be conducted:

- Check for wiring
- Visual and dimension check

Marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/ferruling by pasting the same on the inside of the door.

28. Auxiliary Switches

The auxiliary switch shall confirm to the following type tests:

- a) Electrical endurance test -A minimum of 2000 operation for 2A DC with a time constant examination of mV drop/visual defects/temperature rise test.
- b) Mechanical endurance test. A minimum of operations as specified in the relevant IS with a subsequent checking of contact pressure test visual examination. Heat run test on contacts.

29. Terminal Blocks and Wiring

1. 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.
2. Terminal blocks shall be 1100 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.

3. 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.
4. 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.
5. 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.
6. The terminal blocks shall be of extensible design.
7. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
8. 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.
9. Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

a)	All circuits except CT circuits	Minimum of 2.5 sq.mm copper flexible
b)	All CT circuits copper flexible.	Minimum of 4 sq.mm.

10. 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.
11. 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.
12. There shall be a minimum clearance of 250 mm 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 interphase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets. The wiring required in these items shall be run in metallic ducts or shielded cables in order to avoid surge overvoltage either transferred through the equipment or due to transients induced from the EHV circuits.
13. All input and output terminals of each control cubicle shall be tested for surge withstand capability and transverse modes. The supplier shall also provide all necessary to achieve an impulse withstand level at the cable interfaces of equipment.

30. Lamps and Sockets

1. LAMPS

All indication lamps shall also be LED based. Socket base shall be as per IS-1258, except in the case of signal lamps.

2. SOCKETS

All sockets (convenience outlets) shall be suitable to accept both 5 A & 15 A pin round

Standard Indian plugs. They shall be switched sockets with shutters.

3. HAND LAMP

A 240 Volts, single phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

4. INTERIOR LIGHTING

Each panel shall be provided with a LED lighting fixture of Standard Indian type rates for 240 Volts, single phase, 50 Hz supply for the interior illumination of the panel during maintenance. The Fitting shall be controlled by the respective panel door switch.

5. SWITCHES AND FUSES

5.1 Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switch fuse units. Selection of the main and Sub-circuit fuse rating shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by fuses.

5.2 All fuses be of HRC cartridge type conforming to IS:9228 mounted on plug-in type fuse bases.

5.3 Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuses carrier base shall have imprints of the fuse rating and voltage.

31. Bushings, Hollow Column Insulators, Support Insulators

1. The bidder shall offer composite silicon rubber polymer insulator for all insulation purpose as per project requirement, conforming to IEC-61109. In case if non-compliance of composite insulators with respect to State/National electricity authorities' guidelines/requirements, the anti-fog type porcelain insulators may be used wherever mandatory. The required deviations with respect to above requirements shall be clearly mentioned in the deviation sheet along with the supporting documents. In absence of such deviations statements, the compliance of this point is mandatory and binding on the vendor.

2. Bushing shall be manufactured and tested in accordance with IS:2099 & IEC: 137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/18 5621. The support insulators shall be manufactured and tested as per IS 2544/IEC 168 and IEC 273. The Insulators shall also conform to IEC 815 as applicable.

3. Following requirements to be fulfilled if anti-fog porcelain insulators are provided as instructed in point 29.1 of this chapter.

3.1 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from lamination,

cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vilified tough and impervious to moisture.

- 3.2 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.
- 3.3 Support insulators/ bushings/ hollow column insulators shall be designed to have ample insulation, mechanical and rigidity for the conditions under which they will be used.
- 3.4 When operating at rated voltage there shall be no electric discharge between the conductors and busing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.
- 3.5 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and support other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal as metal or glazed porcelain.
- 3.6 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

4. TESTS

Bushing hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS:2099 & IS: 2544.

4.1 Technical parameters of bushing/ Hollow column insulators/ support insulators,

Sl. No.	Voltage Class	220kV System	132kV System	66kV System	33kV System
a)	Rated Voltage (kV)	245	145	72.5	36
b)	Impulse withstand voltage (dry and wet) (kVp)	1050	650	325	170
c)	Power frequency with stand voltage (dry and wet (kVrms))	460	275	140	75
d)	Total creepage distance (mm)	25mm/kV			
e)	Pollution	Class – III heavy (as per IEC 71) and as specified in section 2 for all class of equipment.			
f)	Insulator shall also meet requirement of and IEC-815 as applicable having alternate long and short sheds.				

32. Motors

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and conform to type tests and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

1. ENCLOSURES

- a) Motor to be installed shall have enclosure equivalent to IP 55 as per IS:4691.
- b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
- c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.
- d) Motor weighing more than 25 kg shall be provided with eyebolts, lugs or other means to facilitate lifting.

33. Rating Plates, Name Plates and Labels

Each main and auxiliary item of equipment is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment, type or serial number together with details of loading conditions under which the item of equipment in question has been designed to operate and such diagram plates as may be required by the Owner. The rating plate shall conform to IEC requirement.

