BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

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TYPE OF DOC.	**TECHNICAL SPECIFICATION**			**NAME**	**AA**	**AA**	**VK**
TITLE				**SIGN**	-Sd-	-Sd-	-Sd-
PLCC Equipment				**DATE**	20-2-16	20-2-16	20-2-16
				GROUP	TBEM	**W.O. No**	
CUSTOMER	PGCIL						
PROJECTS	**765kV Banaskantha & 400kV Sankhari(GETCO)S/s , Project code : 384**						

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Section –I

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of PLCC equipment , site testing & recommissioning of existing indoor PLCC. No deviation from the requirements specified in various clauses of this specification shall be allowed. A certificate to this effect shall have to be furnished along with the offer.
The fitments offered shall be of PGCIL approved make or its subsequent approval from PGCIL shall be bidder's responsibility, with no commercial implications to BHEL. If any of the make offered by the bidder is not acceptable to M/s PGCIL, the bidder has to supply alternate PGCIL approved make, meeting the specification, with no commercial implications to BHEL.
Wherever bidder offers any item/spare in lieu of the same being “Built-in feature” of any fitment or the same being “Not applicable” is subject to approval by Powergrid. No price implication will be entertained by BHEL at contract stage if any separate item is insisted by POWERGRID to meet the contract requirement.

In case of any conflict between the technical details mentioned in this section and the remaining sections of this document, then Section-1 shall prevail and is to be considered as binding requirement.

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of Customer : Power Grid Corporation of India Ltd.

Name of the Project : Package for extension of 765kV Banaskantha S/s and 400kV Sankhari (GETCO) S/s

Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

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

1.2.1 SCOPE:

PLCC Equipments , Digital protection coupler (Suitable for interfacing with E1 port of SDH equipment) and associated power cables for both ends of the following lines-

a) Banaskantha –Chittorgarh : 765kV D/C T/L : 300Km
b) Banaskantha –Sankhari : 400kV D/C T/L : 26Km

Inter circuit coupling mode of PLC (analogue) link shall be provided for Banaskantha –Sankhari -400kV D/C T/L

c) Bidder to decide the wattage of its PLC terminals to ensure that the Power output (PEP) at HF terminal shall be 20/40/80Watt as per the specification and offer accordingly .Any input, if required, to validate the offered wattage of its PLC terminal shall be arranged by the bidder.

d) It is bidders sole responsibility to correctly offer the complete PLCC system, get requisite approval of drawing/document , successfully commission and handover the PLCC system to BHEL/POWERGRID .It is to be noted that if at any stage the wattage of the offered PLC terminals is found inadequate , the PLC terminal shall be modified /replaced with higher wattage terminal without any price implication to BHEL .

e) Any additional item as per the specification ,is required to be supplied for completion of the PLCC system over and above the items indicated in BOQ.

1.3 QUALIFYING REQUIREMENTS

1.3.1 The manufacturer whose PLCC panels are offered should have designed, manufactured, tested, supplied and commissioned PLCC panels for (i) 400kV system or above [for 765 kV & 400 kV substation], (ii) 220 kV System or above [for 220 kV Substation] & (iii) 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. **(24-02-2015)**.

1.3.2 PLCC Panels manufactured by the manufacturer meeting the requirements at Clause No. 1.3.1 except that the PLCC Panels 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 at 1.3.1 above for successful performance of the equipment offered.

1.3.3 The manufacturer(s) whose PLCC Panels 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 1.3.1 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 **in the event of award** 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.

1.3.4 The digital PLCC Panels can also be offered from manufacturer(s) who have Established integration & testing facilities for digital PLCC in India provided the digital PLCC modules/hardware/software are sourced from their parent company (principal) who meets the QR stipulated under clause 1.3.1.

Please note: Forms of undertaking if any (as per customer/BHEL format) shall be furnished

to successful bidder during contract stage.

1.4 TRAINING :

a. The supplier shall impart the necessary training in the field of erection , testing , operation and maintenance of PLCC and Digital Protection coupler to Employer's personnel at one substation-site for three (3) days.

b. However, the travel lodging, & boarding expenses of employers personnel, if any shall be done by Employer.

Note: Charges for Tutorials & other training materials for the trainees shall also be included in the price quoted by the bidder .

1.5 BILL OF QUANTITY

(As per Annexure-I attached along with this Section)

1.6 LIST OF DOCUMENTS TO BE SUBMITTED

1. General Arrangement Drawings of Coupling Device, PLC Terminals, EPAX, Digital Protection Coupler.
2. Guaranteed Technical Particulars for each type of item offered.
3. Type Test Reports as per relevant IEC standards.
4. Quality Assurance Plan.
5. Documents in support of qualifying requirement.
6. Performance certificates.
7. List of Past Supplies.

1.7 SPECIAL TOOLS AND TACKLES :

The bidder shall include in his proposal the deployment of all special tools and tackles required for 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.

1.8 SERVICES :

1.8.1 SUPERVISION OF COMMISSIONING & SITE TESTING-
The erection, testing and commissioning of PLCC system shall be done under the supervision of the Equipment manufacturer (Bidder).

1.8.2 FREQUENCY PLANNING , SNR CALCULATIONS & COMPUTER STUDY-
Frequency planning , SNR Calculations & Computer Study is in the scope of bidder.

