BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

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PLCC EQUIPMENTS		GROUP	TBEM	W.O. No	82003

CUSTOMER	BIHAR STATE ELECTRICITY BOARD (BSEB)
CONSULTANT	----
PROJECT	220/132 kV PUSAULI SUBSTATION PACKAGE

CONTENTS

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SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of PLCC Equipments complete with accessories as listed under this specification.

This section covers the specific technical requirements of PLCC Equipments. This constitutes minimum technical parameters for the above item as specified by the customer (BSEB). The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

The specification comprise of following sections:

Section-1: Scope, Specific Technical Requirements and Quantities
Section-2: Equipment Specification
Section-3: Project Details and General Specification
Section-4: Guaranteed Technical Particulars
Section-5: Checklist

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

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of customer: Bihar State Electricity Board (BSEB)

Name of consultant: ---------

Name of Project: 220/132 kV Pusauli Substation
220 kV Bay Extension at Dehri Substation

Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

1.2.1	Mode of transmission	Amplitude modulation Single side band with suppressed carrier or reduced carrier
1.2.2	Carrier frequency	40 to 500kHz range
1.2.3	Nominal carrier frequency band In either direction of transmission	4.0kHz
1.2.4	Power output at HF Terminal	20W/40W/80W
1.2.5	Supply voltage	48V DC +15%, -10%

1.2.6 Bidder to validate the wattage of its PLC terminals to ensure that the Power output (PEP) at HF terminal shall be as per the specification. Any input, if required, to validate the offered wattage of its PLC terminal shall be arranged by the bidder. No price implication will be entertained on account of increase in wattage of PLC terminal.

1.2.7 The link frequencies shall be arranged by the bidder during contract stage. No manufacturing hold-up is acceptable on account of non-availability of link frequencies from end customer. In absence of tuning frequencies, vendor shall have to program their PLC terminal with dummy set of frequencies during testing and then re-program them at site after availability of actual frequencies.

1.2.8 Transmission Line Details (*Tentative and shall be confirmed during detailed engineering*)

a) 220kV D/C Line to Dehri Extn (approx 80kM)
b) 220kV D/C Line to Sasaram PGCIL (approx 5kM)
c) 220kV D/C Line to Arah PGCIL (approx 80kM)
d) 132kV S/C Line to Sasaram (approx 5kM)
e) 132kV S/C Line to Mohaniya (approx 20kM)
f) 132kV S/C Line to Kochas (approx 50kM)

1.3 QUANTITIES

As per Annexure-1

1.4 TYPE TESTS

The offered equipment should have been successfully type tested as per relevant IS/IEC and valid test reports shall be submitted. Bidder shall submit valid reports of type tests for PLCC Equipments carried out within last five years from 27.07.2012. If these tests are more than 5 years old (from 27.07.2012) or bidder do not have valid test report, the type test shall be repeated with no extra cost to BHEL/BSEB.

1.5 INSPECTION & TESTING

Before being fitted on the equipment, all components shall be subjected to routine tests at the Contractors factory, as per the relevant IEC/IS standards. A detailed test report proving the successful passing of such tests shall be provided.

Prior to dispatch, the routine & acceptance tests shall be carried out on each PLCC Equipment in accordance with the applicable IEC /IS and the material shall be offered for final inspection to BHEL and BSEB in accordance with agreed quality plan with 3 weeks advance information.

Type test reports on identical equipment shall be submitted for approval. In the event of non-acceptability of submitted test reports on technical grounds at the contract stage, the type tests shall be conducted at no additional cost.

1.6 QUALITY PLAN

The contractor shall carry out contract works in accordance with sound quality management principles which shall include such as controls which are necessary to

ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirement shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Contractor shall submit detailed Quality Plan for BHEL / customer's approval.

1.7 TECHNICAL REQUIREMENTS OF EQUIPMENTS

i) The manufacturer whose PLCC panels are offered should have designed, manufactured, tested, supplied and commissioned PLCC panels for 132 kV system or above [for132 kV substation] and the same should be in successful operation for at least 2 (two) years as on the date of the bid opening.

PLCC Panels/line traps manufactured by the manufacturer meeting the requirements except that the PLCC Panels/line traps manufactured, tested and supplied by them is not in operation for the stipulated period can also be offered provided the manufacturer furnishes an undertaking jointly executed by him and his collaborator, who in turn fully meets the requirement specified above in the bid document for successful performance of the equipment offered.

The manufacturer{s} whose PLCC Panels/lines traps are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (principal) or collaborator meets qualifying requirements stipulated above.

And

Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipments.

And

Furnishes a confirmation letter from the parent company or collaborator along with the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipments. This performance guarantee shall be in addition to contract performance guarantee to be submitted by the bidder.

ii) **Performance Certificate** (covering period not less than 2 years) issued by a utility shall be submitted for vendor approval to be done by BSEB.

1.8 SPECIAL TOOLS AND TACKLES :

The bidder shall include in his proposal the deployment of all special tools and tackles required for supervision of erection, testing, commissioning and maintenance of the equipment. The Special tools and tackles shall only cover items which are specifically required for the equipment offered and are proprietary in nature. A list of all such devices shall be furnished.

1.9 SERVICES

1.9.1 SUPERVISION OF COMMISSIONING & SITE TESTING

Supervision of commissioning & site testing of PLCC is in the scope of bidder.

1.9.2 FREQUENCY PLANNING

Frequency Planning is in the scope of bidder. The link frequencies shall be arranged by the bidder during contract stage.

ANNEXURE-1

A. PLCC Equipments for 220/132 kV BSEB Pusauli Substation

220 kV system

Sl. No.	Description of Items/Works		Unit	Quantity
	Description as per LOA	Detailed Description		TOTAL
1	Carrier equipment (for speech + protection + Data)	40W Carrier equipment (for speech + protection + Data) alongwith VFT Equipment	Nos.	12
2	Protection Coupler	Protection Coupler (4 Command)	Nos.	12
3	Coupling device	Coupling Device (Phase to Phase)	Nos.	12
4	HF Cable	HF Cable (75 Ohms Unbalanced)	Meter	1500
5	EPAX (24/8) with 24 telephones, cable etc.	EPAX (24/8)	Nos.	1
6		Telephone Sets (2-wire) with connecting cables	Nos.	24
7		Telephone Sets (4-wire) with connecting cables	Nos.	8
8		Single Pair Telephone cable (Tinned Cu)	Meter	250
9		Five Pair Telephone cable #	Meter	100
10	Testing and Maintenance equipment (Print test kit)	Testing & Maintenance Equipment (Print Test Kit)	Set	6
11		Services - System Engineering as per specification (Including Frequency Planning)	Lot	1
12		Services - Supervision of Pre-Commissioning **(Panel-wise)**	Lot	12
13		Services - Supervision of Testing and Commissioning **(Link-wise)**	Lot	6
	Mandatory Spares			
14	Coupling Device (Ph to Ph) without base plate	Coupling Device (Ph to Ph) without base plate	No.	1
15	Telephone 4 wire with necessary connecting cable	Telephone 4 wire with necessary connecting cable	No.	1
16	Co-axial connector	Co-axial connector	No.	10
17	Set of prints for carrier terminal (1 no. of each type)	Set of prints for carrier terminal (1 no. of each type)	Set	1
18	Set of prints for protection coupler (1 no. of each type)	Set of prints for protection coupler (1 no. of each type)	Set	1
19	Set of prints for EPAX (24/8) (1 no. of each type)	Set of prints for EPAX (24/8) (1 no. of each type)	Set	1
	Maintenance and Testing Equipments			
20	Selective Level Meter	Selective Level Meter	No.	1
21	Selective Level Generator	Selective Level Generator	No.	1

132 kV system

Sl. No.	Description of Items/Works		Unit	Quantity
	Description as per LOA	Detailed Description		TOTAL
1	Carrier equipment (for speech + protection + Data)	40W Carrier equipment (for speech + protection + Data) alongwith VFT Equipment	Nos.	6
2	Protection Coupler	Protection Coupler (2 Command)	Nos.	6
3	Coupling device	Coupling Device (Phase to Phase, 650 W)	Nos.	6
4	HF Cable	HF Cable (75 Ohms Unbalanced)	Meter	1000
5		Services - System Engineering as per specification (Including Frequency Planning)	Lot	1
6		Services - Supervision of Pre-Commissioning **(Panel-wise)**	Lot	6
7		Services - Supervision of Testing and Commissioning **(Link-wise)**	Lot	3

B. PLCC Equipments for 220 kV Bay Extension at BSEB Dehri Substation

Sl. No.	Description of Items/Works		Unit	Quantity
	Description as per LOA	Detailed Description		TOTAL
220 kV system				
1	Carrier equipment (for speech + protection + Data)	40W Carrier equipment (for speech + protection + Data) alongwith VFT Equipment	Nos.	4
2	Protection Coupler	Protection Coupler (4 Command)	Nos.	4
3	Coupling device	Coupling Device (Phase to Phase, 650 W)	Nos.	4
4	HF Cable	HF Cable (75 Ohms Unbalanced)	Meter	500
5		Services - Supervision of Pre-Commissioning **(Panel-wise)**	Lot	4
	Mandatory Spares			
6	Coupling Device (Ph to Ph) without base plate	Coupling Device (Ph to Ph) without base plate	No.	1
7	Telephone 4 wire with necessary connecting cable	Telephone 4 wire with necessary connecting cable	No.	1
8	Co-axial connector	Co-axial connector	No.	10
9	Set of prints for carrier terminal (1 no. of each type)	Set of prints for carrier terminal (1 no. of each type)	Set	1
10	Set of prints for protection coupler (1 no. of each type)	Set of prints for protection coupler (1 no. of each type)	Set	1

NOTES:

1. Cut-lengths of HF cable, 2-pair Telephone Cable & 5-pair Telephone Cable shall be informed to the successful bidder.

2. # Armoured, 0.5 sq. mm. annealed copper conductor and petroleum jelly filled with polyethylene outer jackets.

3. The above BOQ for Pusauli also includes remote end equipments. However, their BOQ and locations shall be informed to successful bidder.

SECTION-2

EQUIPMENT SPECIFICATION

PLCC

1. **GENERAL**

1.1 All the PLCC equipment covered under the package shall conform to the requirements of the latest edition of the relevant IEC/IS Specifications or equivalent National Standards,

2. **Standard And Drawing**

2.1 The IEC/IS Specifications and international publication relevant to the equipment covered under this specification shall include but not be limited to the list given at Section - 3

3. **Location of Equipment**

3.1 The PLCC Equipment and Line traps as specified shall be installed at the respective ends of the transmission lines. The Contractor shall be responsible for coordinating the equipment supplied by him with the already existing carrier equipment at the respective sub-stations. Contractor shall also be responsible for collecting all the necessary information/data from the respective sub-stations for the installation of the equipment.

4. **Frequency Planning**

4.1 For planning frequency and output power of carrier terminals Bidders may plan for a minimum receive signal to noise ratio of 25 dB for the speech channels without companders. The noise power in 2.1 kHz band (300-2400 Hz) may be taken as -13 dBm referred to the coupling point of the H.T. line. An additional minus two and a half dB may be assumed for psophometric factor. As far as coupling loss (phase to phase) is concerned the Bidders may assume the same as 6dB at one coupling end for evaluating SNR. For protection channels the minimum SNR shall not be less than 15 dB under adverse weather. A safety margin of 9 dB shall be taken over and above these SNR values in order to cater for variations in line attenuation from the computed value as inhand reserve. Frequency and output power of PLC terminals for protection shall be planned such that the protection signal is received with full reliability even when one of the phase is earthed or is on open circuit on the line side causing an additional minimum loss of 6 dB.

The Bidder shall indicate the noise power in the bandwidth used for protection signaling and shall submit the SNR calculations for speech as well as protection channels on all the line section given in at the proposed frequencies. Sample calculations for SNR requirement and power allocation over different channels

must be furnished alongwith the bid. Maximum permissible line attenuation shall be clearly brought out in these calculations. Further, Bidder shall submit details of frequency planning done (including computer studies carried out and facilities available) for PLCC links on EHV lines in the past in the relevant schedule of DRS. Bidder must enclose one copy of computer study result done in the past along with the Bid.

4.2 Successful Bidder shall be fully responsible for the coordination required finalising the frequency plan.

4.3 The frequency plan will be referred to wireless Adviser/DOP Department for clearance and in case any change in the Contractor's recommended carrier frequency and power output is proposed by these authorities, the Contractor shall have to modify his proposal accordingly. Change of power output shall, however, not involve repeater stations.

5. **Proposed Arrangement**

5.1 The power line carrier communication equipment required by the OWNER is to provide primarily efficient, secure and reliable information link for carrier aided distance protection and direct tripping of remote-end breaker and also for speech communication between 765/400/220 kV sub-stations. It shall include separate carrier terminals of multipurpose type for speech and protection purposes. All carrier terminals including those for protection shall be suitable for point to point speech communication also.

5.2 132kV transmission lines shall have Main I protection same as above alongwith backup over current and earth fault protections.

5.3 The requirement of carrier information on each link covered under this specification is as below :

a) One protection channel for Main-I and another for Main-II distance protection schemes. Further these channels will also be used as main and back-up channel for direct circuit breaker inter-tripping for 765kV/ 400kV lines.

In case of 400KV/220 KV/132 KV lines ,speech and data channel can also be used for protection wherever possible.

b) One speech channel with a facility to superimpose data signals upto 1200Baud.

However, the number of channels for protection signaling , speech and data communication for SAS and Load dispatch centre shall be as per the BOQ given in price schedule.

5.4 The equipment for protection signals shall have high degree of reliability and speed. It shall be guaranteed to function reliably in the presence of noise impulse caused by isolator or breaker operation. The equipment shall be suitable for direct tripping of

remote end breaker for fault in unswitched Shunt Reactor & Operation of Buchholz relays of reactor etc. It shall also be possible to effect direct tripping of breaker at one end when the other end breaker opens out either manually or by relays such as Bus fault relay etc.

5.5 The time intervals between receipt of a trip command on the transmit side, its transmission over the carrier link, reception at the far end and giving command to the trip relays at the distant end shall not exceed 20 mS. for permissive inter- tripping and 30 m sec. for direct inter-tripping even for the longest line section. The above timings are inclusive of operating time for auxiliary relays and interposing relays, if any, included in the PLCC equipment.

5.6 The requirement of protection signaling channel is such that security against incorrect signals being received shall be at least two to three orders higher than reliability against a signal not being received.

5.7 For reasons of security and reliability, phase to phase coupling shall be employed. Double differential coupling shall also be considered for double circuit lines. Bidders must furnish detailed write-up on methods of coupling and recommend suitable coupling mode for double-circuit lines along- with the bids.

5.8 The Contractor shall have to check and prove through the results of his computer studies that attenuation due to transpositions in the EHV lines is within limits and the offered equipment will perform satisfactorily.

5.9 The Bidder shall submit curves illustrating 'incorrect tripping' and "Failure to trip" probability plotted against corona noise level, in the presence of impulse noise due to switching of isolator and circuit breaker etc. Details of field tests and laboratory tests for successful operation of his equipment, under such adverse conditions shall be furnished by the Bidder. These are to be related to end-to-end signaling and shall take into account the type of communication link e.g. account shall be taken of transpositions in the phase to phase coupled H.T. line. Details of field tests and laboratory tests for successful operation of the equipment under the above circumstances shall be submitted by the Bidder illustrating the above parameters.

6. LINE TRAP (NOT IN SCOPE)

6.1 Line trap shall be broad band tuned for its entire carrier frequency range. Resistive component of impedance of the line trap within its carrier frequency blocking range shall not be less than 570 ohms for 220kV and 132 kV systems..

6.2 Line trap shall be provided with a protective device in the form of surge arrestors which shall be designed and arranged such that neither significant alteration in its protective function nor physical damage shall result from either temperature rise or the magnetic field of the main coil at continuous rated current or rated short time current. The protective device shall neither enter into operation nor remain in operation, following transient actuation by the power frequency voltage developed across the line trap by the rated short time current.

The lightning arrestor shall be station class current limiting active gap type. Its rated discharge current shall be 10 kA. Coordination, however, shall be done by taking 20 kA at 8/20 micro-sec. discharge current into account. Bidder has to furnish full justification in case the use of gap-less metal oxide arrestor is recommended by them.