All such name plates, instruction plates rating plates etc. shall be in bilingual with Hindi inscription first followed by English. Alternatively, two separate plates one with Hindi & the other with English inscription may be provided.

34. Radio Interference Voltage (RIV) Test

1. GENERAL

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for measurement of radio interference voltage (RIV).

2. TEST LEVELS

The test voltage levels for measurement of external RIV are listed under the relevant clauses of the specification.

3. TEST METHOD FOR RIV

3.1 RIV tests shall levels for according to measuring as per International Special-Committee on radio Interference (CISPR) Publication 16-1 (1993) Part-1. The measuring circuit shall preferably be tuned to frequency with 10 % of 0.5 MHz but other frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No.107-1964, except otherwise noted herein.

3.3 In measurement, RIV, temporary additional external shielding may be provided. In measurements of RIV only standard fitting of identical type supplied with the

- equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.
- 3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing voltages 85%, 100%, 115% and 130% of the specified RIV test voltage for all equipment unless otherwise specified.
- 3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.
- 3.6 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

Annexure-A:**List of Standards and Specifications/ General Standards/ Indian Electricity Rules**

IS-5:	Colours for Ready Mixed Paints and Enamels IS-335 Insulating Oil for Transformers and switchgear
IS-375:	Marketing and Arrangement for Bus-bars, Main Connection & Auxiliary Winding
IS-617:	Aluminium and Aluminium alloy & Ingots and Castings for General Engineering Purposes
IS-1448:	Methods of Test for Petroleum and its Products.
IS-2071:	Measuring Devices
IS-2147:	Degree of Protection Provided by Enclosures of for Low voltage switch gear and control Gear
IS-2165:	Phase-to-Phase Insulation Co-ordination, Principles and Rules
IS-2362:	Determination of Water by the Karl fisher Method
IS-3043:	Codes of practice for earthing
IS-3202:	Code of Practice for climate proofing of electrical equipment
IS-3637:	Gas Operated Relays
IS-6103:	Methods of Test for specific resistance (Resistivity) of Electrical Insulating Liquids
IS-6104:	Method of Test for Interfacial Tension of Oil against Water by the Ring Method.
IS-6262:	Method for Determination of Electric strength of insulating liquids.
IS-6792:	Method for Radio Interference Tests on High Voltage Insulators
IEC-214:	On-Load Tap-Changers
IEC-289:	Reactors
IEC-354:	Loading Guide for Oil Immersed power transformers.
IEC-551:	Determination of Transformer and reactor Sound levels
ANSI-C57, 12, 80:	General requirements for Distribution, Power and Regulating Transformers.
ANSI-C57, 12, 90:	Test Code for Distribution, Power and Regulation Transformers.
ANSI-C57, 16:	Terminology & Test Code for current limiting Reactors.
ANSI-C57, 21:	Requirements Terminology and Test Code for Shunt Reactors Rates over 500 KVA.
ANSI-C57, 92:	Guide for loading Oil-Immersed Power Transformer up to and including 100 MVA with 55oC or 65oC Winding Rise
ANSI-CG, IEEE-4:	Standard Techniques for high Voltage Testing
NEMA-TR-1:	Transformers, Regulators and Reactors
IS-4379:	Identification of the Contents of Industrial Gas Cylinders

1. Current Transformers, Voltage Transformers and Coupling Capacitor Voltage Transformers

IS-2705:	Current Transformers
IS-3156:	Voltage Transformers
IS-7311:	Coupling capacitor and capacitor divider
IEC-185:	Current transformers

EC-186A:	Voltage Transformers
IEC-186B:	Coupling capacitors and capacitor dividers
IEC-44:	Instrument Transformers measurement of Partial discharges
IEC-481:	Requirements for instrument transformers
ANSI-C93.1:	Requirements for power line carrier coupling capacitor

2. Bushing Insulators

IS-2099:	Bushing for alternating Voltages above 1000V
IEC-137:	Insulated Bushings for Alternating voltages above 1000 V
IEC-61109:	Composite Silicon Rubber polymer insulators.
IEC-60437:	Radio Interference Test on High voltage Insulators
IEC-60507:	Artificial pollution test on high voltage insulators to be used on AC systems
IEC-60815:	Guide for the selection of insulators in respect of polluted conditions.
IEC-61952:	Insulators for overhead lines, composite line, post insulators for alternative current within nominal voltage greater than 1000 volts upto 245 KV- Definitions, test methods and acceptance criteria.
IEC-61466/1:	Composite strings, insulator units for overhead lines for nominal voltage greater than 1 KV-part-1 Standard strength classes and end fittings.
IEC-61466/2:	Composite strings, insulator units for overhead lines for nominal voltage greater than 1 KV-part-2 Dimensional and electrical characteristics.

