TECHNICAL PRE- QUALIFICATION REQUIREMENT

Project: LSTK Job for ISBL work of 220kV Grid Power Import at IOCL Panipat Refinery

Equipment: Testing Instruments and Operating Tools and Safety Equipment

The following requirement shall be met by the bidders:

Sr No	Description of Technical Requirement	Documents to be submitted for proof
1	The bidder should have supplied the offered make/ model in past to Power Utility, Industry, any NABL accrediated testing laboratory, etc.	a. Purchase order copy shall be submitted b. Proof of dispatch & receipt OR performance certificate shall be submitted
2	The bidder should be manufacturer/ authorized distributor of the item/ items quoted	Valid authorization letter from OEM OR Proof of manufacturing facilities.

Soumik Banerjee 19/10/21
(SOUMIK BANERJEE)
Dy Manager

Sr DGM ~~Vivek Kapil~~ 19.10.21

AGM & HOD 3125011 19/10/21

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NOIDA

DOCUMENT NO.	TB-411-316-019	REV 00	PREPARED	CHECKED	APPROVED
TYPE OF DOC.	TECHNICAL SPECFICATION	NAME	SB	VK	AG
TITLE **Testing Instruments, Operating tools & Safety Equipment** (suitable for highly corrosive environment)		SIGN			
		DATE	18.10.2021	18.10.2021	18.10.2021
		GROUP	TBEM		
		WO NO.	I19TB00003 REV00		

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
LOA. NO. WO. No.	RPRC182491/26286965 dtd. 24.01.2020 26286965 dtd. 24.01.20120

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Remarks: It is to be noted that data and details of Guaranteed Technical Particulars (GTP) shall not be reviewed during Technical Evaluation/ Review, hence compliance of Guaranteed Technical Particulars (GTP) in line with Technical Specification shall be deemed to under complete compliance of bidder.

REV. NO.	DATE	ALTERED	CHECKED	APPROVED	
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				COPIES	

SECTION 1:
CHECKLIST FOR TECHNICAL EVALUATION

Along with the technical offer/ bids, the bidder should submit this checklist confirming the inclusion of the enclosures as listed below,

Sl. No.	Documents to be enclosed	Bidder to confirm (Please tick "Confirmed")
1.	Unpriced BOQ duly mentioning "Quoted" for all the items, signed and sealed.	Confirmed
2.	Annexure-A, B, C & D duly filled, signed and sealed.	Confirmed
3.	Supporting documents for compliance of Technical Qualifying Requirement.	Confirmed

Note: Any bidder not meeting the above requirement is liable for non-evaluation.

The above checklist is reviewed and verified for,

NIT Reference No.:

Name of Bidder:

Name of Equipment/ Material:

Name of Project:

Date: Bidder's Stamp & Signature

SECTION - I
Scope, Quantities and Specific Technical Requirements

1.1 Scope

This specification is intended to specify the requirements for Testing Instruments, Operating Tools and Safety Equipment required at site as mentioned in subsequent clause. The scope of work shall encompass at least the following:

i) Inspection and testing before supply
ii) Packing, Loading & Transportation to site
iii) Providing engineering data, drawings, Brochures and O & M manuals for BHEL/IOCL review, approval and records.
iv) Testing, Demonstration at site of the testing equipment.

1.2 The equipment is required for the following Project

Name of customer : Indian Oil Corporation of India Ltd (IOCL)
Name of consultant : Tata Consulting Engineers Limited
Name of the main contractor: Bharat Heavy Electricals Limited
Name of the project : LSTK Job for ISBL work of 220kV Grid Power Import at IOCL, Panipat Refinery

Refer section-3 of this document for project details and general specification.

Major items supplied and installed in this project are as follows
a) 220kV, CGL make GIS
b) 33kV, UNIVERSAL (Unistar) Make Cables
c) Substation Automation System (SAS) and Control and Relay Panels, GE Make
d) 33kV, BHEL Make LIB Switchgear
e) 220/33kV BHEL Make Transformer

Note: The terms used in this specification namely, "Employer/Purchaser/Owner" refers to IOCL, "Contractor "refers to BHEL & "Sub-contractor/ Supplier/ Vendor" refers to bidder.

1.3 Bill of quantities

S. NO.	Description	Unit	Quantity
A	**Testing Instruments**		
1	Primary current injection kit, portable, Input: 0-230V AC, Output: 2500A continuous with 10 meter cable, Make: Megger, ODEN AT/3S or equivalent	No.	2
2	VLF AC Test kit with attachments for PD assessments and analysis system/DAC@50Hz, Tandelta, Sheath Fault, Portable, 0-40KV AC as per IEC60229, Make: Megger TDM4540PTD or equivalent	No.	2
3	Battery Ground Fault Locator, Make: Megger BGFT or equivalent	No.	2
4	Phase sequence tester, Make: Megger PSI 410 or equivalent	No.	2