6.3 The lightning arrestor provided with the line trap of each rating shall fully comply with the requirements of IS:3070 Part-I/IEC-60099-I Part-I. It shall conform to type tests as applicable and type test certificate for the same shall be submitted by the Bidder.

6.4 The lightning arrestor provided with the line trap shall be subject to routine and acceptance tests as per IEC-60099-1 (Part-I).

6.5 Radio interference voltage for 245/132 kV shall not exceed 500 micro volts at 163/97 kV (rms) respectively.

6.6 Line trap shall be equipped with the bird barriers.

6.7 Line trap shall conform to IEC 60353 (latest) fulfilling all the technical requirements. The rated short time current for 1 Second shall be 31.5 kA as per requirement.

6.8 The Bidder shall indicate continuous current rating of the line trap at 65 deg. C ambient.

6.9 Reports for the following type tests on each type of line trap shall be submitted as per GTR .

1. Measurement of Inductance of the main coil.
2. Measurement of temperature rise.
3. Insulation test.
4. Short time current test.
5. Corona Extinction Voltage test (procedure for this shall be mutually agreed).
6. Radio Interference Voltage measurement test (procedure for this shall be mutually agreed).

6.10 The Bidder must enclose with his bid the reports of type and routine tests conducted on similar equipment earlier as per IEC-60353.

6.11 Welding

All the welding included in the manufacture of line traps shall be performed by personnel and procedure qualified in accordance with ASME-IX and all the critical welds shall be subject to NDT as applicable.

6.12 Line Trap Mounting

6.12.1 The Line Trap shall be suitable for outdoor pedestal or suspension mounting and shall be mechanically strong enough to withstand the stresses due to maximum wind pressure of 260 kg/square meter.

6.12.2 For pedestal mounting, each line trap shall be mounted on a tripod structure formed by three insulator stacks arranged in a triangular form. All the accessories and hardware, mounting stool including bolts for fixing the line trap on insulators shall be of non-magnetic material and shall be supplied by the Contractor.

6.12.3 For suspension mounting, Contractor shall be required to coordinate the mounting arrangement with the existing arrangement. Non-magnetic suspension hook/link of adequate length and tensile strength to provide necessary magnetic clearance between the line trap and suspension hardware shall be supplied by the Contractor.

6.13 Terminal Connectors

6.13.1 The line traps shall be suitable for connecting to or ACSR single/twin Moose conductor with horizontal or vertical take off. Necessary connector shall be supplied by the Contractor.

6.13.2 Terminal Connectors shall conform to IS:5561.

6.13.3 No part of clamp or connector (including hardware) shall be of magnetic material.

6.13.4 Radio interference Voltage shall not exceed 500 microvolts.

6.13.5 Clamps/connectors shall be designed for the same current ratings as line trap and temperature rise shall not exceed 35 deg. C over 50 deg. C ambient. No current carrying part shall be less than 10 mm thick.

6.13.6 Clamps/connectors shall conform to type test as per IS:5561.

6.13.7 Bidders are required to submit alongwith their bid typical drawings clearly indicating the above mentioned features of the line traps, line trap mounting arrangement and terminal connectors. For suspension mounted line traps, Bidder shall submit drawings showing single point as well as multipoint (normally 3 point) suspension arrangements.

7. COUPLING DEVICE

7.1 The coupling devices shall be interposed between the capacitor voltage transformer and coaxial line to the PLC transmitter/receiver, and in conjunction with the capacitor voltage transformer shall ensure :

a) Efficient transmission of carrier frequency signals between the carrier frequency connection and the power line.

b) Safety of personnel and protection of the low voltage parts and

installation, against the effects of power frequency voltage and transient over voltages.

7.2 The coupling device, in conjunction with the CVT shall from an electric filter of band pass type :

a) It shall match characteristic impedance of H.T. line to impedance of the carrier frequency connection.

b) Galvanic isolation between primary and secondary terminals of the coupling device shall be performed by the above mentioned transformer.

c) Power frequency currents derived by the CVT may be drained to the earth by a separate inductance termed drain coil of suitable rating.

d) Voltage surges coming from the power line at the terminals of the coupling device shall be limited by a non-linear surge arrestor of suitable rating in the primary side. Requirement of a gas type voltage arrestor in secondary side of the coupling device shall have to be fully justified. but

in any case the input circuit of PLC. equipment shall have protective devices in the form of zener diodes and surge suppressers.

The surge arrester shall have power frequency spark over voltage coordinated with the equipment ahead of it.

e) For direct and efficient earthing of its primary terminals, the coupling device shall be equipped with an earthing switch. The Earth Switch shall be available for earthing of CVT-HT terminals, when the coupling filter units are removed from circuit for maintenance/ replacement. The design shall take due regard of requirements for safety in accordance with the Indian Electricity Rules.

7.3 Two numbers 'phase to earth' type coupling filters shall be used to achieve 'phase to phase'/ 'inter-circuit coupling'. Connection between secondaries of the two phase to earth type coupling device shall be through a balancing transformer/hybrid such that reliable communication shall be ensured even when one of the coupled phase is earthed or open circuited on the line side.

7.4 Coupling device shall conform to IEC-60481 and shall have the following carrier frequency characteristics as applicable to a phase to earth type coupling device:

a)	Nominal line side impedance	i) 240 ohms for 765kV and 400 kV Quad/triple bundle conductor line. ii) 320 ohms for 400kV twin bundle conductor line. iii) 400 ohms for 220/132 kV line
b)	Nominal equipment side impedance	75 ohms (unbalanced)
c)	Composite loss	Not more than 2 dB

d)	Return Loss	Not less than 12 dB
e)	Bandwidth	Shall suit the frequency plan between 36 and 500 kHz
f)	Nominal peak envelope power (for Inter-modulation product 80 dB down)	Not less than 650 Watt.

7.5 The coupling device shall be suitable for outdoor mounting. Temperature of metallic equipment mounted outdoor is expected to rise upto 65 deg. C during the maximum ambient temperature of 50 deg. C specified. The equipment offered by the Bidder shall operate satisfactorily under these conditions.

7.6 The H.T. Terminal of coupling device shall be connected to H.F. Terminal of the CVT by means of 6 mm sq. copper wire with suitable lugs & taped with 11 kV insulation by the contractor.

7.7 Coupling device shall have at least two terminals for carrier equipment connection. Bidder shall confirm that such a parallel connection to coupling device directly will not result in any additional attenuation.

7.8 The coupling device including the drainage coil, surge arrester and earthing switch shall conform to type tests and shall be subject to routine tests as per IEC-60481/IS:8998.

Routine tests shall include but not be limited to the following :

i) Composite loss and return loss tests on coupling device.

ii) Turns ratio test and insulation tests on the balancing transformer.

iii) Milli volt drop test, power frequency voltage test and mechanical operation test on earthing switch.

iv) Power frequency spark over test for lightning arrester as per relevant IS/IEC.

7.9 Reports for the following type tests on coupling device shall be submitted as per GTR .

1.)Return loss test.

2.)Composite loss test.

3.)Distortion and inter modulation test .

4.)Impulse voltage test.

5)Tests on Arrestors

Bidder shall furnish, alongwith his bid copies of all type and routine test conducted earlier on similar coupling device in accordance with relevant standards.

8. **High Frequency Cable**

8.1 High frequency cable shall connect the coupling device installed in the switchyard to the PLC terminal installed indoor.

8.2 The cable shall be steel armoured and its outer covering shall be protected against attack by termites. Bidder shall offer his comments on method employed by him for earthing of screen and submit full justification for the same with due regard to safety requirements.

Bidder must enclose in his bid a detailed construction drawing of the cable being offered, with mechanical and electrical parameters.

8.3 Impedance of the cable shall be such as to match the impedance of the PLC terminal on one side and to that of the coupling device on the other side over the entire carrier frequency range of 40-500 kHz.

8.4 Conductor resistance of cable shall not exceed 16 ohms per Km at 20°C.

8.5 The cable shall be designed to withstand test voltage of 4 kV between conductor and outer sheath for one minute.

8.6 Bidder shall specify attenuation per Km of the cable at various carrier frequencies in the range of 40 to 500 kHz. The typical attenuation figures for H.F. cable shall be in the range of 1 to 5 dB/km in the frequency range of 40-500 kHz.

8.7 The H.F. cable shall conform to type tests and be subjected to routine tests as per IS 11967(Part 2/Sec 1): 1989/IS 5026:1987.

8.8 All HF cables within the scope of this specification shall be laid and termination shall be carried out by the Contractor.

8.9 The cables shall be supplied wound on drums containing nominal length of 500 meters each. However, exact requirement of drum lengths shall be finalised during detailed engineering to avoid joint in HF cable and its wastage.

9. **Power Line Carrier Terminal**

9.1 As already indicated the information link shall be provided for speech, protection, telex and data services.

9.2 PLC terminal shall use Amplitude Modulation and shall have single side band transmission mode. These shall be equipped for fixed frequency duplex working.

Characteristic input and output parameters of the SSB PLC terminals shall be as per IEC-60495, unless otherwise specified.

9.3 The salient features are detailed out below :

a)	Mode of transmission	Amplitude Modulation single side band with suppressed carrier or reduced carrier.
b)	Carrier frequency	40 to 500 kHz range c)
	Nominal carrier frequency band in either direction of transmission	4.0 kHz
d)	Power output (PEP) terminal	20/40/80 Watt at HF
e)	Frequency difference between a pair of PLC terminals	Frequency difference between VF signal at the transmitting and receiving ends will not exceed 2 Hz with suppressed carrier. With reduced carrier frequency difference shall be zero. This shall include permissible ambient temperature variation and supply frequency and voltage variation of (+) 15% and (-) 10%.
f)	Automatic gain control	For 40 dB change in carrier frequency signal level within the regulation range. change in VF receive levels of both speech and other signals shall be less than 1dB.
g)	Supply voltage	48 V DC + 15%, - 10%. (Positive pole earthed)

9.4 All the PLC terminals shall be of multipurpose type. The Bidder shall confirm that the total transmission time for teleprotection shall not exceed 20 ms for permissive and 30 ms for direct tripping signals. Speech and teleprotection channels shall independently fulfill the SNR requirements out of the power allocated to its channel from the total power of the PLC terminals.

Detailed calculation for SNR requirement and power allocation over different channels should be furnished alongwith the bid.

9.5 In the input circuit of the PLC terminal protective devices shall be provided in the form of zener diodes or surge suppressers in order to eliminate any surge transfer through the coupling device or the surge induced in the connecting path of H.F. cable.

9.6 To improve voice transmission characteristics for the system, compressors and expanders shall be provided. The companders shall have at least 2:1 compression ratio with a corresponding expansion ratio of 1:2. The operating range of compander shall be compatible with the audio power levels specified for 4 wire operation. The improvement gained by companders shall however not be taken into account for power allocation and shall be in-hand reserve.

9.7 Sudden changes in input level to the receiver shall not cause false tripping. The Bidder shall clearly indicate in his offer the methods adopted to ensure above phenomenon. The receiver design shall also provide protection against false tripping from random noise.

9.8 Fail-safe devices shall be provided, so that a malfunction in one unit or subassembly cannot cause damage elsewhere in the system. All plug-in equipment shall be fitted with features to prevent improper insertion. The electrical cables shall not be routed across sharp edges or near sources of high temperature. The adjustments, which are susceptible to misadjustment from accidental contact/vibration, shall be equipped with suitable locking devices.

9.9 The PLC set shall be designed to give guaranteed performance from 0 deg. C to 50 deg. C ambient temperature. The thermal capability of the equipment shall be so designed that the equipment remains operational successfully upto 60 deg. C ambient temperature. Any ventilation fans provided for circulation of air inside the cabinets shall conform to relevant Indian Standards.

9.10 The terminals shall be provided with built-in indicating instrument to facilitate checking of important voltages and current values and signal levels in different parts of the PLC Terminals. Protection fuses shall be provided in all important circuits and fuses shall be so mounted as allow their easy inspection and replacement. All test points shall be easily accessible.

The carrier set shall be provided with suitable supervision and alarm facilities. Individual parts of the carrier set should be accessible from front, making it possible to place the carrier cabinets side-by-side. All components and parts of the carrier set shall be suitably tropicalised.

9.11 PLC terminals shall be housed in floor mounting sheet metal cabinets, suitable for mounting on concrete plinth as well as channel frame by means of nuts and bolts or welding. All the panels shall be properly earthed to the OWNER's earthing grid by the Contractor. Contractor shall submit detailed drawings for earthing connections.

9.12 All the panels shall be protected against moisture ingress and corrosion during storage. Panels shall be properly dried before they are installed and energized.

(b)

Bidder shall indicate measures adopted to prevent ingress of moisture during operation.

9.13 All cabinets having PLC terminals shall be provided with lamps of sufficient wattage for interior illumination with switch. Each panel shall be provided with 240 V AC single phase socket with switch to accept 5 & 15A standard Indian plugs.

9.14 A name plate shall be provided on the front door of each cabinet indicating channel function, transmitter frequency and direction etc.

9.15 Reports for the following type tests for PLC Terminals shall be submitted as per GTR . Tests to determine various characteristics of PLC terminals as per IEC –60495.

a)Voltage variation

b)Carrier frequency range band.

c)Frequency accuracy

d)Transmit/Receive frequency difference.

e)Automatic gain control

f)Harmonic distortion g)

Selectivity

h)Output impedence, Return loss&Tapping loss

i)Return loss, Afinputs/Outputs

j)Balance to ground

k)Limiter action l)Spurious

emission

m)Carrier frequency levels and levels

n)Attenuation distortion

o)Noise generated within terminal

p)Near and far end cross talk

q)Group delay distortion

r)Conducted noise

s)Telephone signaling channel

t)Speech levels

u)Voltage withstand test

v)Insulation test

9.16 Heat Soaking of panels

All the solid state equipment/system panels shall be subjected to the Heat Soaking as per the following procedure :

All solid state equipment shall be burn-in for minimum of 120 hours continuously under operation condition. During the last 48 hours of testing, the ambient temperature of the test chamber shall be 50°C. Each PLC panel shall be complete with all associated sub-systems and the same shall be in operation during the above test. During the last 48 hours of the above test, the temperature inside the panel shall be monitored with all the doors closed. The temperature of the panel interior shall not exceed 65°C.

10. SPEECH COMMUNICATION

10.1 PLC equipment offered shall provide telephone communication between the stations where the transmission lines are terminating. The equipment shall be suitable for providing the following facilities :

a) It shall be possible for subscriber at any of the stations to contact the subscriber at all other stations connected in the system as shown in the specification drawing by dialing his call number. To achieve this a 24 lines EPAX with 4 wire interface & remote subscriber units shall be provided/available at different stations.

b) The equipment shall contain all normal facilities like ring back tone, dial tone. engage tone & priority tone, and suitable pulses to establish and disconnect communication between subscribers.

c) The equipment shall be provided with necessary alarm circuits and fuses etc.

d) The equipment shall be of 4 kHz bandwidth on either direction and be suitable for providing superimposed data and teleprinter facilities at a later date without major modifications and high cost. The Bidder shall clearly indicate in his bid the provision made in his proposal for future development and the

extent to which such additional facilities can be added at a later date.

e) The system shall be completely automatic with definite number allocated for each telephone. The numbering scheme for telephones, exchange and tie lines shall be developed by the Bidder and indicated in the bid. Final numbering scheme shall be fully coordinated with the existing/ proposed future systems by the Contractor.

f) Arrangement for over-riding facilities shall be provided by means of priority keys wherever specified. The over-riding facility shall enable cutting-in ongoing calls with the priority key and ask the concerned parties to finish their conversation. The wanted number should then get automatically connected without having to redial the number.

g) All the carrier telephone conversations shall be secret and it should not be possible for anybody to over hear the conversation going on between any two parties excepting those provided with over-riding facilities.

h) The necessary cables for connecting all the telephone instruments ordered for at each sub-station (including wiring and termination) shall be provided by the Contractor. These telephone instruments shall be located within control room building at respective sub-station.

i) The cabinets housing the equipment for EPAX, four wire E/M interface & remote subscriber units (four wire) shall have mounting arrangement similar to that for PLC terminals.

j) All the terminals for speech shall be with Transit Band Pass Filter suitable for tuning at site and shall be wired for addition of VFTs in future.

k) Equipment for speech communication must be fully compatible with OWNER's existing equipment. Any interfaces required for proper matching and connection with the OWNER's existing equipment shall be provided by the Contractor.

l) Terminals for protection shall be suitable for speech between two ends of each transmission line or on tandem operation basis with back to back connection at the intermediate stations.

n) Each PLC terminal for speech as well as protection purposes shall be provided with a plug-in type service telephone and buzzer. Further, 4 wire remote telephone instruments (parallel to service telephone) shall also be provided on one PLC terminal for protection for each link. These instruments shall be located in respective Switchyard control room to enable the operator to make emergency calls on point-to-point basis. Each such instrument shall be equipped with a buzzer and 'press-to-call' key and shall not require any additional power supply units.