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SECTION-4

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER

RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

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

BHEL ENQUIRY. NO:

BIDDER: OFFER REFERENCE:

A)

Sl. No.	Parameters	Data	YES	Remarks
1	Manufacturer's type designation	Bidder to furnish in Remarks Col.		
2	Type of CVT			
	a) Insulating medium	Oil	YES	
	b) Installation	Outdoor	YES	
	c) Mounting	Upright	YES	
3	Standards Applicable	IEC-61869, IEC-60044-5, IEC-60358, IEC-60044-4, IEC-60481 IS:3156- (P1 to P4), ANSI-C5713, ANSIC92.2, ANSI-C93.1	YES	
4	Rated Voltage (kV rms)	220kV	YES	
5	Standard reference range of frequencies for which the accuracies are valid	As per relevant IS/ IEC	YES	

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Sl. No.	Parameters	Data	YES	Remarks
6	High frequency capacitance for entire carrier frequency range	Within 80% to 150% of rated capacitance	YES	
7	Equivalent series resistance over the entire carrier frequency Range	As per relevant IS/ IEC	YES	
8	Stray capacitance and stray conductance of the LV terminal over entire carrier frequency range	As per IEC 60358	YES	
9	One minute power frequency withstand voltage:			
	a. Between LV(HF) terminal and earth terminal	As per relevant IS/ IEC	YES	
	b. For secondary winding	3 kV (rms)	YES	
10	Maximum temperature rise over design ambient temperature	As per IEC:60186/ 61869	YES	
11	Winding parameters	As per table 1.2.1 & 1.2.2 of Section-1	YES	
12	CVT is Capacitor voltage divider type with electromagnetic Units		YES	
13	CVT is suitable for carrier coupling		YES	
14	FUSES:			
	a. All Secondary windings are protected by HRC cartridge type fuses		YES	
	b. Additional fuses provided for fuse monitoring		YES	
15	RF Choke / Reactor			
	a. Suitable for effectively blocking carrier signals over the entire carrier freq. range 40 to 500kHz		YES	
	b. Details of arrangement of the RF choke/reactor to prevent carrier signal from flowing into Potential transformer (EMU), furnished along with this offer		YES	

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Sl. No.	Parameters	Data	YES	Remarks
16	HF Terminal			
	a. Brought out through suitable bushing		YES	
	b. Earthing link with Fastener provided		YES	
17	The electromagnetic unit comprises of Compensating reactor, intermediate transformer & protective and damping devices		YES	
18	Additional protection <u>if required</u>			
	a. Protective surge arrestor provided		YES	
	b. If alternate arrangement is provided, bidder to furnish details along with offer		YES	
19	External Surface			
	Steel	As per Section-2 & 3	YES	
20	Insulator /Bushing			
	a. Material			
		i. Shedded Polymer insulator	YES/ NO	
		ii. Shedded Porcelain insulator	YES/ NO	
	b. One piece construction without any metallic flange joint		YES	
21	Specific requirements for CVT's			
	a. Oil filled CVT's:			
	i. Grade of oil	EHV grade	YES	

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Sl. No.	Parameters	Data	YES	Remarks
	ii. Standard to which oil conforms	IS-335 / IEC-60296	YES	
	iii. Oil filling and drain plug provided for Electromagnetic unit of CVT		YES	
	iv. Oil sight glass provided for Electromagnetic unit of CVT		YES	
22	Cantilever Strength	Not less than 600Kg	YES	
23	Hermetic Sealing			
	a. Hermetically Sealed		YES	
	b. Details of arrangement made for Hermetical sealing of the CVT's are available and shall be furnished for approval at contract stage		YES	
	c. Details of Site test to check the effectiveness of the hermetic sealing are available and shall be furnished for approval at contract stage		YES	
24	Impregnation details along with Test/Checks: to ensure successful completion of impregnation cycle are available and shall be furnished for approval at contract stage		YES	

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Sl. No.	Parameters	Data	YES	Remarks
25	Name Plate			
	a. As per IEC standards, and shall clearly indicate Year of manufacture, Rated voltage, voltage factor & intermediate voltage		YES	
	b. Shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided		YES	
26	The CVT manufacturer meets the Technical Requirements specified in Section-1, Clause No. 1.3 of this Technical Specification		YES	
27	Valid Type test reports as per Section-1 & 2, submitted along with offer		YES	
28	Two Nos. Separate weather-proof secondary terminal boxes provided for protection & metering cores.		YES	

B) TYPE TESTS

i) Whether type test reports of the tests as per relevant IS/IEC and additional type tests as per technical specification Section-1 & 2, conducted earlier on identical or similar material are available (test reports should be of the tests conducted not earlier than five years from the date of techno-commercial bid opening). (YES)

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

Date:

Signature of the authorized representative of Bidder

Company Seal