5	Power Quality Analyser, 3 Phase with 4 voltage and 5 current inputs, Make: Megger MPQ2000 or equivalent	No.	2
6	Transformer oil moisture analyser, Make: Megger KF875 or equivalent	No.	2
7	Cable route tracer, Make: SPX RD8100 or equivalent	No.	2
8	Transformer Oil BDV test Kit. Make: Megger OTS100 or equivalent	No.	1
S. NO.	**Description**	**Unit**	**Quantity**
B	**Operating Tools and Safety Equipment**		
1	Insulated hand gloves for HV systems	Pair	10
2	Contact type live line detectors upto 220KV voltage level	No.	4
3	Non- Contact type Live line Detectors upto 220 KV voltage level	No.	4
4	Arc Flash suit	No.	2
5	Face shield	No.	10
6	Discharge rod suitable for EHV system	No.	6
7	Safety Goggles	No.	10

1.4 **Specific Technical Requirements**

1. Supplier should specify the Make & Model & accessories/complete scope of supply offered against each item along with Technical Bid.
2. Supplier is required to provide all the Technical details/ Catalogue/Datasheet of the offered make/model against each item.
3. The Catalogue of the offered make/ Model shall be available on OEM website as on Technical Bid opening date. The catalogue submitted should match with the one available on website.
4. Make/Model offered is subject to IOCL approval. IOCL approval shall be considered as final.
5. All the above listed equipment shall be supplied with standard accessories & any other accessory required to meet the technical specification.
6. The Test equipment shall be delivered to site in new/ fresh condition.
7. Supplier shall provide valid calibration certificate, test certificate & warranty certificate for the quoted test equipment (as applicable), in the event of order.
8. Supplier is required to give an undertaking "to address issue of warranty / after sales services either itself or from the respective manufacturer/OEM of the equipment" along with technical offer on its/OEM letterhead.
9. Supplier is required to give undertaking (in the technical offer) from respective manufacturer/OEM of the equipment on OEM letterhead stating that the offered make/model is suitable for use in 220kV AC charged station in a Refinery & there will be no change in technical performance of the equipment during the equipment life in the site conditions.
10. The test and maintenance equipment shall be of top quality & IOCL may call for demonstration of the offered test equipment in 220kV charged switchyard, to ensure satisfactory performance before accepting the equipment. The same shall be without any

price implication.

11. The instrument is intended for use in high-voltage substation and in refinery environment. The testing equipment are generally meant for carrying out testing at site and movement from one place to another is unavoidable. Therefore, equipment shall be robust in design so that it gives desired performance even in adverse site conditions. Necessary transport packing arrangement shall be provided along with the equipment.
12. Necessary tools, accessories, hardware and licensed-software are deemed to be included in the equipment price which are necessary for successful demonstration of instrument at site and to analyse the diagnosed values/ measured parameters. These tools and hardware include connectors, connecting-leads, wires, converters, adaptors, standard accessories etc.
13. Bidder shall offer equipment complying to the requirements given in Section-2 of this specification. Bidder can, however, offer alternative features and parameters which meet the functional requirements of end-customer. End-customer, M/s IOCL, will have final say on its acceptance/ rejection of the model. Bidder shall be liable for considering the same without any implication to BHEL.
14. Laptops shall be provided wherever it is necessary for the offered instrument to operate. Price for the Laptop and its accessories is deemed to be included in offered price.
15. Price for conduction of FAT, Inspection, testing and site-demonstration is deemed to be included in offered price.
16. Technical Evaluation of above items will be done item wise. Bidder may quote for One or more no of items from the above BOQ.
17. In event of placement of order, if the selected make/model is obsolete during the supply stage, vendor need to supply equivalent/better make/model without any price implication with prior approval of BHEL/IOCL.

1.5 **Inspection and Testing**

1. Bidder to submit Certificate of conformance (COC) and Manufacturer's Test Certificate for customer dispatch clearance. MRC shall be issued after successful demonstration at site for items under Sr No A of BOQ.

1.6 **Packing and Dispatch**

1. The items/ materials 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. 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.
2. Storage instructions for each item should be sent to site before dispatch of items.

1.7 **Drawings / Documents required for Engineering Clearance**

1. The drawings/ documents, as follows shall be used for providing engineering manufacturing clearance of the equipment and furthermore, it shall be used for delay analysis, if any from bidder. The schedule for submission and resubmission shall be in line with activity schedule of Purchase Order.

1	Instruments - Drawings & Guaranteed Technical Particulars, catalogues
2	Instruments - Test Reports and Test Certificate

2. Date of Submission of first lot of drawings/ documents shall be counted only from the date of submission of reasonably correct drawings/ documents.
3. The successful bidder shall ensure vendor approvals, if required as well as approvals of all requisite drawings/ datasheets/ type test reports/ QAP etc, wherever required, for the offered equipment as per this specification from Customer/IOCL.
4. The successful bidder shall have to extend all possible supports like timely submission/ resubmission of drawings, visit to end customer to facilitate documents approval without any commercial implications to BHEL. Acceptance of bidder's documents shall be subject to end customer approval.

SECTION – 2
Equipment specification under scope of supplies

1.0 TESTING INSTRUMENTS

1.1 Primary Current Injection Kit (Make Megger ODEN AT/3S or Equivalent)

The Unit shall be suitable for secondary injection and primary injection as well with built-in timer of 1msec resolution. It should be designed for primary injection testing of protective relay equipment, circuit breaker, turns ratio of current transformer and for other applications that require high variable currents.

Input power supply of the test unit should be single phase 50 Hz AC. The instrument is intended for use in high-voltage substation and industrial environments.