10.4 **Network Protection Equipment (Protection Coupler)**

10.4.1 The Bidder shall offer voice frequency transmission equipment which shall work on frequency shift or coded signal principle for transmission/reception of protection signals as single purpose channel. The equipment shall be suitable for connection to the power line carrier terminal.

10.4.2 The voice frequency transmission equipment shall not only be insensitive to corona noise but shall also remain unaffected by impulse type noise which are generated by

electrical discharge and by the opening and closing of circuit breakers, isolators, earthing switches etc. The equipment shall also be made immune to a field strength of 10V/m expected to be caused by portable radio transmitters in the range of 20-1000 MHz. In his offer, bidder shall clearly explain as to what measures have been taken to make the equipment insensitive to corona noise, white noise and to impulse noise of an amplitude larger than the wanted signal and submit full field test and laboratory test reports. The guarantee on design data shall not be acceptable.

10.4.3 The equipment shall be unaffected by spurious tripping signals. The Bidder shall submit proof as to how this is achieved satisfactorily.

10.4.4 The equipment shall be suitable for transmission of direct and permissive trip signal as well as blocking signals for protective gear of power system. The equipment shall be operated in the audio frequency range in speech band or above speech band as superimposed channel in 4 kHz band of SSB carrier. The equipment shall operate with full duplex frequency shift mode of operation or by switching between two frequencies in case of coded signals . The protection signaling equipment shall be of solid state design, modular in construction and have a proven operating record in similar application over EHV systems. Details regarding application of the equipment over 765kV/400kV/220kV systems shall be submitted along with the bid. Each protection signaling equipment shall provide:

i) Transmission facilities for minimum three protection signals.

ii) Reception facilities for minimum three protection signals.

10.4.5 The equipment shall be designed for remote tripping/ blocking on permissive basis and direct tripping for reactor fault and others. The overall time of PLC, VFT and transmission path for permissive trip/blocking shall be 20 m. Sec. or less and for direct tripping 30 m. Sec. or less even for the longest line section.

Operating time lower than specified above may be preferred provided they fulfill the requirements of security and reliability as mentioned below :

False - trip probability burst of any amplitude)	10^{-5} (Noise
Fail to trip probability S/N 6 dB in 3.1 kHz Band (white Noise Measurement)	10^{-2} for

10.4.6 It may be emphasized that specified time, as mentioned above is composed of the following :

a) Back-to-back signal delay in frequency shift or coded signals protection equipment.

b) Back-to-back delay in PLC terminal.

c) Delay in transmission line.

d) Operation time of interposing relay, if any, in frequency shift or coding equipment.

Reference is invited in this regard to the guide lines expressed in CIGRE Publication "Teleprotection" report by Committee 34 and 35.

10.4.7 The following transfer criteria shall be provided by the equipment:

a) Transmit side
One number potential free NO (normally open) contact of protective relays (To be supplied by the OWNER) of under noted rating for each of the following functions:

i) Permissive trip command ii)

Direct trip command

Contact Rating:

Maximum voltage	: 660 Volts
Maximum current rating	: 5 amps Maximum
power rating	: 1250 W/VA

b) Receive Side
Voice frequency transmission equipment for network protection shall be provided with one potential free NO (normally open) contact of the under noted rating for each of the following functions:

i) Permissive trip command ii)

Direct trip command

Contact Rating:

Rated voltage	:	250 Volts DC Rated
current	:	0.1 A DC
Other Parameters	:	As per IEC-60255-25 c)

Alarm

In addition, the voice frequency protection terminal shall provide at least one number potential free change over contact of the following rating for alarm purposes.

Rated voltage	:	250 volts DC Rated
current	:	0.1 A DC
Other Parameters	:	As per IEC-60255-25

10.4.8 The Contractor shall submit drawings showing inter-connection between PLCC and protection panels for approval by the OWNER.

10.4.9 It has to be ensured that under no circumstances protection channel should share the power. Each protection channel shall be able to transmit power for which system is designed. For example, a 40 W PLC terminal shall transmit 40 Watt (max.) for protection channel alone in the event of fault. Speech and super- imposed data channels, in the same protection terminal must get disconnected momentarily during the operation of protection channels.

10.4.10 The equipment shall be constructed such that in permissive line protection system, operational reliability of the protection channel may be checked over the carrier link by means of a loop test. It shall be possible to carry out the above test from either end of the carrier link. During healthy condition of the transmission line, the loop test shall not initiate a tripping command. In the event of a system fault, while loop test is in progress, protection signal shall over-ride the test signal.

10.4.11 The equipment shall be complete with built in counters for counting the number of trip commands sent and number of trip commands received.

10.4.12 Reports for the following tests as per GTR shall be submitted for approval for protection coupler and the relays associated with PLCC equipment for network protection signaling equipment and interface unit with protective relay units if any :

1)Protection coupler (As per IEC 60834 -1)

a)Power supply variation b)Power

supply interruption c)Reflected

noise

d)Reverse polarity

e)Interference by discrete frequency

f)Transmission time

g) Interference by frequency deviation. (Wherever applicable)

h)Alarm function g)Security

h)Dependability i)Voltage

withstand test j)Insulation test.

j) Electrical fast transient test (along with carrier terminal)

k)HF disturbance test (along with carrier terminal)

l)Electro static discharge test (along with carrier terminal)

m)Radiated electromagnetic field susceptibility test (along with carrier terminal)

n)Environment test (as per IS 9000)

2. **Relays.**

a) Impulse voltage withstand test as per Clause 5.1 of IS:8686 (for a test voltage appropriate to Class III as per Clause 3.2 of IS:8686).

b) High Frequency Disturbance test as per Clause 5.2 of IS:8686 (for a test voltage appropriate to Class III as per Clause 3.2 of IS:8686).

12. **LIST OF COMMISSIONING TESTS**

The following tests shall be carried out on complete system/subsystem during commissioning:

1. **Composite loss and return** loss on coupling device using dummy load.

2. Composite loss (Attenuation) for HF Cable coupling device.

3. End to end attenuation measurement for verification of optimum coupling mode. Test shall be done for all combinations.

4. End to end return loss for optimum coupling mode.

a. open behind line trap.

b. grounded behind line trap.

5. If end to end return loss for optimum coupling mode is not satisfactory, same shall be measured for other coupling modes also.

6. Adjustment of Tx/Rx levels on PLCC equipment as per test schedule.

7. AF frequency response (end to end) for the entire 4 kHz Bandwidth for speech and teleoperation channels.

8. Measurement of noise in 2 kHZ bandwidth with and without line energised.

9. SNR (test-one) with line energised noting down weather conditions.

10. Transmission time for teleprotection and other data channels.

11. Observation of Tx/Rx levels (test-tone) for each channel at both ends by sequential switching on/off parallel channels using dummy load and also with the transmission line.

12. Observation of end to end and trunk dialing performance.

13. Observation of end-to-end protection signaling (command sent & received) in conjunction with protective relays, noting down transmission/receipt of unwanted commands under switching operations in the switchyard during protective relay testing.

Notes

1. All measurements for link attenuation, composite loss and return loss shall be carried out for the entire range of carrier frequencies with specific attention to the frequencies.

   i. within coupling device bandwidth. ii.

   within line trap bandwidth, and

   iii. operating frequencies.

2 Following tests shall be carried out independently at each and i.

   Composite loss & return loss for coupling device.

   ii. Attenuation test for HF cable + coupling device.

   iii. Levels and other local adjustments (on dummy load).
   Final adjustment shall be on end to end basis.

   iv. Test for loading by parallel channels with dummy load.
   This test can be done alongwith tests for coupling device. v.

   Protection signaling under local loop test (dummy load).

3. Necessary test instruments required for all the above tests shall be brought by commissioning engineers of the contractor.

SECTION 3

GENERAL TECHNICAL REQUIREMENT

GENERAL TECHNICAL REQUIREMENT

1.0 FOREWORD

1.1 The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under other sections of tender documents and is not exclusive.

2.0 GENERAL REQUIREMENT

2.1 The bidders shall submit the technical requirements, data and information as per the technical data sheets provided in the bid documents.

2.2 The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification.

2.3 It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different from 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 Purchaser's. 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 specific requisite schedule, will not be considered as valid deviation.

2.4 Except for lighting fixtures, wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition. For lighting fixtures, makes shall be as defined in Section- Lighting System.

2.5 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 included 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/substation unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment provided, shall be inter-changeable with one another.

3.0 STANDARDS

3.1 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.

3.2 The equipment to be furnished under this specification shall conform to latest

issue with all amendments (as on the date of bid opening) of standard specified unless specifically mentioned in the specification.

3.3 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other.

3.4 The Contractor shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.

3.5 When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

3.6 Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards specified / individual sections for various equipments shall also, be accepted, however the salient points of difference shall be clearly brought out in additional information schedule of Vol. III along with English language version of such standard. The equipment conforming to standards other than specified / individual sections for various equipments shall be subject to Purchaser's approval.

3.7 The bidder shall clearly indicate in his bid the specific standards in accordance with which the works will be carried out.

4.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

4.1 The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc under such over voltage conditions.

4.2 All equipments shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.

4.3 All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc for the equipment.

4.4 The bidder shall design terminal connectors of the equipment taking into account various forces that are required to withstand.

4.5 The equipment shall also comply to the following:

a) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

b) 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.

4.6 EHV equipments and system shall be designed to meet the following major technical parameters as brought out hereunder.

4.6.1 System Parameter

SL No	Description of parameters	132 kV System	33 kV System
1.	System operating voltage	132kV	33kV
2.	Maximum operating voltage of the system(rms)	145kV	36kV
3.	Rated frequency	50Hz	50Hz
4.	No. of phase	3	3
5.	Rated Insulation levels		
i)	Full wave impulse withstand voltage (1.2/50 microsec.)	650 kVp	170 kVp
ii)	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	-	-
iii)	One minute power frequency dry withstand voltage (rms)	-	-
iv)	One minute power frequency dry and wet withstand voltage (rms)	275kV	70kV
6.	Corona extinction voltage	105kV	-
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 508 kV rms for 765kV, 320KV rms for 400KV system and	500 micro-volt	-
	156KV rms for 220KV system & 92 KV rms for 132KV system		
8.	Minimum creepage distance	25 mm/KV (3625 mm)	25 mm/KV (900 mm)
9.			
i.	Phase to phase	1300 mm	320 mm
ii.	Phase to earth	1300 mm	320 mm
iii)	Sectional clearances	4000 mm	3000 mm
10.	Rated short circuit current for 1 sec. duration	31.5 KA	25 KA
11.	System neutral earthing	Effectiv ely Earthed	Effectiv ely earthed
12			

i.	Phase to phase	1220 mm (for BIL-550 kVp)	530 mm (for BIL-250 kVp)/ 350 mm (for BIL-170 kVp)
ii.	Phase to earth	1050 mm (for BIL-550 kVp)	480 mm (for BIL-250 kVp)/ 320mm (for BIL-170 kVp)

Note : The insulation and RIV levels of the equipments if applicable shall be as per values given in the respective chapter of the equipments.

4.6.2 Major technical parameters of bushings / hollow column / support insulators are given below:

S.N.	Parameters	**145 kV**
(a)	Max. System voltage Um(kV)	145
(b)	Impulse withstand voltage (dry & wet) (kVp)	± 650
(c)	Switching surge withstand voltage (dry & wet) (kVp)	-
(d)	Power frequency withstand voltage (dry and wet) (kV rms)	± 275
(e)	Total creepage distance (min) (mm)	3625

4.6.3 Major Technical Parameters

The major technical parameters of the equipments are given below. For other parameters and features respective technical sections should be referred.

(A) **For 245/145 kV Circuit Breaker and Isolator**

Rated voltage kV (rms)	245/145
Rated frequency (Hz)	50/50
No. of Poles	3/3
Design ambinet temperature (°C)	50/50

Rated insulation levels :

1) Full wave impulse withstand voltage (1.2/50 micro sec.)

-	between line terminals and ground	±1050/650 kVp
-	between terminals with circuit breaker open	±1050/650 kVp
-	between terminals with isolator open	±1250/750 kVp

2) One minute power frequency dry and wet withstand voltage

-	between line terminals and ground	460/275 kV (rms)

- between terminals with circuit breaker open — 460/275 kV (rms)
- between terminals with Isolator open — 530/315kV (rms)

Max. radio interference voltage (microvolts) for 500 (at 92 kV frequency between 0.5 MHz and 2 MHz in all positions of the equipments. rms)/1000at 156 kV

Minimum creepage distance :-

Phase to ground (mm) — 6125/3625

Between CB Terminals (mm) — 6125/3625

System neutral earthing — Effectively earthed

Seismic acceleration — 0.3 G Horizontal

Rating of Auxiliary Contacts

Breaking capacity of Auxiliary Contacts — 2 A DC with circuit time constant of not less than 20ms.

Phase to phase spacing (mm) — 400/3000 or 2700

Auxiliary Switch shall also comply with other clauses of this chapter.

(B) **FOR 245 kV & 145 kV CT/CVT/SA**

Rated voltage kV (rms) — 245/145

Rated frequency (Hz) — 50/50

No. of poles — 1/1

Design ambient temperature (°C) — 50/50

Rated insulation levels :

1) Full wave impulse withstand voltage (1.2/50 micro sec.)

- between line terminals and ground for CT and CVT — ±1050/650 kVp
- for arrester housing — ±1050/650 kVp

2) One minute power frequency dry and wet withstand voltage

- between line terminals and ground for CT and CVT — 460/275 kV rms
- for arrester housing — 460/275kV rms

Max. radio interference

		1000/500
voltage (microvolts) for frequency between 0.5 MHz and 2 MHz in all positions of the equipment.	500 for SA (at 156 kV)	(at 92 kV rms)
Minimum creepage distance :-		
Phase to ground (mm)		61253625
System neutral earthing	- Effectively earthed -	
Seismic acceleration	- 0.3g horizontal -	
Partial discharge for :-		
- Surge arrester at 1.05 COV	- Not exceeding 50 pc. -	
- for CT/CVT	- Not exceeding 10 pc. –	

(C) **For 36 kV EQUIPMENTS**

Rated Voltage KV (rms)	36
Rated frequency (Hz)	50
No. of Poles	3
Design ambinet temperature (°C)	50

Rated insulation levels :

1) Full wave impulse withstand voltage (1.2/50 micro sec.)

- between line terminals and ground	± 170 kVp
- between terminals with Isolator open	± 180 kVp

2) One minute power frequency dry and wet withstand voltage

- between line terminals and ground	70 kV (rms)
- between terminals with Isolator open	80 kV (rms)

Minimum creepage distance :-

Phase to ground (mm) 900

Seismic acceleration -- 0.3g horizontal --

Rating of Auxiliary Contacts	10A at 220/ DC (As applicable)
Breaking capacity of Auxiliary Contacts	2 A DC with circuit time constant of not less than 20 ms.
Phase to phase spacing (mm)	1500

Auxiliary Switch shall also comply with other clauses of this chapter.