Input: 0-230V AC, Output: 2500A continuous with 10 meter cable

At 240V mains voltage, 50/60 Hz		
Sr No	Open Circuit Voltage	Max Continuous current
1)	6V	2500A
2)	18V	840A

1.2 VLF AC Test Kit with attachments for PD assessments and analysis system (Make Megger TDM4540PTD or Equivalent)

Unit shall be suitable for testing and diagnosis of MV cables. The offered instrument shall be suitable for Very Low Frequency (VLF) testing of short-length, long-length cables and tan-delta diagnostics. The operator shall be able to perform VLF withstand testing as per IEC or IEEE standards, DC testing, sheath testing as per IEC 60229. The offered unit shall be portable.

Base Module VLF

Output Voltage	
VLF sine wave	0 – 32 kV RMS/ 0 – 45 kV peak
DC Voltage	$\pm$ 0 – 45 kV
VLF rectangular voltage	$\pm$ 0 – 45 kV
Output Current	
Measuring Range	0 – 20 mA
Frequency Range	0.01Hz – 0.1 Hz
Internal tanDelta	
Measuring Range	10^{-3} - 10^{0}
Sheath testing (as per IEC 60229)	0 – 5 kV, 0 – 10 kV, 0 – 20 kV

Boost Module VLF

Output Voltage	
VLF	0 – 40 kV RMS
Leakage Current	
Measuring Range	0 – 20 mA
Frequency	0.1 Kz

The unit shall be complete with connecting cables (HV and Ground)

1.3 Battery Ground Fault Locator (Make Megger BGFT or Equivalent)

Unit which shall be able to find ground faults on Line in ungrounded Battery/ intricate D.C. System up to 220V, UPS systems and any other ungrounded DC System. The instrument should be provided with digital display of voltage and current Signal amplitudes. Bridge measurement of fault resistance and System Capacitance should be possible with the instrument. The instrument's fault resistance range should be from 1Ω to 399 kΩ. The instrument should comprise of Transmitter that operates on mains and a portable, convenient, hand held receiver that operates on battery. The measured reading should not be affected by any presence of A.C. ripple or D.C. current.

Source Voltage	Variable from 0 to 15 V rms in low range
	Variable from 0 to 50 V rms in high range
Source Current	Load dependent from 0 to 1.7A rms
Source Frequency	20Hz, ± 2%
Fault Resistance	1 kΩ to 399 kΩ at 50 V; bridge accuracy ±10%
Line Capacitance	0.01 to 11.1 µF; bridge accuracy ±20%

1.4 Phase sequence Tester (Make Megger PSI410 or Equivalent)

Phase Sequence tester should determine phase rotation sequence of energised three phase power circuits and indicate phase continuity. Meter should indicate faulty phase if continuity is not proven. Heavily insulated fused leads with boot protected alligator clips should be provided for extra safety. Identify true phase sequence of energised 3 phase ac power lines up to max 500 volts (Ph-Ph). The tester should be self-powered and requires no battery.

Rotation display	3 x red / green LEDs
Phase connection status indication	Phase present indication = 195 to 265 V
Audible rotation tone	Clockwise rotation = continuous tone
	Counter clockwise = warble tone (0.4 s on / 0.4 s off)
Maximum voltage (phase to phase)	500 V
Frequency	50 Hz ± 1%

1.5 Power Quality Analyser (Make Megger MPQ2000 or Equivalent)

The unit shall be portable, 9 channel, 3-phase analyser capable of viewing RMS data, waveforms, demand data, phase angles, harmonics, unbalance in real time. The unit shall be capable of recording.

Voltage	4 voltage channels (isolated)
AC voltage range	0 to 1000 V AC RMS
DC voltage range	±1500 Vdc
Current Channels	5 current channels
Current range	0 to 6000 A (CT dependent)

Current ratios	Adjustable current ratios for measuring secondary (000.1 through 9999)
Harmonics	0 through 50th continuous
Inter-harmonics	0 through 50th continuous

1.6 Transformer Oil moisture analyser (make Megger KF875 or Equivalent)

The unit shall be designed to determine moisture in oil, to provide highly accurate results onsite. The unit shall be highly portable instruments, complete with integral printer and carrying case, are easy to use and provide highly accurate results.

Titration Method	Coulometric Karl Fischer Titration
Type of sensor	Two pin platinum electrode
Measuring range	1 µg - 10 mg water
Moisture range	1 ppm - 100 ppm
Max. titration speed	2 mg per minute
Max. current	400 mA

1.7 Cable Route Tracer (Make SPX RD8100 or Equivalent)

The unit shall have antennas which allows to choose optimum level of precision. It shall have integrated GPS. The unit shall have rechargeable battery for locator and transmitter. The 4kHz locate frequency with current direction shall enable the unit to locate and trace higher impedance cables for long distances. Upto 5 additional frequencies can be programmed into all locators to match it to the signals found on target telecom networks.

Locator

Locate Frequencies	18
Sonde Frequencies	4
Passive Modes	5
Power Filters	Yes
4 kHz	4k+CD
Current Direction	Yes
Fault Find	Yes
Depth in Power	Yes
Passive Avoidance	Yes

Transmitter

Max. Output Power	5 W
Active Frequencies	16
Induction frequencies	8
Fault Find	Yes
Induction field strength	0.85

1.8 Transformer Oil BDV Test Kit (Make Megger OTS100 or Equivalent)

Monitoring and maintenance of oil quality is essential in ensuring the reliable operation of oil filled electrical equipment. One of the fundamental tests of oil quality is the breakdown voltage test, which is a measure of the oil's ability to withstand electric stress. A low breakdown voltage can indicate the presence of contaminants such as water or conducting particles.

Max test voltage	100kV
Test Voltage	0 to 100 kV rms maximum (50 kV - 0 - 50 kV)
Voltage rise time	0.5 kV/s, 2.0 kV/s or 3 kV/s depending on selected test standard

2.0 OPERATING TOOLS and SAFETY EQUIPMENT

2.1 Insulated Hand Glove for HV System (33V)

a) Good gloves are durable and flexible.
b) These hand gloves have seamless construction and made from specially compounded latex for compute insulation.
c) Electrical Rubber Hand Gloves for protection against electrical shocks
d) This industrial rubber hand gloves have excellent grip water resistance high strength lightweight and high durability.
e) It is 100% shock proof.

2.2 Contact Type live line detector upto 220kV voltage level

Frequency	50-60 Hz
Power Source	Rechargeable/ Replaceable Battery
Voltage	Upto 220kV.
Design	Contact Type

a) Rugged, durable housing
b) Contact detector with voltage range upto 220kV.
c) When voltage is detected, it gives an audible and visual indication (flashing Red).
d) Has the ability to detect voltage on most elbow test points
e) Dual hotstick connections - universal spline and shotgun stick
f) Loud beeper and LED lights indicate voltage
g) Easy to use electronic touch pad with large buttons

2.3 Non-contact type Live-Line Detector upto 220kV voltage level

Frequency	50 Hz
Power Source	Rechargeable/ Replaceable Battery
Voltage	Upto 220kV.
Design	Non-contact probe type

The High Voltage Detector is a safety device used to verify that transmission lines are not live prior to earthing.

a) Rugged, durable housing
b) Non-Contact type probe with voltage range upto 220kV.
c) When voltage is detected, it gives an audible and visual indication (flashing Red)
d) Telescopic insulation stick, Insulation Class F
e) Loud beeper and LED lights indicate voltage
f) Easy to use electronic touch pad with large buttons

2.4 Arc Flash Suit

a) Protective suits meet NFPA 70E hazard risk category (HRC) 4
b) Made with Indura Ultra Soft (88% cotton) for comfort and breathability
c) Meets current ASTM F2178 and NFPA 70E standards and the flammability requirements for ASTM F1506
d) INCLUDES arc flash coat, bib overalls, Pro-Hood, hard hat, safety glasses, and a carrying bag
e) These kits meet NFPA 70E hazard risk category (HRC) 4. All are rated to 40 cal/cm2. Kit includes an arc flash coat, bib overalls, Pro-Hood, hard hat, safety glasses, and carrying bag

2.5 Face Shield

a) Suitable for ARC, TIG, MIG, Spot, Micro, Wire, AC, DC, and Plasma Welders and Plasma Cutters.
b) Auto-Darkening Welding Helmets is designed & equipped with a special turnover up & down headband mechanism. When welder turns over the helmet to welder's head top, the headband mechanism makes helmet's gravity center to be more-lower, and be coincided with the center of welder's head.
c) At the moment of starting welding, it automatically changes filter screen from clear to dark in only 1/25,000 sec.
d) Dark to clear delay adjustment: Operator can vary the time for the filter to return to clear state.
e) Sensitivity car: be adjustable by turning the sensitivity-setting switch to high(low) position.

2.6 Discharge Rod for EHV system

Size	18 Ft
Material	FRP
Voltage	220000 Volts
Color	White, Yellow
Diameter	40 mm
Clamp	Aluminium/Copper
Cable Type	Single Core Copper ISI
Number Of Pipe	3 Section
Rubber Hand Grip	Yes

2.7 Safety Goggle

a) OG, GLARE, AND SCRATCH RESISTANT FOR BETTER VISIBILITY — Double coated, untainted lenses mean no fogging up or optical distortion so you can see better at all times. In addition, it has the features of anti-dust, anti-pollen, anti-allergy. It can reduce UV rays and block glare, protecting eyes from harmful light.
b) DESIGNED TO BE PROTECTIVE AND BUILT TO LAST—These Safety Glasses keep your eyes safe from direct and peripheral threats with a strong and durable polycarbonate wraparound construction. Also protects eyes from 90-100% of harmful UV radiation.
c) ADJUSTABLE TEMPLE—The temples are stretchable, can be adjusted to suit your comfort, no matter the face type or head size. Ergonomic one-piece lens design, comfortable to wear and stress-free.
d) IDEAL FOR WORK— Ideal for woodworking and carpentry, metal and construction, or other outdoor activities in a dusty climate you need to wear the safety glasses. It has function of anti-splash, can protect eyes from strong impact when handling heavy objects such as grinder work, car factories and ironworks, making it ideal for DIY work.
e) SIZE— Frame width: 148mm, Frame height: 55mm, Temple length: 125-145mm, Length of temple adjustable range: 20mm.