(D) 36 KV SURGE ARRESTOR WITHOUT SURGE MONITOR

1.	Rated voltage of arrestor	30 KV
2.	Maximum continuous operating voltage (COV) at design ambient temperature	25 kv
3.	Standards	IEC 60099-4
4.	Normal discharge current (8/20 msec)	10.KA
5.	Minimum discharge capability (FJ/KV) referred	5.0 KJ/KV
6.	One minute Power Frequency (dry) withstand voltage of arrestor	80 KV rms
7.	Line discharge class as per IEC	3
8.	Maximum residual voltage at S.No. 4 above	85 KVp

(E) 36kV Isolator

1.	Rated voltage	36 KV
2.	Rated current	As per price sehedule
3.	Standards	IS 9921/IEC 129
4.	Rated short time withstand (inKA)	25 KA for 1 sec.
5.	Operating drive	Manual operating mechanism
6.	Type	Double break Isolator w/o E/S 3 pole, outdoor, Gang operated.
7.	Constructed detail	All ferrous parts to be galvanized except nuts and bolts which shall be electroplated as per relevant IS.
8.	Terminal Connector	To suit site conditions and layout requirements.

5.0 ENGINEERING DATA AND DRAWINGS

5.1 The engineering data shall be furnished by the Contractor in accordance with the Schedule for each set of equipment as specified in the Technical Specifications.

5.2 The list of drawings/documents which are to be submitted to the Purchaser shall be discussed and finalised by the Purchaser at the time of award.

The Contractor shall necessarily submit all the drawings/ documents unless anything is waived.

The Contractor shall submit 4 (four) sets of drawings/ design documents
/data/ test reports as may be required for the approval of the Purchaser.

5.3 Drawings

5.3.1 All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, fixing arrangement required and any other information specifically requested in the specifications.

5.3.2 Each drawing submitted by the Contractor shall be clearly marked with the name of the Purchaser, 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.

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

5.4 The review of these data by the Purchaser will cover only general conformance of the data to the specifications and documents, interfaces with the equipment providedunder the specifications, external connections and of the dimensions which might affect substation layout. This review by the Purchaser may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Purchaser shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

5.5 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings 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 Purchaser. Approval of Contractor's drawing or work by the Purchaser shall not relieve the contractor of any of his responsibilities and liabilities

under the Contract.

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

5.7 Approval Procedure

The scheduled dates for the submission of the drawings as well as for, any data/information to be furnished by the Purchaser would be discussed and finalised at the time of award.

NOTE :

(1) The contractor may please note that all resubmissions must incorporate all comments given in the earlier submission by the Purchaser or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

(2) All major drawings should be submitted in Auto Cad Version 2004 or better.

(3) The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.

(4) 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 manuals shall be submitted by the Contractor to the Purchaser.

(5) The Contractor shall furnish to the Purchaser catalogues of spare parts.

5.8 The contractor shall have to furnish details and documents required as per specifications for release of advance.

6.0 MATERIAL/ WORKMANSHIP

6.1 General Requirement

6.1.1 Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they

are intended.

6.1.2 Incase where the equipment, materials or components are indicated in the specification as "similar" to any special standard, the Purchaser shall decide upon the question of similarity. When required by the specification or when required by the Purchaser the Contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and 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 Contractor.

6.1.3 The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

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

6.1.5 All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, levelling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances, instructions and the Specification. All factor 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 purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

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

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

6.1.8 Corona and radio interference voltage test and seismic withstand test procedures for equipments shall be in line with the procedure as applicable.

6.2 Provisions For Exposure to Hot and Humid climate

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

6.2.1 Space Heaters

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

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

6.2.1.3 Suitable anti condensation heaters with the provision of thermostat shall be provided.

6.2.2 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on 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.

6.2.3 Ventilation opening

Wherever ventilation is provided, the compartments shall have ventilation openings with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds and suitable provision shall be made so as to avoid any communication of air / dust with any part in the enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc.

6.2.4 Degree of Protection

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

a) Installed out door: IP- 55

b) Installed indoor in air conditioned area: IP-31 c) Installed in covered area: IP-52

d) Installed indoor in non air conditioned area where possibility of entry of water is limited: IP-41.

e) For LT Switchgear (AC & DC distribution Boards) : IP-52

The degree of protection shall be in accordance with IS:13947 (Part-I) / IEC-60947 (Part-I) / IS 12063 / IEC-60529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

6.3 RATING PLATES, NAME PLATES AND LABELS

6.3.1 Each main and auxiliary item of substation 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 name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

6.3.2 All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators, C & R panels and PLCC equipments shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

6.4 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, 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 furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

7.0 DESIGN IMPROVEMENTS / COORDINATION

7.1 The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. However, the Purchaser or the Contractor may propose changes in the specification of the equipment or quality thereof and if the Purchaser & contractor agree upon any such changes, the specification shall be modified accordingly.

7.2 If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

7.3 The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated 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 that it facilitates easy field assembly and maintenance.

7.4 The Contractor has to coordinate designs and terminations with the agencies (if any) who are Consultants/Contractor for the Purchaser. The names of agencies shall be intimated to the successful bidders.

7.5 The Contractor will be called upon to attend design co-ordination meetings with the Engineer, other Contractor's and the Consultants of the Purchaser (if any) during the period of Contract. The Contractor shall attend such meetings at his own cost at Patna or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

8.0 QUALITY ASSURANCE PROGRAMME

8.1 To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's Works or at his Sub-contractor's premises or at the Purchaser's site or at any other place of Work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be broadly outlined by the contractor and finalised after discussions. The detailed programme shall be submitted by the contractor after the award of contract and finally accepted by Chief Engineer(Transmission) after discussion. However, in case detailed valid programme approved by Chief Engineer(Transmission) for the equipment already exist, same would be followed till its validity. A quality assurance programme of the contractor shall generally cover the following:

(a) His organisation structure for the management and implementation of the proposed quality assurance programme:

(b) Documentation control system;

(c) Qualification data for bidder's key personnel;

(d) The procedure for purchases of materials, parts components and selection of sub-Contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.

(e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;

(f) Control of 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 Purcahser.

(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 rendered.

The Purchaser 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.

8.2 Quality Assurance Documents

The contractor would be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of purchaser's inspection of equipment/material

9.0 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

9.1 All equipment being supplied shall conform to type tests including additional type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections. Purchaser reserves the right to witness any or all the type tests. The Contractor shall intimate the Purchaser the detailed program about the tests atleast three (3) weeks in advance in case of domestic supplies& six (6) weeks in advance in case of foreign supplies. This shall conform to the details provided in the volume III of the Board's specifications.

10.0 TESTS

10.1 Pre-commissioning Tests

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 Purchaser and the Contractor for correctnessand 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 respective chapters and shall be included in the Contractor's quality assurance programme.

10.2 **Commissioning Tests**

10.2.1 The available instrumentation and control equipment will to be used during such tests and the Purchaser will calibrate, all such measuring equipment and devices as far as practicable.

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

10.2.3 The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.

10.3 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 reimbursed by POWERGRID on production of requisite documents.

11.0 PACKAGING & PROTECTION

11.1 All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the Purchaser, the Contractor shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Purchaser to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Purchaser takes no responsibility of the availability of the wagons.

11.2 All coated surfaces shall be protected against abrasion, impact, discolouration 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 pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

12.0 FINISHING OF METAL SURFACES

12.1 All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts & bolts and spring washers shall be electro galvanized to service condition 4. All steel conductors including those used for earthing/grounding (above ground level) shall also be galvanized according to IS: 2629.

12.2 HOT DIP GALVANISING

12.2.1 The minimum weight of the zinc coating shall be 610 gm/sq. m and minimum thickness of coating shall be 85 microns for all

items thicker than

6mm. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

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

12.2.3 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.

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

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

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

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

12.3 PAINTING

12.3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf 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.

12.3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

12.3.3 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.

12.3.4 The exterior and interior colour of the paint in case of new substations shall be RAL 7032 for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective sections of the equipments. Glossy white colour inside the equipments /boards /panels/junction boxes is also acceptable. The exterior colour for panels shall be matching with the existing panels in case of extension of a substation. 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 equipments.

12.3.5 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 alongwith the Bids for Purchaser's review & approval.

12.3.6 The colour scheme as given below shall be followed for Fire Protection and Air Conditioning systems

S.No.	PIPE LINE	Base colour	Band colour
Fire Protection System			
1	Hydrant and Emulsifier system pipeline	FIRE RED	-
2	Emulsifier system detection line – water	FIRE RED	Sea Green
3	Emulsifier system detection line –Air	FIRE RED	Sky Blue
4	Pylon support pipes	FIRE RED	
Air Conditioning System			
5	Refrigerant gas pipeline – at compressor suction	Canary Yellow	-

6	Refrigerant gas pipeline – at compressor discharge	Canary Yellow	Red
7	Refrigerant liquid pipeline	Dark Admiralty Green	-
8	Chilled water pipeline	Sea Green	-
9	Condenser water pipeline	Sea Green	Dark Blue

The direction of flow shall be marked by → (arrow) in black colour.

Base Colour Direction of flow Band Colour

12.3.7 For aluminium casted surfaces, the surface shall be with smooth finish.

Further, in case of aluminium enclosures the surface shall be coated with power (coating thickness of 60 microns) after surface preparation for painting.

13.0 HANDLING, STORING AND INSTALLATION

13.1 In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the 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.

13.2 Contractor may engage manufacturer's Engineers to supervise the unloading, transportation to site, storing, 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) and shall extend full cooperation to them.

13.3 In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

13.4 Where assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and

their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.

13.5 Contractor shall be responsible for examining all the shipment and notify the Purchaser immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. The Contractor shall submit to the Purchaser every week a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

13.6 The Contractor shall be fully responsible for the equipment/material until the same is handed over to the Purchaser in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken

over by Purchaser, as well as protection of the same against theft, element of nature, corrosion, damages etc.

13.7 Where material / equipment is unloaded by Purchaser before the Contractor arrives at site or even when he is at site, Purchaser 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.

13.8 The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment which requires indoor storage.

13.9 The words 'erection' and 'installation' used in the specification are synonymous.

13.10 Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

13.11 The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances as given in clause 4.7.1 the Contractor shall immediately proceed to correct the discrepancy at his risks and cost.

13.12 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 Purchaser. 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.

14.0 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.

15.0 AUXILIARY SUPPLY

15.1 The sub-station auxiliary supply is normally met through a system indicated under section "Electrical & Mechanical Auxiliaries" having the following parameters. The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, air-conditioning, lighting etc shall be designed for the specified Parameters as under. The DC supply for the instrumentation and PLCC system shall also conform the parameters as indicated in the following.

Normal Voltage	Variation in Voltage	Frequency in HZ	Phase/ Wire	Neutral connection
415V	± 10%	50 ± 5%	3/4 Wire	Solidly Earthed.
240V	± 10%	50 ± 5%	1/2 Wire	Solidly Earthed.
220V	190V to 240V	DC	-	Isolated 2 wire System
110V	95V to 120V	DC	-	Isolated 2 wire System
50V	–	DC	–	2 wire system (+) earthed

Combined variation of voltage and frequency shall be limited to ± 10%.

16.0 SUPPORT STRUCTURE

16.1 The equipment support structures shall be suitable for equipment connections at the first level . All equipment support structures shall be supplied alongwith brackets, angles, stools etc. for attaching the operating mechanism, control cabinets & marshalling box (wherever applicable) etc.

16.2 The support structures should be hot dip galvanised with minimum 610 gram/sq.m net of zinc.

16.3 In case of any deviation in this regard the bid is liable to be considered technically non responsive and shall be liable to be rejected.

16.4 Support structure shall meet the following mandatory requirements:

16.4.1 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 metres.

17.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

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

a)	For connecting casting, ACSR conductors designation A6	Aluminum alloy conforming to of IS:617 and all test shall conform to IS:617
b)	For connecting made equipment ter- casting, minals made of designation A6 copper with thick ACSR conductors test	Bimetallic connectors from aluminum alloy conforming to of IS:617 with 2mm bimetallic liner and all shall conform to IS:617
c)	For connecting G.I wire	Galvanised mild steel shield
d)	i) Bolts, nuts & Plain, washers	i) Electrogalvanised for sizes below M12, for others hot dip galvanised.
	ii) Spring washers for items 'a' to 'c'	ii) Electro-galvanised mild steel suitable for atleast service condition-3 as per IS:1573

17.2 Each equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation. The conductor terminations of equipment shall be either expansion, sliding or rigid type suitable for a) If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.

17.3 Where copper to aluminum 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 Purchaser by the Contractor.

17.4 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.

17.5 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminum body for Bi-metallic clamps.

17.6 All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

17.7 Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be .

17.8 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 ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.

17.9 All current carrying parts shall be designed and manufactured to have minimum contact resistance.

17.10 Clamps and connectors shall be designed as per IEC/ISS & Board's requirement.

17.11 Tests

17.11.1 Clamps and connectors should be type tested as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports on samples of similar type shall be submitted for approval

i) Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient)

ii) Short time current test

iii) Corona (gry) and RIV (dry) test (for 220 kV voltage class clamp)

iv) Resistance test and tensile test

18.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL

BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

18.1 All types of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS-5039/IS-8623, IEC-60439, as applicable, and the clauses given below:

18.2 Control cabinets, junction boxes, Marshalling boxes & terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be atleast 2.0 mm thick cold 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 aluminum enclosed box the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.

18.3 Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements. A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes / Control cabinets to prevent ingress of rain water.

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

18.5 All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. The quality of gasket shall be such that it does not get damaged/ cracked during the ten years of operation of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

18.6 All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting at least 150 mm above 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. 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.

18.7 A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.

18.8 For illumination, a 20 Watts fluorescent tube or 15 watts CFL shall be provided. The switching of the fittings shall be controlled by the door switch.

For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.

18.9 All control switches shall be of rotary switch type and Toggle/piano switches shall not be accepted.

18.10 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 self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

18.11 The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/feruling by pasting the same on the inside of the door.

18.12 a) The following routine tests alongwith the routine tests as per IS:5039 shall also be conducted:

i) Check for wiring

ii) Visual and dimension check

b) The enclosure of bay marshalling kiosk, junction box, terminal box shall conform to IP-55 as per IS:13947 including application of, 2.5 KV rms for 1 (one) minute, insulation resistance and functional test after IP-55 test.

19.0 Auxiliary Switches (Applicable for isolators and circuit breakers)

The following type test reports on auxiliary switches shall be submitted for approval:

(a) Electrical endurance test - A minimum of 2000 operation for 2A D. C. with a time constant greater than or equal to 20 millisecond with a subsequent examination of mV drop/visual defects/temperature rise test.

(b) Mechanical endurance test. A minimum of 1,00,000

operations with a subsequent checking of contact pressure test/visual examination.

(c) Heat run test on

contacts. (d) IR/HV

test etc.

20.0 TERMINAL BLOCKS AND WIRING

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

20.2 Terminal blocks shall be 650 V grade and have continuous rating to carry the maximum expected current on the terminals and non breakable type. These 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 of Elmex or Phoenix or Wago or equivalent make.

20.3 Terminal blocks 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.

20.4 The terminal shall be such 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.

20.5 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.

20.6 The terminal blocks shall be of extensible design.

20.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

20.8 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.

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

a) All circuits except Minimum of two of 2.5 sq mm

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

20.10 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.

20.11 Atleast 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

20.12 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.

20.13 The Contractor shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets. For equipments rated for 400 kV and above the wiring required in these items shall be run in metallic ducts or shielded cables in order to avoid surge overvoltages either transferred through the equipment or due to transients induced from the EHV circuits.

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

21.0 LAMPS AND SOCKETS

21.1 Lamps

All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

21.2 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp &
15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

21.3 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.

21.4 Switches and Fuses:

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

21.4.2 All fuses shall be of HRC cartridge type conforming to IS:9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

22.0 Bushings, Hollow Column Insulators, Support Insulators:

22.1 Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC-60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-60233/IS:5621. The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable.

The bidder may also offer composite silicon rubber insulator, conforming to IEC-61109.

22.2 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

22.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

22.4 Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

22.5 When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing 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.

22.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service 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 supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

22.7 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.

22.8 Tests

In 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 & IS : 5621. The type test reports shall be submitted for approval.

23.0 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 shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

23.1 Enclosures

a) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP-55 as per IS: 4691. For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust proof equivalent to IP-44 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) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

23.2 Operational Features

a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.

b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system having the particulars as given in Clause 15.0 of this Section.

23.3 Starting Requirements:

a) All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.

b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.

c) The locked rotor current shall not exceed six (6) times the rated full load current for all motors, subject to tolerance as given in IS:325.

d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified under Clause 15.0 shall be capable of withstanding atleast two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.

e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

23.4 Running Requirements:

a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified.

b) The double amplitude of motor vibration shall be within the limits specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.

c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

23.5 TESTING AND COMMISSIONING

An indicative list of tests is given below. Contractor shall perform any additional test based on specialities of the items as per the field Q.P./Instructions of the equipment Contractor or Purchaser without any extra cost to the Purchaser. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Purchaser for approval.

(a) Insulation resistance.

(b) Phase sequence and proper direction of rotation.

(c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.

24.0 TECHNICAL REQUIREMENT OF EQUIPMENTS

24.1 Circuit Breakers (Applicable for 132 kV)

24.1.(i) The manufacturer(s) whose SF6 Circuit Breaker are offered should have designed, manufactured tested as per IEC/IS or equivalent standard supplied the same for the specified system voltage and 31.5applicable for 132 KV Class **or above class** which are in satisfactory operation for at least 2 (two) years as on the date of bid opening

OR

24.1(ii) The manufacturer(s) whose SF6 Circuit Breaker are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 24.4. (a) & **(b)** given below.

AND

24.1.(iii) Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s).

AND

24.1.(iv) Furnishes a confirmation letter from the parent company or collaborator alongwith the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

24.2 Isolators (Applicable for 132 kV)

24.2.(i) The manufacturer whose isolator are offered, should have designed, manufactured & tested as per IS/IEC or equivalent standard and supplied the isolator for the specified system voltage and and 31.5 **kA fault level (Applicable for 132kV) 40.00 kV (for 220 kV) or above class** and should be in satisfactory operation for at least 2 (two) years as on the date of bid opening

OR

24.2.(ii)(a) The manufacturer(s) whose Isolator are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 24.2.(i) (a) & (b) given above.

AND

24.2.(ii)(b) Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

AND

24.2.(ii)(c) Furnishes a confirmation letter from the parent company or collaborator alongwith the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

24.3 Instrument Transformers (Applicable for 132 kV & 220 kV)

24.3.(i) (a) The manufacturer whose instrument transformers are offered, should have designed, manufactured & tested as per IS/IEC or equivalent standard and supplied the same for the specified

system voltage for CT & CVT and 31.5kA fault level (Applicable for 132kV CT) and or above class 40 kA for 220 kV). These equipment should be in satisfactory operation for at least 2 (two) years as on the date of bid opening

OR

24.3.(ii)(a) The manufacturer(s) whose Instrument Transformer are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 24.6.(i) given above.

AND

24.3.(ii)(b) Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

AND

24.3.(ii)(c) Furnishes a confirmation letter from the parent company or collaborator alongwith the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

24.4 **Surge Arresters (Applicable for 132 kV & 220 kV)**

(a) The manufacturer whose Surge Arresters are offered should have designed, manufactured and tested as per IEC/IS or equivalent standard and supplied the Surge Arrester for the specified energy capability with rated system voltage and which are in satisfactory operation for at least 2 (two) years as on the date of bid opening.

OR

(b) The manufacturer(s) whose Surge Arrestors are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no (a) given above.

AND

Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the

equipment(s)

AND

Furnishes a confirmation letter from the parent company or collaborator alongwith the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder.

24.5 1.1 KV Grade Power & Control Cables

24.5.1 Applicable for PVC Control Cable

The manufacturers, whose PVC control cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 100 Kms of 1.1 KV grade PVC insulated control cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 27C x 2.5 Sq.mm or higher size as on the date of bid opening.

24.5.2 Applicable for PVC Power Cable

The manufacturer, whose PVC Power Cables are offered, should have designed, manufactured, tested and supplied in a single contract atleast 100 Kms of 1.1 KV or higher grade PVC insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 150 Sq. mm or higher size as on the date of bid opening.

24.5.3 Applicable for XLPE Power Cables

The Manufacturer, whose XLPE Power cables are offered, should have designed, manufactured, tested and supplied in a single contract atleast 25 Kms of 1.1 KV or higher grade XLPE insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 630 Sq. mm or higher size as on the date of bid opening.

24.6 LT Switchgear

24.6.1 The Manufacturer whose LT Switchgear are offered, should be a manufacturer of LT Switchboards of the type and rating being offered. He should have designed, manufactured, tested and supplied at least 50 nos. draw out circuit breaker panels, out of which at least 5 nos. should have been with relay and protection schemes with current transformer. He should have also manufactured at least 50 nos. motor control center panels of the type and rating being offered which should be in successful operation as on date of bid opening.

24.6.2 The Switchgear items (such as circuit breakers, fuse switch units, contactors etc.), may be of his own make or shall be procured from reputed manufacturers and of proven design. At least one hundred circuit breakers of the make and type being offered shall be operating satisfactory as on date of bid opening.

24.7 Battery and Battery Charger

24.7.1 Requirements for Battery Manufacturers

The manufacturer whose Batteries are offered should have designed, manufactured and supplied DC Batteries of the type specified and being offered, having a capacity of at least 300 AH and these shall be operating satisfactorily for two years in power sector and/or industrial installations as on date of bid opening.

24.7.2 Requirements for Battery Charger Manufacturers

The manufacturer, whose Battery Chargers are offered, should have designed, manufactured and supplied Battery Chargers generally of the type offered, with static automatic voltage regulators and having a continuous output of atleast ten (10) KW and these should be in successful operation as on the date of bid opening.

24.8 LT Transformers

The manufacturer, whose transformers are offered should have designed, manufactured, type tested including short circuit test as per IEC/IS or equivalent standards and supplied transformers of at least 33 kV class of 3 1 5 KVA or higher. The transformer should have been in successful operation for at least 2 years as on the date of bid opening.

24.9 Fire Fighting System

The bidder or his sub-vendor should have designed, tested and similar equipments.

24.10 Control and Relay Panels

24.10.1 The manufacturer whose C&R panels and protective relay are offered should have designed, manufactured, tested, installed and commissioned C&R panels including protection relays which must be in satisfactory operation on specified voltage level or above [for 400 kV & below substation] for atleast 2 (two) years on the date of bid opening.

24.10.2 The C&R Panel from a manufacturer who has designed, manufactured, tested, installed and commissioned C&R panels which are in satisfactory operation on 132 kV system or above [for 132 kV substation] for atleast 2 (two) years on the date of bid opening can also be offered, provided the protective relay schemes should be offered from a Contractor who fully meets the

requirements stipulated under specifications.

Further, in such an event the manufacturer shall furnish an undertaking jointly executed by him and his protective relay schemes Supplier, as per the format enclosed in the bid documents for successful performance of the protection system offered.

24.11 PLCC

24.11.1 The manufacturer whose PLCC panels are offered should have designed, manufactured, tested, supplied and commissioned PLCC panels for 132 kV system or above [for 132 kV substation] and the same should be in successful operation for atleast 2 (two) years as on the date of bid opening.

24.11.2 The manufacturer whose line traps are offered should have designed, manufactured tested, supplied and commissioned similar line traps for specified voltage level or above and specified fault level and should be in successful operation for atleast 2 (two) years as on the date of bid opening.

24.11.3 PLCC Panels/line traps manufactured by the manufacturer meeting the requirements except that the PLCC Panels/line traps manufactured, tested and supplied by them is not in operation for the stipulated period can also be offered provided the manufacturer furnishes an undertaking jointly executed by him and his collaborator, who in turn fully meets the requirement specified above as per the format enclosed in the bid document for successful performance of the equipment offered.

24.11.4 The manufacturer(s) whose PLCC Panels/Line traps are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 24.14.1/24.14.2 given above.

and

Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

and

Furnishes a confirmation letter from the parent company or collaborator alongwith the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder.

ANNEXURE - A

LIST OF SPECIFICATIONS GENERAL STANDARDS AND CODES

India Electricity Rules

Indian Electricity Act

Indian Electricity (Supply) Act

Indian Factories Act

IS-5,	-	Colors for Ready Mixed Paints and Enamels.
IS-335,	-	New Insulating Oils.
IS-617,	-	Aluminium and Aluminium Alloy Ingots and Castings for General Engineering Purposes
IS-1448 (P1 to P 145)	-	Methods of Test for Petroleum and its
Products. IS-2071 (P1 to P3)	-	Methods of High Voltage Testing.
IS-12063	-	Classification of degrees of protection provided by enclosures of electrical equipment.
IS-2165 P1:1997 P2:1983	-	Insulation Coordination.
IS-3043	-	Code of Practice for Earthing
IS-6103	-	Method 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 of test for Power factor & Dielectric Constant of Electrical Insulating Liquids.
IS-6792	-	Method for determination of electric strength of insulating oils.
IS-5578	-	Guide for marking of insulated
conductors. IS-11353	-	Guide for uniform system of marking & identification of conductors & apparatus terminals.
IS-8263	-	Methods for Radio Interference Test on High voltage Insulators.
IS-9224 (Part 1,2&4)	-	Low Voltage Fuses
IEC-60060 (Part 1 to P4)	-	High Voltage Test Techniques

IEC 60068	-	Environmental Test
IEC-60117	-	Graphical Symbols
IEC-60156,	-	Method for the Determination of the Electrical Strength of Insulation Oils.
IEC-60270,	-	Partial Discharge Measurements.
IEC-60376	-	Specification and Acceptance of New Sulphur Hexafloride
IEC-60437	-	Radio Interference Test on High Voltage Insulators.
IEC-60507	-	Artificial Pollution Tests on High Voltage Insulators to be used on AC Systems.
IEC-60694	-	Common Specification for High Voltage Switchgear & Controlgear Standards.
IEC-60815	-	Guide for the Selection of Insulators in respect of Polluted Conditions.
IEC-60865 (P1 & P2)	-	Short Circuit Current - Calculation of effects.
ANSI-C.1/NFPA.70	-	National Electrical Code
ANSI-C37.90A	-	Guide for Surge Withstand Capability (SWC) Tests
ANSI-C63.21,	-	Specification for Electromagnetic Noise
and C63.3	-	Field Strength Instrumentation 10 KHz to
1 GHZ C36.4ANSI-C68.1	-	Techniquest for Dielectric Tests
ANSI-C76.1/EEE21	-	Standard General Requirements and Test Procedure for Outdoor Apparatus Bushings.
ANSI-SI-4	-	Specification for Sound Level Metres
ANSI-Y32-2/C337.2	-	Drawing Symbols
ANSI-Z55.11	-	Gray Finishes for Industrial Apparatus and Equipment No. 61 Light Gray
NEMA-107T	-	Methods of Measurements of RIV of High Voltage Apparatus
NEMA-ICS-II	-	General Standards for Industrial Control and Systems Part ICSI-109
CISPR-1	-	Specification for CISPR Radio Interference Measuring Apparatus for the frequency range 0.15 MHz to 30 MHz
CSA-Z299.1-1978h	-	Quality Assurance Program Requirements
CSA-Z299.2-1979h	-	Quality Control Program Requirements

CSA-Z299.3-1979h	-	Quality Verification Program Requirements
CSA-Z299.4-1979h	-	Inspection Program Requirements

TRANSFORMERS AND REACTORS

IS:10028 (Part 2 & 3)	-	Code of practice for selection, installation & maintenance of Transformers (P1:1993), (P2:1991), (P3:1991)
IS-2026 (P1 to P4)	-	Power Transformers
IS-3347 (part 1 to Part 8)	-	Dimensions for Porcelain transformer Bushings for use in lightly polluted atmospheres.
IS-3639	-	Fittings and Accessories for Power Transformers
IS-6600	-	Guide for Loading of Oil immersed Transformers.
IEC-60076 (Part 1 to 5)	-	Power Transformers
IEC-60214	-	On-Load Tap-Changers.
IEC-60289	-	Reactors.
IEC- 60354	-	Loading Guide for Oil - Immersed power trans formers
IEC-60076-10	-	Determination of Transformer and Reactor Sound Levels
ANSI-C571280	-	General requirements for Distribution, Power and Regulating Transformers
ANSI-C571290	-	Test Code for Distribution, Power and Regulation Transformers
ANSI-C5716	-	Terminology & Test Code for Current Limiting Reactors
ANSI-C5721	-	Requirements, Terminology and Test Code for Shunt Reactors Rated Over 500 KVA
ANSI-C5792	-	Guide for Loading Oil-Immersed Power Transformers upto and including 100 MVA with 55 deg C or 65 deg C Winding Rise
ANSI-CG,1EEE-4	-	Standard Techniques for High Voltage Testing

CIRCUIT BREAKERS

IEC-62271-100 Breakers	-	High Voltage Alternating Current Circuit
IEC-60427	-	Synthetic Testing of High Voltage alternating current circuit Breakers.
IEC-61264 Insulators	-	Pressurised Hollow Column

CURRENT TRANSFORMERS, VOLTAGE TRANSFORMERS AND COUPLING CAPACITOR VOLTAGE TRANSFORMERS

IS-2705- (P1 to P4)	-	Current Transformers.
IS:3156- (P1 to P4)	-	Voltage Transformers.
IS-4379 Cylinders	-	Identification of the Contents of Industrial Gas
IEC-60044-1	-	Current transformers.
IEC-60044-2	-	Voltage Transformers.
IEC-60358	-	Coupling capacitors and capacitor dividers.
IEC-60044-4	-	Instrument Transformes : Measurement of Partial Discharges
IEC-60481	-	Coupling Devices for power Line Carrier
Systems. ANSI-C5713	-	Requirements for Instrument transformers
ANSIC92.2	-	Power Line Coupling voltage Transformers
ANSI-C93.1	-	Requirements for Power Line Carrier Coupling Capacitors

BUSHING

IS-2099	-	Bushings for Alternating Voltages above1000V
IEC-60137	-	Insulated Bushings for Alternating Voltages above 1000V

SURGE ARRESTERS

IS-3070 (PART2) systems	-	Lightning arresters for alternating current
		: Metal oxide lightning arrestors without gaps.
IEC-60099-4	-	Metal oxide surge arrestors without gaps
IEC-60099-5	-	Selection and application recommendation
ANSI-C62.1	-	IEE Standards for S A for AC Power Circuits
NEMA-LA 1	-	Surge Arresters

CUBICLES AND PANELS & OTHER RELATED EQUIPMENTS

IS-722, IS-1248,	-	Electrical relays for power system
IS-3231, 3231 (P-3)		protection
IS:5039	-	Distributed pillars for Voltages not Exceeding 1000 Volts
IEC-60068.2.2	-	Basic environmental testing procedures

		Part 2: Test B: Dry heat
IEC-60529	-	Degree of Protection provided by enclosures.
IEC-60947-4-1	-	Low voltage switchgear and control gear.
IEC-61095	-	Electromechanical Contactors for household and similar purposes.
IEC-60439 (P1 & 2)	-	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: (Part I to 3)	-	Specification for Switchgear & Control Assemblies.
NEMA-AB	-	Moulded Case Circuit and Systems
NEMA-CS	-	Industrial Controls and Systems
NEMA-PB-1	-	Panel Boards
NEMA-SG-5	-	Low voltage Power Circuit breakers
NEMA-SG-3	-	Power Switchgear Assemblies
NEMA-SG-6	-	Power switching Equipment
NEMA-5E-3	-	Motor Control Centers
1248 (P1 to P9)	-	Direct acting indicating analogue electrical measuring instruments & their accessories.
Disconnecting switches		
IEC-60129 and	-	Alternating Current Disconnectors (Isolators) Earthing switches
IEC-1129	-	Alternating Current Earthing Switches Induced Current switching
IEC-60265 (Part 1 & 2)	-	High Voltage switches
ANSI-C37.32	-	Schedule of preferred Ratings, Manufacturing Specifications and Application Guide for high voltage Air Switches, Bus supports and switch accessories
ANSI-C37.34	-	Test Code for high voltage air switches