SECTION 3:
PROJECT DETAILS & GENERAL TECHNICAL REQUIREMENTS (FOR ALL EQUIPMENT UNDER PROJECT)

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 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/ 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	^{0}C	50
1.2	Minimum ambient temperature	^{0}C	-5
1.3	Average ambient temperature	^{0}C	35
1.4	Design ambient temperature	^{0}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 conductive 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 contractor 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 inter changeable 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 Contractor 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 Contractor 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 Contractor, 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 Contractor after final process including review and approval by the owner shall from 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 Contractor after final process including review and approval by the Owner shall from 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 Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other 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 Contractor 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 Contractor 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 Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Owner. Approval of Contractor's drawing or work by the Owner shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

5.5 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Owner would be discussed and finalised at the time of award. The supplier shall also submit six (6) copies of all drawings/design documents/test report for approval of the Owner. The following tentative schedule shall be followed in general for approval. However final schedule shall be prepared with approval of Engineer in-charge post award of approval.

1	Submission, comments, by resubmission and approval recommended agency	Within 4 weeks of receipt
2	Approval/ comments/ by Owner on initial submission	Within 4 weeks of receipt.
3	Resubmission	Within 3 (three) weeks (whenever from date of comments required) including both ways postal time.
4	Approval or comments	Within 3 weeks of receipt of commented drawing/ documents.
5	Furnishing of distribution copies	1 weeks from the date of last approval.

NOTE: The contractor may please note that all resubmission must incorporate all

comments given in the submission by the Owner failing which the submission of documents is likely to be returned.

5.6 The drawing which are required to be referred frequently during execution should be submitted on cloth lined paper.

5.7 OTHER REQUIREMENTS OF DOCUMENTATION

5.7.1 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.

5.7.2 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, handing, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.

5.7.3 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 Contractor to the Owner.

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

5.8 TITLE BLOCK

Title block for project shall be as follows,

Customer:	Indian Oil Corporation Ltd.
Consultant:	TATA Consulting Ltd.
LSTK Contractor:	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 contractor 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 cubicals.
   - 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 ardent 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 if 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 Contractor 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 if 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 contractor 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 contractor's Work or at his Subcontractor's premises or at the Owner's site or at any other place of work are in accordance with the specification, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary.

Such programme shall be outlined by the contractor and shall be finally accepted by the Owner after discussions before award of contract. A quality assurance programme of the contractor 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 subcontractor'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 Contractor/his vendor's quality management and control activities.

2. QUALITY ASSURANCE DOCUMENTS

The contractor 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 Contractor'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 contractor shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the work were manufactured or assembled on the Contractor 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 Contractor 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 Contractor'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 contractor 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 contractor, of any objection to any drawings and all any equipment and workmanship which in his opinion is not in accordance with the contract. The Contractor 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 Contractor's or Subcontractor'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 Contract provides for tests whether at the premises or at the works of the contractor or of any Sub-Contractor. The Contractor 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 contractor 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 Contractor in respect of the agreed quality assurance programme forming a part of the contractors.
8. The Owner will have the right of having at his own expenses any other test(s) of Reasonable nature carried out at Contractor 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 Contractor 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 Contractor'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 Contractor, 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 Contractor 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 Contractor 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 liked is 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 notices 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 digressed, 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 to 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 contractor 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 energisation at rated voltage.
2. Contractor may engage manufacturer's engineer to supervise the unloading, transportation to site, storing and erection. The contractor shall engage the manufacturer’s Engineer’s for testing and commissioning of the various equipment being procured by them separately. Contractor 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. Contractor 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, Contractor shall make all necessary mechanical and electrical connections between section including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected during testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor 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 Contractor shall be fully responsible for the equipment material unit the same is handed over to the Owner in an operating condition after commissioning. Contractor 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 Contractor arrives at site or even when he is at site. Owner by right can hand over the same to Contractor and there upon it will be the responsibility of Contractor 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 Contractor 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 Contractor has to coordinate designs and termination with the agencies (If any) who are LSTK vendors/ contractor for the Owner if applicable. The names of agencies shall be intimated to the successful bidders.

22. Design Co-Ordination Meeting

The Contractor will be called upon to attend design co-ordination meeting with the Engineer, other Contractor's and the LSTK vendors of Owner (If any) during the period of Contract. The Contractor 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 Contractor 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

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

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 then 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 contractor 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 though 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. AII 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 2544/1EC 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 lEC 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 ratio 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 earning
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. Circuit Breakers

IEC-56: High Voltage Alternating Current Circuit Breakers
IS 13118/ IEC-427: Synthetic Testing of high voltage alternating current circuit breakers

2. 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

3. 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.

4. Surge Arresters

IS-3070: Lightning arrestors for alternating current systems: Metal (part-3) oxide lightning arrestors without gaps.
IEC 99-4: Metal oxide urge arresters without gaps

5. Cubicles and Panels & Other related Equipment

IS:722: AC Electricity Meters (P1 to P9)

IS 1248 Direct acting indicating analogue electrical measuring instruments their accessories.
IS722, IS-1248: (PO-3) Electrical relays for power system protection.
IS-3231, 3231, IEC-68.2.2: Basic environmental testing procedures Part 2: Test B: Dry heat
IEC-529: Degree of Protection provided by enclosures
IEC-158: Low Voltage control gear, contractors
IEC-439: Low voltage switchgear and control gear assemblies
ANSI-C37.20: Switchgear assemblies, including metal enclosed bus.
ANSI-C37.50: Test Procedures for low voltage alternating current power circuit breakers
ANSI-C39: Electric Measuring instrument.
ANSI-C83: Components for electric equipment
IS:8623: Specification for sugar NEMA-AB-Moulded Case circuit and systems