NEMA-SG6	-	Power switching equipment
PLCC and line traps		
IS-8792	-	Line traps for AC power system.
IS-8793	-	Methods of tests for line traps.
IS-8997	-	Coupling devices for PLC systems.
IS-8998	-	Methods of test for coupling devices for PLC systems.
IEC-60353	-	Line traps for A.C. power systems.
IEC-60481	-	Coupling Devices for power line carrier
systems. IEC-60495	-	Single sideboard power line carrier terminals
IEC-60683	-	Planning of (single Side-Band) power line carrier systems.
CIGRE	-	Teleprotection report by Committee
34 & 35. CIGRE	-	Guide on power line carrier 1979.
CCIR	-	International Radio Consultative Committee
CCITT Consultative	-	International Telegraph & Telephone Committee
EIA	-	Electric Industries Association
Protection and control equipment		
IEC-60051 : (P1 to P9)	-	Recommendations for Direct Acting indicating analogue electrical measuring instruments and their accessories.
IEC-60255 (Part 1 to 23)	-	Electrical relays.
IEC-60297		
(P1 to P4)	-	Dimensions of mechanical structures of the 482.6mm (19 inches) series.
IEC-60359	-	Expression of the performance of electrical & electronic measuring equipment.
IEC-60387	-	Symbols for Alternating-Current Electricity meters.
IEC-60447	-	Man machine interface (MMI) - Actuating principles.
IEC-60521	-	Class 0.5, 1 and 2 alternating current watt hour metres
IEC-60547	-	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 systems associated with electric power apparatus
ANSI-C39.1	-	Requirements for electrical analog indicating instruments
MOTORS		
IS-325	-	Three phase induction motors.
IS-4691	-	Degree of protection provided by enclosure for rotating electrical machinery.
IEC-60034 (P1 to P19:)	-	Rotating electrical machines
IEC-Document 2	-	Three phase induction motors
(Central Office) NEMA-MGI		Motors and Generators
Electronic equipment and components		
MIL-21B, MIL-833 & MIL-2750		
IEC-60068 (P1 to P5)	-	Environmental testing
IEC-60326 (P1 to P2)	-	Printed boards
		Material and workmanship standards
IS-1363 (P1 to P3)	-	Hexagon headbolts, screws and nuts of product grade C.
IS-1364 (P1 to P5)	-	Hexagon head bolts, screws and nuts of products grades A and B.
IS-3138	-	Hexagonal Bolts and Nuts (M42 to
M150) ISO-898	-	Fasteners: Bolts, screws and studs
ASTM	-	Specification and tests for materials
Clamps & connectors		
IS-5561	-	Electric power connectors.
NEMA-CC1	-	Electric Power connectors for sub station
NEMA-CC 3	-	Connectors for Use between aluminium or aluminum-Copper Overhead Conductors

Bus hardware and insulators

IS: 2121	-	Fittings for Aluminum and steel cored Al conductors for overhead power lines.
IS-731	-	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V.
IS-2486 (P1 to P4)	-	Insulator fittings for overhead power lines with a nominal voltage greater than 1000 V.
IEC-60120	-	Dimensions of Ball and Socket Couplings of string insulator units.
IEC-60137 above	-	Insulated bushings for alternating voltages 1000 V.
IEC-60168	-	Tests on indoor and outdoor post insulators of ceramic material or glass for Systems with Nominal Voltages Greater than 1000 V.
IEC-60233	-	Tests on Hollow Insulators for use in electrical equipment.
IEC-60273	-	Characteristices of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V.
IEC-60305	-	Insulators for overhead lines with nominal voltage above 1000V-ceramic or glass insulator units for a.c. systems Characteristics of String Insulator Units of the cap and pintype.
IEC-60372 (1984)	-	Locking devices for ball and socket couplings of string insulator units : dimensions and tests.
IEC-60383 (P1 and P2)	-	Insulators for overhead lines with a nominal voltage above 1000 V.
IEC-60433	-	Characteristics of string insulator units of the long rod type.
IEC-60471	-	Dimensions of Clevis and tongue couplings of string insulator units.
ANSI-C29	-	Wet process proelain insulators
ANSI-C29.1	-	Test methods for electrical power insulators
ANSI-C92.2	-	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
CISPR-7B	-	Recommendations of the CISPR, tolerances of form and of Position, Part 1
ASTM A-153 hardware	-	Zinc Coating (Hot-Dip) on iron and steel
Strain and rigid bus-conductor		
IS-2678	-	Dimensions & tolerances for Wrought Aluminum and Aluminum Alloys drawn round tube.
IS-5082	-	Wrought Aluminum and Aluminum Alloy Bars. Rods, Tubes and Sections for Electrical
purposes. ASTM-B 230-82	-	Aluminum 1350 H19 Wire for electrical
purposes		
ASTM-B 231-81	-	Concentric - lay - stranded, aluminum 1350 conductors
ASTM-B 221 shape	-	Aluminum - Alloy extruded bar, road, wire,
ASTM-B 236-83	-	Aluminum bars for electrical purpose
(Bus-bars) ASTM-B 317-83	-	Aluminum-Alloy extruded bar, rod,
pipe and		structural shapes for electrical purposes (Bus Conductors)
Batteries and batteries charger		
Battery		
IS:1651	-	Stationary Cells and Batteries, Lead-Acid Type (with Tubular Positive Plates)
IS:1652	-	Stationary Cells and Batteries, Lead-Acid Type (with Plante Positive Plates)
IS:1146	-	Rubber and Plastic Containers for Lead-Acid Storage Batteries
IS:6071	-	Synthetic Separators for Lead-Acid Batteries
IS:266	-	Specification for Sulphuric Acid
IS:1069	-	Specification for Water for Storage Batteries

IS:3116	-	Specification for Sealing Compound for Lead-Acid Batteries
IS:1248	-	Indicating Instruments
IS:10918	-	Vented type nickel Cadmium Batteries
IEC:60896-21&22	-	Lead Acid Batteries Valve Regulated types – Methods of Tests & Requirements
IEC: 60623	-	Vented type nickel Cadmium Batteries
IEC:60622	-	Secondary Cells & Batteries – Sealed Ni-Cd rechargeable single cell
IEC:60623	-	Secondary Cells & Batteries – Vented Ni-Cd rechargeable single cell
IEC:60896-11	-	Stationary Lead Acid Batteries – Vented Type – General requirements & method of tests
IEEE-485	-	Recommended practices for sizing of Lead Acid Batteries
IEEE-1115	-	Sizing of Ni-Cd Batteries
IEEE-1187	-	Recommended practices for design & installation of VRLA Batteries
IEEE-1188	-	Recommended practices for design & installation of VRLA Batteries
IEEE-1189	-	Guide for selection of VRLA Batteries
Battery Charger		
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 Transformers
IS:2959	-	AC Contactors for Voltages not Exceeding 1000 Volts
IS:1248	-	Indicating Instruments
IS:2208	-	HRC Fuses
IS:13947 (Part-3)	-	Air break switches, air break disconnectors & 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 controlgear.
IS:6005	-	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 paint
IEEE-484	-	Recommended Design for installation design and installation of large lead storage batteries for generating stations and substations.
IEEE-485	-	Sizing large lead storage batteries for generating stations and substations
Wires and cables		
ASTMD-2863	-	Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)
IS-694	-	PVC insulated cables for working voltages upto and including 1100 Volts.
IS-1255	-	Code of practice for installation and maintenance of power cables, upto and including 33 kV rating
IS-1554 (P1 and P2) (part 1)	-	PVC insulated (heavy duty) electric cables for working voltage upto and including 1100 V.
	-	Part (2) for working voltage from 3.3 kV upto and including 11kV.
IS:1753	-	Aluminium conductor for insulated cables
IS:2982	-	Copper Conductor in insulated cables.
IS-3961 (P1 to P5)	-	Recommended current ratings for cables.
IS-3975	-	Mild steel wires, formed wires and tapes for armouring of cables.
IS-5831	-	PVC insulating and sheath of electric cables.
IS-6380	-	Elastometric insulating and sheath of electric cables.
IS-7098	-	Cross linked polyethylene insulated PVC sheathed cables for working voltage upto and including 1100 volts.
IS-7098	-	Cross-linked polyethyle insulated PVC sheathed cables for working voltage from

		3.3kV upto and including 33 kV.
IS-8130	-	Conductors for insulated electrical cables and flexible cords.
IS-1753	-	Aluminum Conductors for insulated cables.
IS-10418	-	Specification for drums for electric cables.
IEC-60096 (part 0 to p4)	-	Radio Frequency cables.
IEC-60183	-	Guide to the Selection of High Voltage Cables.
IEC-60189 (P1 to P7)	-	Low frequency cables and wires with PVC insulation and PVC sheath.
IEC-60227 (P1 to P7)	-	Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V.
IEC-60228	-	Conductors of insulated cables
IEC-60230	-	Impulse tests on cables and their accessories.
IEC-60287 (P1 to P3)	-	Calculation of the continuous current rating of cables (100% load factor).
IEC-60304	-	Standard colours for insulation for low-frequency cables and wires.
IEC-60331	-	Fire resisting characteristics of Electric cables.
IEC-60332 (P1 to P3)	-	Tests on electric cables under fire conditions.
IEC-60502	-	Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto to 30 kV
IEC-754 (P1 and P2)	-	Tests on gases evolved during combustion of electric cables.

AIR conditioning and ventilation

IS-659	-	Safety code for air conditioning
IS-660	-	Safety code for Mechanical Refrigeration
ARI:520	-	Standard for Positive Displacement RefrigerationCompressor and Condensing Units
IS:4503	-	Shell and tube type heat exchanger
ASHRAE-24	-	Method of testing for rating of liquid coolers
ANSI-B-31.5	-	Refrigeration Piping
IS:2062	-	Steel for general structural purposes
IS:655	-	Specification for Metal Air Dust
IS:277	-	Specification for Galvanised Steel Sheets
IS-737	-	Specification for Wrought Aluminium and

		Aluminium Sheet & Strip
IS-1079	-	Hot rolled cast steel sheet & strip
IS-3588	-	Specification for Electrical Axial Flow Fans
IS-2312	-	Propeller Type AC VentilationFans
BS-848	-	Methods of Performance Test for Fans
BS-6540 Part-I	-	Air Filters used in Air Conditioning and General Ventilation
BS-3928	-	Sodium Flame Test for Air Filters (Other than for Air Supply to I.C. Engines and Compressors)
US-PED-2098	-	Method of cold DOP & hot DOP test
MIL-STD-282	-	DOP smoke penetration method
ASHRAE-52	-	Air cleaning device used in general ventilation for removing particle matter
IS:3069 Relating to	-	Glossary of Terms, Symbols and Units
		Thermal Insulation Materials.
IS:4671	-	Expanded Polystyrene for Thermal Insulation Purposes
IS:8183	-	Bonded Mineral Wool
IS:3346	-	Evaluation of Thermal Conductivity properties by means of guarded hot plate method
ASTM-C-591-69	-	Standard specification for rigid preformed cellular urethane thermal insulation
IS:4894	-	Centrifugal Fans
BS:848 Fans	-	Method of Performance Test for Centrifugal
IS:325	-	Induction motors, three-phase
IS:4722	-	Rotating electrical machines
IS:1231	-	Three phase foot mounted Induction motors, dimensions of
IS:2233	-	Designations of types of construction and mounting arrangements of rotating electrical machines
IS:2254	-	Vertical shaft motors for pumps, dimensions of
IS:7816	-	Guide for testing insulation resistance of rotating machines
IS:4029	-	Guide for testing three phase induction motors

IS:4729	-	Rotating electrical machines, vibration of, Measurement and evaluation of
IS:4691	-	Degree of protection provided by enclosures for rotating electrical machinery
IS:7572	-	Guide for testing single-phase a.c. motors
IS:2148	-	Flame proof enclosure for electrical apparatus
BS:4999	-	Noise levels
(Part-51)		

Galvanizing

IS-209	-	Zinc Ingot
IS-2629	-	Recommended Practice for Hot-Dip galvanizing on iron and steel.
IS-2633	-	Methods for testing uniformity of coating of zinc coated articles.
ASTM-A-123	-	Specification for zinc (Hot Galavanizing) Coatings, on products Fabricated from rolled, pressed and forged steel shapes, plates, bars and strips.
ASTM-A-121-77	-	Zinc-coated (Galvanized) steel barbed wire

Painting

IS-6005	-	Code of practice for phosphating of iron and steel.
ANSI-Z551	-	Gray finishes for industrial apparatus and equipment
SSPEC	-	Steel structure painting council

Fire protection system

Fire protection manul issued by tariff advisory committee (TAC) of India.

HORIZONTAL CENTRIFUGAL PUMPS

IS:6595(Part 2) water	-	Horizontal centrifugal pumps for clear, cold
IS:9137	-	Code for acceptance test for centrifugal & axial pumps
IS:5120	-	Technical requirement - Rotodynamic special purpose pumps
API-610	-	Centrifugal pumps for general services
	-	Hydraulic Institutes Standards

BS:599	-	Methods of testing pumps
PTC-8.2	-	Power Test Codes - Centrifugal pumps

DIESEL ENGINES

IS:10000	-	Methods of tests for internal combustion engines
IS:10002	-	Specification for performance requirements for constant speed compression ignition engines for general purposes (above 20 kW)
BS:5514	-	The performance of reciprocating compression ignition (Diesel) engines, utilising liquid fuel only, for general purposes
ISO:3046	-	Reciprocating internal combustion engines performance
IS:554	-	Dimensions for pipe threads where pressure tight joints are required on threads
ASME Power Test Code	-	Internal combustion engine PTC-17
	-	Codes of Diesel Engine Manufacturer's Association, USA

PIPING VALVES & SPECIALITIES

IS:636	-	Non percolating flexible fire fighting delivery hose
IS:638	-	Sheet rubber jointing and rubber inserting jointing
IS:778	-	Gun metal gate, globe and check valves for general purpose
IS:780	-	Sluice valves for water works purposes (50 to 300 mm)
IS:901	-	Couplings, double male and double female instantaneous pattern for fire fighting
IS:902	-	Suction hose couplings for fire fighting purposes
IS:903	-	Fire hose delivery couplings branch pipe nozzles and nozzle spanner
IS:1538	-	Cast iron fittings for pressure pipes for water, gas and sewage
IS:1903	-	Ball valve (horizontal plunger type) including floats for water supply purposes
IS:2062	-	SP for weldable structural steel

IS:2379	-	Colour Code for the identification of pipelines
IS:2643	-	Dimensions of pipe threads for fastening purposes
IS:2685	-	Code of Practice for selection, installation and maintenance of sluice valves
IS:2906	-	Sluice valves for water-works purposes (350 to 1200 mm size)
IS:3582	-	Basket strainers for fire fighting purposes (cylindrical type)
IS:3589	-	Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter)
IS:4038	-	Foot valves for water works purposes IS:4927
	-	Unlined flax canvas hose for fire fighting
IS:5290	-	Landing valves (internal hydrant)
IS:5312 (Part-I)	-	Swing check type reflex (non-return) valves
IS:5306	-	Code of practice for fire extinguishing installations and equipment on premises
Part-I	-	Hydrant systems, hose reels and foam inlets
Part-II	-	Sprinkler systems
BS:5150	-	Specification for cast iron gate valves

MOTORS & ANNUNCIATION PANELS

IS:325	-	Three phase induction motors
IS:900	-	Code of practice for installation and maintenance of induction motors
IS:996	-	Single phase small AC and universal electric motors
IS:1231	-	Dimensions of three phase foot mounted induction motors
IS:2148	-	Flame proof enclosure of electrical apparatus
IS:2223	-	Dimensions of flange mounted AC induction motors
IS:2253	-	Designations for types of construction and mounting arrangements of rotating electrical machines
IS:2254	-	Dimensions of vertical shaft motors for pumps

IS:3202	-	Code of practice for climate proofing of electrical equipment
IS:4029	-	Guide for testing three phase induction motors
IS:4691	-	Degree of protection provided by enclosure for rotating electrical machinery
IS:4722	-	Rotating electrical machines
IS:4729	-	Measurement and evaluation of vibration of rotating electrical machines
IS:5572	-	Classification of hazardous areas for electrical (Part-I) installations (Areas having gases and vapours)
IS:6362	-	Designation of methods of cooling for rotating electrical machines
IS:6381	-	Construction and testing of electrical apparatus with type of protection 'e'
IS:7816	-	Guide for testing insulation for rotating machine
IS:4064	-	Air break switches
IEC DOCUMENT 2 (Control Office) 432	-	Three Phase Induction Motor
VDE 0530 Part I/66	-	Three Phase Induction Motor
IS:9224 (Part-II)	-	HRC Fuses
IS:6875	-	Push Button and Control Switches
IS:694	-	PVC Insulated cables
IS:1248	-	Indicating instruments
IS:375	-	Auxiliary wiring & busbar markings
IS:2147	-	Degree of protection
IS:5	-	Colour Relay and timers
IS:2959	-	Contactors
PG Test Procedures		
NFPA-13	-	Standard for the installation of sprinkler system
NFPA-15	-	Standard for water spray fixed system for the fire protection
NFPA-12A	-	Standard for Halong 1301 Fire Extinguishing

		System
NFPA-72E	-	Standard on Antomatic Fire Detectors
		Fire Protection Manual by TAC (Latest Edition)
NFPA-12 systems	-	Standard on Carbon dioxide extinguisher
IS:3034	-	Fire of industrial building: Electrical generating and distributing stations code of practice
IS:2878	-	CO2 (Carbon dioxide) Type Extinguisher
IS:2171	-	DC (Dry Chemical Powder) type
IS:940	-	Pressurised Water Type
D.G. SET		
IS:10002	-	Specification for performance requirements for constant speed compression ignition (diesel engine) for general purposes
IS:10000	-	Method of tests for internal combustion
engines IS:4722	-	Rotating electrical machines-specification
IS:12063	-	Degree of protection provided by enclosures
IS:12065	-	Permissible limit of noise levels for rotating electrical machines.
	-	Indian Explosive Act 1932
Steel structures		
IS-228 (1992)	-	Method of Chemical Analysis of pig iron, cast iron and plain carbon and low alloy steels.
IS-802 (P1 to 3:)	-	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 of carbon manganese steel.
IS-816	-	Code of Practice for use of metal arc welding for general construction in Mild steel
IS-817	-	Code of practice for training and testing of metal arc welders. Part 1 : Manual Metal arc welding.
IS-875 (P1 to P4)	-	Code of practice for design loads (other than earthquake) for buildings and structures.