6. Lt Switchgear

IS:8623: Specification for factory built assemblies of Switchgear & Control gear for voltages upto and including 1000 V AC/ 1200V DC
IS:4237: General requirements for switchgear and control gear for voltage not exceeding 1000 V.
IS2147: Degree of protection provided by enclosures for low voltage switchgear and control gear.
IS:3202: Code of practice for climate proofing of electrical equipment.
IS:3072: Code of practice for installation and maintenance of switchgear
IS:8544: AC motor starters of voltage not exceeding 1000 Volts
IS:4064: Air-break switches, air break dis-connectors air break dis-connectors and fuse combination unit for voltages not exceeding 1000V AC or 1200V DC.
IS:3231: Electrical relays for power system protection.
IS:1248: Electricity indicating instruments
IS:722: AC Electricity meters.
IS:375: Marking and arrangements of bus bars.
IS:9224: HRC Cartridge fuses (Part II)
IS:6875: Switches and push-buttons
IS:6005: Code of practice of phosphating iron and steel
IS:5082: Wrought Aluminium and Aluminium alloys for electrical purposes.

7. Disconnecting Switches

IEC-129: Alternating Current Dis-connectors (Isolators) and Earthing switches
IS-9921: Isolators
IEC-265: High voltage switches
ANSI-C37.32: Schedule of preferred Ratings, manufacturing specification and application guide of high voltage air switches, bus supports and switch accessories.
ANSI-C37.34: Test code for high voltage air switches
NEMA-SG6: Power switching equipment.

8. Protection and Control Equipment

IEC-51: Recommendations for Direct acting indicating analogue electrical measuring instruments and their accessories.
IEC-255: Electrical relays

IEC-297: Dimensions of mechanical structures of the 482.6mm (19 inches) series.
IEC-359: Expression of the performance of electrical & electronic measuring equipment. IEC-387 Symbols for Alternating-Current Electricity meters
IEC-447: Man machine interface/ MM-Alternating principles
IEC-521: Class 0.5, 1 and 2 alternating current wall hour meters
IEC-547: Modular plug-in unit and standard 19-inch rack mounting unit based on NIM standard (for electronic nuclear instruments)
ANSI-81: Screw threads.
ANSI-B18: Bolts and Nuts
ANSI-C37.1: Relays, Station controls etc.
ANSI-C37.2: Manual and automatic station control, supervisory and associated telemetering equipment.
ANSI-C37.2: Relays and relay system associated with electric power apparatus.
ANSI-C39.1: Requirements for electrical analogue indicating instruments.

9. Motors

IS-325: Three phase induction motors
IS-4691: Degree of protection provided by enclosure for rotating electrical machinery
IEC-34: Rotating electrical machines
IEC-68 (P1 to P5): Environmental testing
IEC-326 (P1 to P2): Printed boards.

10. Material and Workmanship Standards

IS-1363: Hexagon head bolts, screws and nuts of product grade C.
IS-1364: Hexagon head bolts, screws and nuts of products grades A and B
IS-3138: Hexagonal Bolts and nuts (M42 to M150)
IS-898: Fasteners: Bolts, screws and studs

11. Clamps and Connectors

IS:2121: Fitting for aluminium and steel cored aluminium conductors for overhead power lines.
IS:731: Porcelain insulators for overhead power line with a nominal voltage than 1000 V
IS:2486: Insulator fitting for overhead power lines with a nominal voltage greater than 1000 V
IEC-120: Dimensions of Ball and socket couplings of string insulator units.
IEC-137: Insulated turning for alternating voltages above 1000 V.
IEC-168: Tests on indoor and outdoor post insulators of glass for system with nominal voltages greater than 1000 V.
IEC-233: Tests on Hollow insulators for use in electrical equipment.
IEC-273: Characteristics of indoor and outdoor post insulators for systems with nominal voltage greater than 1000 V.
IEC-305: Insulators for overhead lines with nominal volt above 1000 V-ceramic or glass mull units for AC system characteristics of string insulator units of the cap and pin type.
IEC-372: Locking devices for ball and socket couplings of string insulator units dimensions and tests
IEC-383: Insulators for overhead lines with a nominal voltage above 1000 V.
IEC-433: Characteristics of string insulator units of the long rod type.

IEC-471: Dimensions of Clevis and tongue coupling of string insulator units
ANSI-C29: Wet Process porcelain insulators
ANSI-C29.1: Test Methods for electrical power insulators
ANSI-C29.2: For insulators, wet-process porcelain and toughened glass suspension type. ANSI-C29.8 For wet-process porcelain insulators apparatus, post-type.
ANSI-G.8: Iron and steel hardware
ASTM A-153: Zinc Coating (Hot-Dip) on iron and steel hardware

12. Strain and Rigid Bus-Conductor

IS-2678: Dimensions & tolerances for wrought aluminium and aluminium alloys.
IS-5082: Wrought aluminium and aluminium alloy bars, Roads, tubes and sections for electrical purposes.
ASTM-B 230-82: Aluminium 1350 H19 Wire for electrical purposes
ASTM-B 221-81: Concentric – lay – stranded, aluminium 1350 conductors
ASTM-B 221: Aluminium – Alloy extruded bard, road, wire shape.
ASTM-B 236-83: Aluminium bars for electrical purpose (Bus-bars)
ASTM-B 317-83: Aluminium – Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)