IS-1161	-	Steel tubes for structural purposes.
IS-1182	-	Recommended practice for radiographic examination of fusion welded butt joints in steel plates.
IS-1363 (P1 to P3)	-	Hexagonal head bolts, screws & nuts of products grade C.
IS-1364	-	Hexagon headbolts, screws and nuts of product grades A and B.
IS-1367 (P1 to P18)	-	Technical supply condition for threaded steel fasteners.
IS-1599	-	Methods 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 coil rectagular section spring washers for bolts, nuts and screws.
IS-3664	-	Code of practice for ultrasonic 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 carbon and carbon manganese steels.
ANSI-B18.2.1	-	Inch series square and Hexagonal bolts and screws
ANSI-B18.2.2	-	Square and hexagonal nuts
ANSI-G8.14	-	Round head bolts
ASTM-A6	-	Specification for General Requirements for rolled steel plates, shapes, sheet piling and bars of structural use
ASTM-A36	-	Specifications of structural steel
ASTM-A47	-	Specification for malleable iron castings
ASTM-A143	-	Practice for safeguarding against embilement of Hot Galvanized structural steel products and procedure for

		detaching embrilement
ASTM-A242	-	Specification for high strength low alloy structural steel
ASTM-A283	-	Specification for low and intermediate tensile strength carbon steel plates of structural quality
ASTM-A394	-	Specification for Galvanized steel transmission tower bolts and nuts
ASTM-441	-	Specification for High strength low alloy structural manganese vanadium steel.
ASTM-A572	-	Specification for High strength low alloy colombium-Vanadium steel of structural quality
AWS D1-0	-	Code for welding in building construction welding inspection
AWS D1-1	-	Structural welding code
AISC	-	American institute of steel construction
NEMA-CG1	-	Manufactured graphite electrodes
Piping and pressure vessels		
IS-1239 (Part 1 and 2)	-	Mild steel tubes, tubulars and other wrought steel fittings
IS-3589	-	Seamless Electrically welded steel pipes for water, gas and sewage.
IS-6392	-	Steel pipe flanges
ASME	-	Boiler and pressure vessel code
ASTM-A120	-	Specification for pipe steel, black and hot dipped, zinc-coated (Galvanized) welded and seamless steel pipe for ordinary use
ASTM-A53	-	Specification for pipe, steel, black, and hot- dipped, zinc coated welded and seamless
ASTM-A106	-	Seamless carbon steel pipe for high temperature service
ASTM-A284	-	Low and intermediate tensile strength carbon- silicon steel plates for machine parts and general construction.
ASTM-A234	-	Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures

ASTM-S181	-	Specification for forgings, carbon steel for general purpose piping
ASTM-A105	-	Forgings, carbon steel for piping components
ASTM-A307	-	Carbon steel externally threated standard fasteners
ASTM-A193	-	Alloy steel and stainless steel bolting materials for high temperature service
ASTM-A345	-	Flat rolled electrical steel for magnetic applications
ASTM-A197	-	Cupola malleable iron
ANSI-B2.1	-	Pipe threads (Except dry seal)
ANSI-B16.1	-	Cast iron pipe flangesand glanged fitting. Class 25, 125, 250 and 800
ANSI-B16.1 -		Malleable iron threaded fittings, class 150 and 300
ANSI-B16.5	-	Pipe flanges and flanged fittings, steel nickel alloy and other special alloys
ANSI-B16.9	-	Factory-made wrought steel butt welding fittings
ANSI-B16.11	-	Forged steel fittings, socket-welding and threaded
ANSI-B16.14	-	Ferrous pipe plug, bushings and locknuts with piplethreads
ANSI-B16.25	-	Butt welding ends
ANSI-B18.1.1	-	Fire hose couplings screw thread.
ANSI-B18.2.1	-	Inch series square and hexagonal bolts and screws
ANSI-B18.2.2	-	Square and hexagonal nuts
NSI-B18.21.1	-	Lock washers
ANSI-B18.21.2	-	Plain washers
ANSI-B31.1	-	Power piping
ANSI-B36.10	-	Welded and seamless wrought steel pipe
ANSI-B36.9	-	Stainless steel pipe
Other civil works standards		
IS-269	-	33 grade ordinary portland cement.
IS2721	-	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 (P1 and P2)	-	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	-	Methods of sampling and analysis of
concrete. IS-1566	-	Hard-dawn steel wire fabric for concrete reinforcement.
IS-1742	-	Code of Practice for Building drainage.
IS-1785	-	Plain hard-drawn steel wire for prestressed concrete.
IS-1786	-	High strength deformed Steel Bars and wires for concrete reinforcement.
IS-1811	-	Methods of sampling Foundry sands.
IS-1893	-	Criteria for earthquake resistant design of structures.
IS-2062	-	Steel for general structural purposes.
IS-2064	-	Selection, installation and maintenance of sanitary appliances-code of practices.
IS-2065	-	Code of practice for water supply in buildings.
IS-2090	-	High tension steel bars used in prestressed concrete.
IS-2140	-	Standard Galvanized steel wire for fencing.
IS-2470 (P1 & P2)	-	Code of practice for installation of septic
tanks. IS-2514	-	Concrete vibrating tables.
IS-2645	-	Integral cement waterproofing compounds.
IS-3025 (Part 1 to Part 48)	-	Methods of sampling and test (Physical and chemical) for water and waste water.
IS-4091	-	Code of practice for design and construction of foundations for transmission line towers and poles.

IS-4111 (Part 1 to P5)	-	Code of practice for ancillary structures in sewerage system.
IS-4990	-	Plywood for concrete shuttering work.
IS-5600	-	Sewage and drainage pumps.

National buiding code of India 1970

USBR E12	-	Earth Manual by United States Department of the interior Bureau of Reclamation
ASTM-A392-81	-	Zinc/Coated steel chain link fence fabric
ASTM-D1557-80	-	test for moisture-density relation of soils using 10- lb (4.5 kg) rame land 18-in. (457 mm) Drop.
ASTM-D1586	-	Penetration Test and Split-Barrel
(1967)	-	Sampling of Soils
ASTM-D2049-69	-	Test Method for Relative Density of Cohesionless Soil
ASTM-D2435	-	Test method for Unconsolidated, (1982) Undrained Strengths of Cohesive Soils in Triaxial Compression.
BS-5075	-	Specification for accelerating Part I Admixtures, Retarding Admixtures and Water Reducing Admixtures.
CPWD	-	Latest CPWD specifications

ACSR MOOSE CONDUCTOR

IS:6745	Methods for Determination of Mass of zinc coating on zinc coated Iron and Steel Articles	BS:443-1969
IS:8263	Methods for Radio Interference	
IEC:437-1973 CISPR	Test on High Voltage Insulators	NEMA:107-1964
IS:209	Zinc Ingot	BS:3436-1961
IS:398	Aluminum Conductors for	IEC:209-1966
Part - V	Overhead Transmission Purposes	
BS:215(Part-II)	Aluminium Conductors galvanized steel reinforced extra high	IEC:209-1966
BS:215(Part-II)	voltage (400 kV and above)	

IS:1778	Reels and Drums forBS:1559-1949 Bare Conductors
IS:1521	Method for Tensile Testing ISO/R89-1959of steel wire
IS:2629	Recommended practice for Hot dip Galvanising on Iron and Steel.
IS:2633	Method for Testing Uniformity of coating of zinc Coated Articles.
IS:4826	Hot dip galvanised coatings on round steel wiresASTMA-472-729

GALVANISED STEEL EARTHWIRE

IS:1521	Method for Tensile Testing ISO/R:89-1959 of Steel Wire
IS:1778	Reels and Drums for Bare Conductors
IS:2629	Recommended practice for Hot Dip Galvanising on Iron and Steel.
IS:2633	Methods for testing Uniformity of Coating of Zinc Coated Articles.
IS:4826	Hot dip Galvanised Coatings ASTM:A 475-72a on Round Steel Wires BS:443-1969
IS:6745 Zinc	Method for Determination BS:443-1969of mass of Coating on Zinc coated Iron and Steel Articles.
IS:209	Zinc ingot BS:3463-1961
IS:398 (Pt. I to	Aluminum Conductors for BS:215
(Part-II) P5:1992)	overhead transmission purposes.

Lighting Fixtures and Accessories

IS:1913	General and safety requirements for electric lighting fittings.
IS:3528	Water proof electric lighting fittings.
IS:4012	Dust proof electric lighting fittings.
IS:4013	Dust tight proof electric lighting fittings.
IS:10322	Industrial lighting fittings with metal reflectors.
IS:10322	Industrial lighting fittings with plastic reflectors.
IS:2206	Well glass lighting fittings for use under ground in mines (non-flameproof type).
IS:10322	Specification for flood light.
IS:10322	Specification for decorative lighting outfits.
IS:10322	Luminaries for street lighting

IS:2418	Tubular fluorescent lamps
IS:9900	High pressure mercury vapour lamps.
IS:1258	Specification for Bayonet lamp fluorescent lamp.
IS:3323	Bi-pin lamp holder tubular fluorescent lamps.
IS:1534	Ballasts for use in fluorescent lighting fittings. (Part-I)
IS:1569	Capacitors for use in fluorescent lighting fittings.
IS:2215	Starters for fluorescent lamps.
IS:3324	Holders for starters for tubular fluorescent lamps
IS:418	GLS lamps
IS:3553	Water tight electric fittings
IS:2713	Tubular steel poles
IS:280	MS wire for general engg. purposes

Conduits, Accessories and Junction Boxes

IS:9537	Rigid steel conduits for electrical wiring
IS:3480	Flexible steel conduits for electrical wiring
IS:2667	Fittings for rigid steel conduits for electrical wiring
IS:3837	Accessories for rigid steel conduits for electrical
wiring IS:4649	Adaptors for flexible steel conduits.
IS:5133	Steel and Cast Iron Boxes
IS:2629	Hot dip galvanising of Iron & Steel.

Lighting Panels

IS:13947	LV Switchgear and Control gear(Part 1 to 5)
IS:8828	Circuit breakers for over current protection for house hold and similar installations.
IS:5	Ready mix paints
IS:2551	Danger notice plates
IS:2705	Current
transformers	
IS:9224 2)	HRC Cartridge fuse links for voltage above 650V(Part-
(7)IS:5082	Wrought aluminium and Al. alloys, bars, rods, tubes and sections for electrical purposes.

(8)IS:8623	Factory built Assemblies of Switchgear and Control Gear for voltages upto and including 1000V AC and 1200V DC.
(9)IS:1248	Direct Acting electrical indicating instruments

Electrical Installation

IS:1293	3 pin plug
IS:371	Two to three ceiling roses
IS:3854	Switches for domestic and similar purposes
IS:5216	Guide for safety procedures and practices in electrical work.
IS:732	Code of practice for electrical wiring installation (system voltage not exceeding 650 Volts.)
IS:3043	Code of practice for earthing.
IS:3646	Code of practice of interior illumination part II & III.
IS:1944	Code of practice for lighting of public through fares.
IS:5571	Guide for selection of electrical equipment for hazardous areas.
IS:800	Code of practice for use of structural steel in general building construction.
IS:2633	Methods of Testing uniformity of coating on zinc coated articles.
IS:6005	Code of practice for phosphating iron and steel.
	INDIAN ELECTRICITY ACT INDIAN ELECTRICITY RULES

LT SWITCHGEAR

IS:8623 (Part-I)	Specification for low voltage switchgear and control gear assemblies
IS:13947 (Part-I)	Specification for low voltage switchgear and control gear, Part 1 General Rules
IS:13947 (part-2)	Specification for low voltage switchgear and control gear, Part 2 circuit breakers.
IS:13947 (part-3)	Specification for low voltage switchgear and control gear. Part 3 Switches, Disconnectors, Switch-disconnectors and fuse combination units
IS:13947 (part-4)	Specification for low voltage switchgear and control gear. Part 4 Contactors and motors starters.

IS:13947 (part-5)	Specification for low voltage switchgear and control gear. Part 5 Control-circuit devices and switching elements
IS:13947 (part-6) gear.	Specification for low voltage switchgear and control Part 6 Multiple function switching devices.
IS:13947 (part-7) gear.	Specification for low voltage switchgear and control Part 7 Ancillary equipments
IS:12063	Degree of protection provided by enclosures
IS:2705	Current Transformers
IS:3156	Voltage Transformers
IS:3231	Electrical relays for power system protection
IS:1248	Electrical indicating instruments
IS:722	AC Electricity meters
IS:5578	Guide for Marking of insulated conductors of apparatus terminals
IS:13703 (part 1)	Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC Part 1 General Requirements
IS:13703 (part 2) AC o 1500V DC Part 2 Fuses for use of authorized persons	Low voltage fuses for voltage not exceeding 1000V
IS:6005	Code of practice of phosphating iron and steel
IS:5082	Wrought Aluminum and Aluminum alloys for electrical purposes
IS:2633	Hot dip galvanising

Annexure- 'B'

LIST OF THE MAKES FOR WHICH TYPE TEST REPORTS NOT REQUIRED TO BE SUBMITTED

S.No.	ITEM DESCRIPTION	MAKE
1.	Out door receptacles	CGL / B&C / BCH / Sakti, Chennai / Indo Asian
2.	Tre foil clamps	Moulded Fibre Glass Products, Calcutta
3.	Diesel Engine	K.Cummins / Ruston & Hornsby
4.	Alternator	AVK / KIRLOSKAR / STAMFORD
5.	Motors	KEC / Siemens/ NGEF/Crompton/ABB
6.	Cable Glands	Sunil & Co. / Arup/ Comet / QPIE
7.	Junction Box	Sarvana / ECS / C&S / Vikas/ Maktel/Unilac/Jasper
8.	Lighting Fixtures	Phillips/CGL/Bajaj

NOTE : **For a new make other than above approved list of sub vendor, type test reports as per relevant standard shall be submitted for Purchaser's approval.**

TB 357 510 023

SECTION-4

GUARANTEED TECHNICAL PARTICULARS

A.	COUPLING DEVICE (Phase to Phase Type)	
1.	Name of Manufacturer and Country	1.....
2.	Type, Model and Catalogue Number	2.....
3.	Nominal primary side impedance	3.....
4.	Nominal secondary side impedance	4.....
5.	Composite loss with in pass-band	5.....
6.	Return loss with in pass-band	6.....
7.	Available Bandwidth (with 4400/6600/8800 pF CVTS)	7.....
8.	Nominal Peak Envelope Power (with Distortion and Inter modulation Products 80 dB down)	8.....
9.	Maximum number of PLC terminals that can be connected in parallel: a) 20 W (PEP) PIC terminals b) 40 W (PEP)PLC terminals c) 100 W(PEP) PLC terminals	9..... a)..... b)..... c).....
10.	Power Frequency Impedance between primary terminal and Earth Terminals of Coupling Device.	10.....
11.	No of H.F. terminals provided for carrier equipment connection	11.....
	HIGH FREQUENCY CABLE	
1.	Name of Manufacturer and country	1.....
2.	Type, Model and Catalogue no.	2.....
3.	Applicable standards	3.....
4.	Maximum attenuation per km of cable for carrier Frequency range 40 to 500 kHz	4.....
5.	Maximum loop resistance/ km of cable	5.....
	POWER LINE CARRIER TERMINAL FOR SPEECH AND DATA TRANSMISSION OR NETWORK PROTECTION	
1.	Name of Manufacturer and country	1.....