13. Battery Chargers

IS:3895: Mono-Crystalline Semiconductor Rectifier Cells and stacks
IS:4540: Mono-crystalline semiconductor rectifier assemblies and equipment
IS:6619: Safety code for semiconductor rectifier equipment.
IS:2026: Power Transformer
IS:2959: AC Contractors for voltage not exceeding 1000 Volts
IS:1248: Indicating Instruments
IS:2208: HRC Fuses
IS:4064: Air break switches, air break Disconnector & fuse combination units for voltage not exceeding 1000V Ac or 1200V DC.
IS:2147: Degree of protection provided by enclosures for low voltage switchgear and control gear.
IS: 600:5: Code of practice for phosphating of Iron and steel.
IS:3231: Electrical relays for power system protection
IS:3842: Electrical relay for AC systems.
IS:5: Colours for ready mix paints.

14. Battery

IS:1651: Stationary Cells and Batteries, Lead-Acid Type (with Tubular Positive Plates).
IS:1652: Stationary Cells and Batteries, Lead-Acid Type (with Plant Positive Plates).
IS:1146: Rubber and plastic containers for Lead-Acid Batteries
IS:6071: Synthetic separators for Lead-Acid batteries.
IS:266: Specification for Sulphuric Acid.
IS:1069: Specification of water for storage batteries
IS:3116: Specification for sealing compound for lead-acid batteries
IS:1248: Indicating Instruments

15. Wire and Cables

IS-694:	PVC insulated cables for working voltages upto and including 1100Volts.
IS-1255:	Code of practice for installation and maintenance of power cables upto and including 33 kV rating.
IS-1554:	PVC insulated (heavy duty) electric cables (part 1) for working voltage upto and including 1100 V Part (2) for working voltage from 3.3 upto including 11 kV.
IS-1753:	Aluminium conductors for insulated cables
IS-2982:	Copper conductors in insulated cables and cords.
IS-3961:	Recommended current rating for cables.
IS-3975:	Mild steel wires, formed wires and tapes for armouring of cables
IS-5831:	PVC insulated and sheath of electric cables
IS-6380:	Elastomeric insulating and sheath of electric cables.
IS-7098:	Cross linked polyethylene insulated PVC sheathed cables for working voltage up to and including 1100 volts. Part (2) Cross-linked polyethylene insulated PVC sheathed cables for working voltage from 3.3 kV up to and including 33 kV.
IS-8130:	Conductors for insulated electrical cables and flexible cords.
IS-10418:	Specification for drums for electrical cables. IEC-96 Radio Frequency cables
IEC-183:	Guide to the selection of High Voltage Cables.
IEC-189:	Low frequency cables and wires with PVC insulation and PVC Sheath
IEC-227:	Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750 V.
IEC228L	Conductors of insulated cables.
IEC-230:	Impulse tests on cables and their accessories.
IEC-287:	Calculation of the continuous current rating of cables (100% load factor).
IEC-304:	Standard colours for insulation for low frequency cables and wires.
IEC-331:	Fire resisting characteristics of Electric cables.
IEC-332:	Tests on electric cables under fire conditions
IEC-502:	Extruded solid dielectric insulated power cable for rates voltages from 1 kV up to 30 kV.
IEC-754:	Tests on gases evolved during combustion of electric cables.
NEMA-WC1:	Asbestos and asbestos-varnished cloth and asbestos thermoplastic insulated wire and cable
NEMA-WC2:	Steel armour and associated covering for impregnated paper insulated cables
NEMA-WC3:	Rubber insulated wire and cable for transmission and distribution of electrical energy.
NEMA-WC5:	Thermoplastic insulated wire and cable for the transmission and distribution of electric energy.
NEMA-WC7:	Cross linked thermo setting polyethylene insulated wire and cable for the transmission and distribution of electrical energy.
NEMA-WC8:	Ethylene-propylene-rubber insulated wire and cable for the transmission and distribution of electrical energy.
NEMA-W67:	Cross linked thermo setting polyethylene
IS-659:	Safety code for air conditioning
IS-1391:	Room air conditioners.
IS-6272:	Industrial cooling fans.

16. Galvanizing

IS-209: Zinc Ingot.
IS-2629: Recommended practice for Hot-Dip galvanizing on iron and steel.
IS-2629: Methods for testing uniformity of coating of zinc coating articles.
ASTM-a-123: Specification for zinc (Hot galvanizing) coatings on products fabricated from rolled, pressed and forged steel shapes, plates, bars and strips.
ASTM-A-153: Specification for Zinc coating (Hot Dip) on iron and steel hardware
ASTM-A-239: Test method for locating the thinnest. Spot in a Zinc (galvanised) coating on iron and steel articles by the preece test (Copper sulfated dip).

17. Fire Protection

IS-554: Dimensions for pipe threads where pressure tight joints are required on the threads.
IS638: Sheet rubber jointing and rubber insertion jointing.
IS-778: Copper alloy gate, globe and check values for water works purposes.
IS-780: Sluice valves for water-works purposes (50 to 300 mm size)
IS-1536: Centrifugally cast (spun) iron pressure pipes for water gas and sewage.
IS-1538(1993): Cast iron fitting for pressure pipes for water gas and sewage.
IS-1703(1989): Copper aloy bar values (horizontal plunger type) for water supply fittings.
IS2379(1990): Colour code for identification of pipe lines.
IS-2643 (P1 to P3: 1990): Dimensions for pipe threads for fastening purposes.
IS-2685(1992): Code of practice for selection, installation and maintenance of sluice valves.
IS-2906(1990): Specification for sluice valves for water works purposes (350 to 1200 mm size)
IS-3589(1991): Seamers or eclectically welded steel pipes for water, gas and sewage (168.3 to 2032 mm outside diameter).
IS-4038(1990): Foot valves for water works purposes
IS-4927(1991): Unlined flax canvas hose for firefighting.
IS-5321-(P1 and P2 1991): Swing check type reflux (non-return) valves
IS-13095 (1991): Butterfly valves for general purposes

18. Steel Structures

IS-228: Method of chemical analysis of pig iron, cast iron and plain carbon and low alloy steels.
IS-802: Code of practice for use of structural steel in overhead transmission line towers.
IS-806: Code of practice for use of steel tubes in general building construction.
IS-808: Dimensions for hot rolled steel beam column channel and angle sections.
IS-814: Covered electrodes for manual arc welding of carbon manganese steel
IS-816: Code of practice for use of metal arc welding for general construction in mild steel.
IS817: Code of practice for training and testing of metal arc welders. Part 1: Manual metal arc welding
IS-875: Code of practice for design loads (other than earthquake) for buildings and structures.
IS-1161: Steel tube for structural purposes.
IS-1182: Recommended practice for radiographic examination of fusion welded but joints in steel plates.
IS-1363: Hexagonal head bolts, screws and nuts of products grade C.
IS-1364: Hexagon head bolts, screw & nuts of products grade A and B.

IS-1367: Technical supply condition for threaded steel fasteners
IS-1599: Method for bend test.
IS-1608: Method for tensile testing of steel products.
IS-1893: Criteria for earthquake resistant design of structures
IS-1978: Line pipe
IS-2062: Steel for general structural purposes
IS-2595: Code of practice for Radiographic testing
IS-3063: Single built rectangular section spring washers for bolts, nuts and screws.
IS-3664: Code of practice for ultra-sonic pulse echo testing by contact and immersion methods.
IS-7205: Safety code for erection of structural steel work.
IS-9595: Recommendations for metal arc welding of iron and carbon manganese steels.
ANSIB18.2.1: Inch series square and Hexagonal bolts and screws.
ANSI-B18.2.2: Square and hexagonal nuts
ANSI-G8.14: Round head bolts

19. Other Civil Works Standards

IS-269 33: Grade ordinary portland cement
IS-2721: Galvanized steel chain link fence fabric.
IS-278: Galvanized steel barbed wire for fencing
IS-383: Coarse and fine aggregates from natural sources for concrete.
IS-432: Mild steel and medium tensile steel bars and hard-dawn steel wire for concrete reinforcement
IS-456: Code of practice for plain and reinforced concrete.
IS-516: Method of test for strength of concrete
IS-800: Code of practice for general construction in steel
IS-806: Steel tubes for structural purposes
IS-1172: Basic requirements for water supply, drainage and sanitation
IS-1199: Method of sampling and analysis of concrete
IS-1566: Hard-dawn steel wire fabricated concrete reinforcement
IS-1742: Building drainage
IS-1785: Plain hard-drawn steel wire for pre stressed concrete
IS-1786: High strength deformed and wires for concrete reinforcement
IS-1811: Method of sampling Foundry sands.
IS-1893: Criteria for earthquake resistant design of structures. IS-2062 Steel for general structural purposes
IS-2065: Code of practice for water supply in buildings
IS-2090: High tension steel bars used in pre-stressed concrete
IS-2140: Standard galvanised steel wire for fencing
IS-2470: Code of practice for installation of septic tanks
IS-2514: Concrete vibrating tables
IS-2645: Integral cement waterproofing compounds
IS-3025: Method of sampling and test physical chemical for water waste water.
IS-4091: Code of practice for design and construction of foundations for transmission line tower and poles

IS-4111:	Code of practice for ancillary structure in sewerage system
IS-4990:	Plywood for concrete shuttering work
IS-5600:	Sewage and drainage pumps

Contents

SECTION 4:
ANNEXURES

ANNEXURE-A: COMPLIANCE CERTIFICATE OF TECHNICAL SPECIFICATION

The bidder shall confirm compliance to the following by signing and stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.

2. There are no deviation(s) with respect to specification other than those furnished in the schedule of deviations.

3. Only those technical submittals which are specifically asked for in Notice Inviting Tender (NIT) to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of technical offer.

4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.

5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

Date: Bidder's Stamp & Signature

ANNEXURE-B: DEVIATION/ CHANGE REQUEST OF TECHNICAL SPECIFICATION

Bidder shall list out all technical potential deviation/ change request (s) along with clause with respect to technical specifications.

Sl. No.	Page No.	Clause No.	Deviation	Reason/ Justification(s)

Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date: Bidder's Stamp & Signature