(Bidder's Signature)

(1)

2.	Type, Model and Catalogue no.	2.....
3.	Type of Modulation	3.....
4.	Mode of transmission	4.....
5.	Carrier Frequency Range	5.....
6.	Nominal carrier frequency band in either direction of transmission	6.....
7.	Return loss within the nominal carrier frequency band	7.....
8.	Effectively transmitted V.F. band a) For speech b) For telephone signaling	8.....
9.	Return Loss within the effectively transmitted voice frequency band	9.....
10.	Maximum H.F Amplifier output with single /Multiple tone keying (Peak Envelope Power)	10.....
11.	Nominal carrier frequency power (peak envelop power) at output terminals.	11.....
	VF TRANSMISSION TERMINAL FOR NETWORK PROTECTION SIGNALS (PROTECTION COUPLER)	
1.	Name of Manufacturer and country	1.....
2.	Type, Model and catalogue number	2.....
3.	Whether equipment works on frequency shift principle of coded signal principle	3.....
4.	Whether Equipment is suitable for independently protecting two circuits	4.....
5.	Frequencies used in the equipment for transmission of signal for un-coded signal transmission	5.....
	a) Guard frequency	a) .....
	c) Working frequency (Trip system-I)	b) .....
	d) Working frequency (Trip system-II)	c) .....
	e) Working frequency (Trip system (I&II)	d) .....

(Bidder's Signature)

6.	Criteria used for command transmission	6.....
7.	Transmission time corresponding to telegraph speed for transmission on PLCC channel of coded signal	7.....
	a) 600 Bds.	a).....
	b) 400 Bds.	b).....
	c) 200 Bds.	c).....
8.	Mode of transmission of guard signal	8.....
9.	Whether equipment is suitable for Direct circuit breaker tripping.	9.....
10.	Whether loop test is possible	10.....
11.	Whether the equipment is suitable for transmitting and receiving more than two independent commands (please furnish details)	11.....
12.	Whether receiver design provides protection against false tripping from random noise	12.....
	LINE TRAPS	
1.	Name of Manufacturer and country	1.....
2.	Type & Model	2.....
3.	System Voltage Rating	3.....
4.	Continuous current rating at 50°C ambient	4.....
5.	Continuous current rating at 65°C	5.....
6.	Maximum Symmetrical short circuit current rating for 1 sec. duration	6.....
7.	Asymmetric peak value of first half wave of rated short time current	7.....
8.	Rated Inductance	8.....
9.	Blocking Range	9.....
10.	Minimum Guaranteed Resistive component in blocking frequency range	10.....

(Bidder's Signature)

(3)

11.	Details of protection of capacitors and coils against voltage surges. Indicate type of protective device.	11.....
12.	Rated voltage of the arrestor (protective device)	12.....
	ELECTRONIC PRIVATE AUTOMATIC EXCHANGE (EPAX)	
1.	Name of manufacturer	1.....
2.	Type and model	2.....
3.	Capacity of exchange (Subscribers & trunk lines)	3.....
4.	Whether compatible to both i.e PLCC & DOT lines for communication	4.....

(Bidder's Signature)

SECTION 5
CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

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

BHEL ENQUIRY. NO:

BIDDER:OFFER REFERENCE:

I. A) CARRIER EQUIPMENT

(1)	(2)	(3)	(4)	(5)
S.No.	**Parameters**	**Data**	**Yes / No**	**Remarks in case reply in Col (4) is NO**
1.	Applicable Standard	IEC 60495		
2.	Type			
3	Type of Modulation	Amplitude Modulation		
3	Mode of Transmission	Single Side band		
4	Carrier frequency range	40 - 500 kHz		
5	Nominal carrier frequency band in either direction of transmission	4 kHz		
6	Return Loss within the nominal carrier frequency band	10 dB min		
7	Return Loss within the effectively transmitted voice frequency band	Not more than 14 dB		
8	Frequency difference between the V.F. input and V.F. output of a pair of terminals connected back to back for permissible ambient temperature and supply voltage variation	Will not exceed 2 Hz		
9	Power Output at HF terminal (Bidder to indicate Wattage)	20/40/80 W for S/C		

(1)	(2)	(3)	(4)	(5)
S.No.	**Parameters**	**Data**	**Yes / No**	**Remarks in case reply in Col (4) is NO**
10	Nominal carrier frequency power (peak envelope power) at output terminal	As per Specification		
11	H.F. Impedance at output of carrier terminals	75 ohms (unbalanced) or 150 ohms (balanced)		
12	Stability of carrier frequency	$< \pm 10$ Hz		
13	Whether compander is provided	Provided		
14	Compression and expansion ratio of compander	At least 2:1 compression ratio with a corresponding expansion ratio of 1:2.		
15	Improvement in S/N due to compander	15 dB		
16	Whether carrier is suppressed during transmission of signal	Yes		
17	Whether frequency locking between Tx/Rx provided	Yes		
18	Automatic gain control range and regulation	For 40 dB change in carrier frequency signal level within the regulation range change in VF receive levels of both speech and other signals shall be less than 1 dB		
19	Level of spurious emission at			
(a)	Edge of nominal carrier frequency	As per IEC 495		
(b)	4.0 kHz away from nominal carrier frequency band	As per IEC 495		
(c)	8.0 kHz away from nominal carrier frequency band	As per IEC 495		

(1)	(2)	(3)	(4)	(5)
S.No.	**Parameters**	**Data**	**Yes / No**	**Remarks in case reply in Col (4) is NO**
20	Near and far end cross talk due to telephone signaling channel in a pair of PLC terminals (without companders) connected back to back	Less than or equal to 55 dBmop		
21	Psophometric noise contribution of a pair of PLC terminals connected back to back	Less than or equal to - 55 dBmop		
22	Group delay distortion in the frequency band relevant to the transmission of protection signals	As per CCITT recommendation G.232		
23	Performance under noise condition			
(a)	Noise generated within terminal	As per IEC 495		
(b)	Additional noise introduced when terminals are connected back to back at repeater station	As per IEC 495		
(c)	Noise bandwidth	As per IEC 495		
24	Power supply requirements			
(a)	Voltage	48 V DC		
(b)	Permissible voltage requirement	15 %, - 10% (positive pole earthed)		
25	Insulation level	2 kV for all AC circuits 500 V DC for all signal points		
26	All solid state equipment /system panels subjected to heat soaking as per clause 9.16 of Section II			

I. B) TYPE TESTS

i)Whether type test reports of the following test conducted earlier as per IEC on identical or similar material are available. **(YES / NO)**

S.No.	TESTS	REPORT NO.	Date	Conducted at accredited laboratory or witnessed by independent authority
1	Voltage Variation			
2	Carrier frequency range & band			
3	Frequency accuracy			
4	Transmit / Receive frequency difference			
5	Automatic gain control			
6.	Harmonic distortion			
7	Selectivity			
8	Output impedance, Return loss & Tapping loss			
9	Return loss, Af inputs/outputs			
10	Balance to ground			
11	Limiter action			
12	Spurious emission			
13	Carrier frequency levels and levels			
14	Attenuation distortion			
15	Noise generated within terminal			
16	Near and far end cross talk			
17	Group delay distortion			
18	Conducted noise			
19	Telephone signaling channel			
20	Speech levels			
21	Voltage withstand test			
22	Insulation test			

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

II. A) PROTECTION COUPLER

(1)	(2)	(3)	(4)	(5)
S.No.	**Parameters**	**Data**	**Yes / No**	**Remarks in case reply in Col (4) is NO**
1.	Applicable Standard	IEC 60834		
2.	Type			
3	Principle of working for transmission / reception of protection signal	Frequency shift keying / coded signal		
4	Each protection signaling equipment shall provide	Transmission facilities for minimum three protection signals and reception facilities for minimum three protection signals.		
5	The equipment shall be suitable for	Transmission of direct and permissive trip signal as well as blocking signals		
6	The overall time of PLC,VFT and transmission path for permissive trip / blocking	20 msec. or less		
7	The overall time of PLC,VFT and transmission path for direct trip	30 msec. or less		
8	Under no circumstances protection channel should share power	Yes		
9	Whether loop facilities is provided for operational reliability	Yes		
10	Whether built in counters for counting the number of trip command sent and number of trip command received is provided	Yes		

(1)	(2)	(3)	(4)	(5)
S.No.	**Parameters**	**Data**	**Yes / No**	**Remarks in case reply in Col (4) is NO**
11	Whether equipment is suitable for direct circuit breaker	Yes		
12	Transmitter input requirements (contact requirements)			
(a)	Voltage	660 volts		
(b)	Current	5 amps		
(c)	Power	1250 W/VA		
(d)	No. of contacts	2 No. potential free NO contact		
13	Receiver output requirements (contact requirements)			
(a)	Voltage	250 V (DC)		
(b)	Current	0.1 A (DC)		
(c)	Power	As per IEC-255--25		
(d)	No. of contacts	2 No. potential free NO contact		
14	Supervisory and alarm contact facilities			
(a)	Current	0.1A(DC)		
(b)	Voltage	250 V(DC)		
(c)	No of contacts	2 number potential free change over contact		
15	Power Supply			
(a)	Voltage	48 V DC , + 15 % - 10% (Positive pole earthed)		
16	Whether loop test is possible	Yes		
17	Insulation level	As per IEC 60834		

II. B.1) PROTECTION COUPLER :

i) Whether type test reports of the following test conducted earlier as per IEC 60834-1 on identical or similar material are available **(YES / NO)**

S.No.	TESTS	REPORT NO.	Date	Conducted at accredited laboratory or witnessed by independent authority
1	Power supply variation			
2	Power supply interruption			
3	Reflected noise			
4	Reverse Polarity			
5	Interference by discrete frequency			
6.	Transmission time			
7	Interference by frequency deviation (Wherever applicable)			
8	Alarm functioned			
9	Security			
10	Dependability			
11	Voltage withstand test			
12	Insulation test			
13	Electrical fast transient test (along with carrier terminal)			
14	HF disturbance test (along with carrier terminal)			
15	Electrostatic discharge test (along with carrier terminal)			
16	Radiated electromagnetic field susceptibility test (along with carrier terminal)			
17	Environment test (as per IS 9000)			

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

II. B.2) RELAY ASSOCIATED WITH PLCC EQUIPMENT :

i) Whether type test reports of the following test conducted earlier as per IS 8686 on identical or similar material are available. **(YES / NO)**

S.No.	TESTS	REPORT NO.	Date	Conducted at accredited laboratory or witnessed by independent authority
1	Impulse voltage withstand test as per clause 6.1 of IS: 8686 (for a test voltage appropriate to clause III as per clause 3.2 of IS : 8686).			
2	High frequency disturbance test as per clause 5.2 of IS: 8686 (for a test voltage appropriate to clause III as per clause 3.2 of IS: 8686).			

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

II. A) COUPLING DEVICE

(1)	(2)	(3)		(4)	(5)
S.No.	**Parameters**	**Data**		**Yes / No**	**Remarks in case reply in Col (4) is NO**
1.	Applicable Standard	IEC 481, IS 8998			
2.	Type, Model Number				
	Type of Coupling device (indentor to tick)	Phase to Phase √	~~Phase to earth~~		
3	Type of mounting	Outdoor			
4	Maximum temperature limit for satisfactory operation	50 ^{0}C (Satisfactory operation upto 65 ^{0}C)			
5	Nominal line side Impedance	240 ohms for 765kV and 400kV Quad bundle conductor line			
6	Nominal equipment side impedance	75 ohm (unbalanced)			
7	Composite loss within passband	Not more than 2 dB			
8	Return loss within passband	Not less than 12 dB			
9	Available bandwidth	36 to 500 kHz			
10	Nominal peak Envelope Power (with distortion and inter modulation products 80 dB down)	Not less than 650 watt			
11	Power frequency impedance between primary terminal and Earth terminals of coupling device	Less than 20 ohms			
12	1 Minute power frequency insulation level between primary and secondary terminals of coupling device	5 kVrms			

(1)	(2)	(3)	(4)	(5)
S.No.	**Parameters**	**Data**	**Yes / No**	**Remarks in case reply in Col (4) is NO**
13	Impulse (1.2/50 micro-sec.) withstand level between primary and secondary terminals of coupling device	As per IEC 481		
14	Power frequency current carrying capacity of drain coil (or primary winding of matching transformer)	As per IEC 481		
15	Whether Surge arrester in primary side of coupling device as per IEC 481 provided	Provided		
16	No. of H.F terminals provided for carrier equipment	At least 2		

III. B) TYPE TESTS

i) Whether type test reports of the following test conducted earlier on identical or similar material are available.
(YES / NO)

S.No.	TESTS	REPORT NO.	Date	Conducted at accredited laboratory or witnessed by independent authority
1	Return loss test (as per IEC 481)			
2	Composite loss test (as per IEC 481)			
3	Distortion and inter modulation test (as per IEC 481)			
4	Impulse voltage test (as per IEC 481)			
5	Tests on arrestors (as per IEC 481)			

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

III. A) H.F.CABLE

(1)	(2)	(3)	(4)	(5)
S.No.	**Parameters**	**Data**	**Yes / No**	**Remarks in case reply in Col (4) is NO**
1.	Applicable Standard	IEC 60096-2, BS:2316, IS-5082		
2.	Type			
3	Characteristic Impedance	75 ohm unbalanced		
4	Attenuation per km. of cable at various carrier frequencies in the range of 40 to 500 kHz	1 to 5 dB/Km		
5	Details and particulars of insulation			
6	Withstand test voltage (rms) between conductor and outer sheath	4 kV for 1 min.		
7	Conductor resistance of cable	Not exceed 16 ohms /Km at 20 ^{o}C Cent		
8	Minimum bending radius	15 cms		
9	Packing length per drum	500 meter.		

IV. B) TYPE TESTS

i) Whether type test reports of the following test conducted earlier on identical or similar material are available.
(YES / NO)

S.No.	TESTS	REPORT NO.	Date	Conducted at accredited laboratory or witnessed by independent authority
1	Inner conductor Tests			
2	Dielectric Tests			
3	Insulation Tests			
4	Outer conductor Tests			
5	Inner Sheath Tests			
6	Armour Tests			
7	Outer sheath Tests			
8	Ageing Tests			

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

V. A) Electronic Private Automatic Exchange (EPAX)

(1)	(2)	(3)	(4)	(5)
S.No.	**Parameters**	**Data**	**Yes / No**	**Remarks in case reply in Col (4) is NO**
1.	Type			
2	Construction feature	Solid state and fully automatic		
3	Number of subscriber lines (Indentor to tick)	4 ~~8~~ 24 √ ~~48~~		
4	Number of trunk lines (Indentor to tick)	4 8 √ ~~12~~		
5	Type of Switching	PCM/TDM		
6	Operating voltage	48 V DC with + ve pole earthed		
7	Whether four wire E/M interfaces unit is provided	Yes		
7	Whether suitable to work in conjunction with Electro - mechanical PAX	Yes		
9	Whether suitable to work with DOT leased lines	Yes		

VI) Qualifying Requirements

a) Bidder fulfils the technical requirement stipulated in clause 1.7 of Section-1 **(Yes/ No)**

b) **Performance Certificate** (covering period not less than 2 years) issued by a utility shall be submitted for vendor approval to be done by BSEB **(Yes/ No)**

c) Bidder shall submit valid reports of type tests for PLCC Equipments carried out within last five years **(Yes/ No)**

Date: **Signature of the authorized representative of Bidder**

Company Seal