1.9 STANDARD DRAWINGS :

1.9.1 If Powergrid standard approvals are available with bidder, the same shall be adhered to during contract stage.

Annexure-I **BILL OF QUANTITY**

SN	`	Unit	At Banaskantha Substation	At Chittorgarh Substation	At Sankhari Substation	Total Quantity
1	Coupling device(Phase to Phase)	Nos.	3	2	1	6
2	HF cable	m	500+300	500	300	1600
3	Carrier equipment (for speech + protection and speech +data) (Analogue type)	Nos.	5	3	2	10
4	Analogue Protection coupler	Nos.	4	2	2	8
5	Digital Protection Coupler	Nos.	4	2	2	8
6	4 wire telephone instrument(Along with telephone wiring)					
6a	4 wire telephone set with connecting cables	Nos.	2	1	1	4
6b	5 Pair Telephone Cables, armoured ,0.5 sq. mm annealed copper conductor and petroleum jelly filled with polyethene outer jackets	m	2400+1200	2400	1200	7200
7.	Testing & maintenance equipment(print test kit only)	Set	1	1	NIL	2
8.	EPAX (24/8) with 24Nos telephones, cables etc.	Set	1	NIL	NIL	1

Annexure-I **BILL OF QUANTITY**

SN	Description	Unit	At Banaskantha Substation	At Chittorgarh Substation	At Sankhari Substation	Total Quantity
8	**Mandatory Spares**					
8a	Set of prints for carrier terminal	Set	2	NIL	1	3
8b	Set of prints for Analogue protection coupler(of each type)	Set	2	NIL	1	3
8c	Set of print for digital protection coupler	Set	2	NIL	1	3
8d	Set of prints for EPAX	Set	1	NIL	NIL	1
9	**Services :** System engineering including Computer study , frequency planning and SNR Calculations	Lot	1	NIL	NIL	1
10	**Services:** Supervision of pre-commissioning (panel wise)	Nos.	6	3	3	12
11	**Services :** Supervision of Testing and commissioning (link wise)	Nos.	2	NIL	NIL	2
12	**Services:** Training Charges at Sub-station site as per technical Specification clause 1.4 of Section-1	Lot	1	NIL	NIL	1

Note-

1. **Cut lengths of HF cable & 5 pair telephone cable shall be furnished to the successful bidder.**
2. **Digital protection coupler shall be mounted in a separate panel.**
3. **The digital protection coupler shall be used as one of the two teleportation channel on the lines between the stations having optical fibre link.**
4. **Interface Cable/Hardware (E1 cable ,FO Cable ,Convertors etc as required) for interfacing Digital Protection Coupler and SDH Equipment is in bidders scope of supply and is deemed to be included in the main equipment price. No additional price implication shall be entertained during contract stage in this regard.**

SECTION II

PLCC EQUIPMENTS

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 IS-8792,8793,8997,8998,IEC-60353,-60481,-60495,-60683,CIGRE-Teleprotection report by Committee 34 & 35.t, CIGRE-Guide on PLC 1979.,CCIR,CCITT,EIA

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/concerned State Electricity Boards 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 with concerned State Electricity Boards for 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 For security reasons each 765/400/220kV transmission line shall be protected by Main-I and Main-II protections as given below :

Main-I Numerical Distance protection with permissive inter-tripping.

Main-II Distance protection of a different measuring technique than that of relay under Main I.

132kV transmission lines shall have Main I protection same as above alongwith backup overcurrent 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 765kV/400 kV 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 for 765kV/400 kV S/C , D/C & 220kV S/C lines shall be employed. Inter-circuit coupling shall be used for 220/132kV D/C lines and phase to ground coupling shall be used for 132 KV S/C lines. 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. Coupling mode shall, however, be fully confirmed by Contractor after conducting detailed computer study taking into account the transpositions of 765kV/400 kV lines for optimum coupling mode over these line sections. The coupling arrangement shall be fully optimized by the Contractor after conducting detailed study of every line section individually, taking into account the temperature variations, transpositions, earth resistivity, conductor configuration, carrier channels requirements, security and reliability criteria and other relevant details. The line attenuation shall be calculated for complete range of frequencies. The earth resistivity data, existing frequency networks and other relevant details of each line will be furnished to the Contractor for carrying out the computer studies and frequency planning. The Contractor shall complete the computer

studies wherever required and submit the frequency plan and optimum coupling details within a period of one month from the date of receipt of above data.

5.8 The 765kV/400 kV transmission lines may be transposed.

The transmission tower configuration and conductor details shall be forwarded after the award to enable the contractor to make his own computer study assessment of the carrier path based on wave propagation over transposed lines with each transposition point acting as "Modal Converter".

5.9 The parameters of the equipment quoted shall be such that the mode of wave propagation on 765kV/400 kV power line (with transpositions indicated) shall not impose any limitation on the efficient and reliable performance of information link from protection or communication point of view.

5.10 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.

5.11 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**~~

~~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 450 ohms for 765kV/400 kV system and 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 The line trap on 765kV & 400 kV lines shall show no visual corona discharge at a voltage of 508kV(rms) and 320 KV (rms) power frequency falling voltage. Suitable corona rings may be incorporated in the line trap. Radio interference voltage for 420/245/132 kV shall not exceed 500 micro volts at 280/163/97 kV (rms) respectively. For 765kV, RIV shall not exceed 1000 micro volts at 508kV(rms).

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 31.5/40/50/63 kA as per requirement. The mH. rating shall be 0.25/0.5/1.0 mH depending on frequency plan.

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 clause 9.2 of Section III

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 4" IPS Aluminium tube or 3" IPS Al. tube or ACSR single/twin/Quad bundle 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 Clamps and connectors shall be designed corona controlled. Visual Corona extinction voltage shall not be less than 508kV(rms) & 320kV(rms) for 765kV and 420kV respectively. All nuts and bolts shall be suitably shrouded.

6.13.5 Radio interference Voltage for 420/245/132 kV shall not exceed 500 microvolts at 280/163/97 kV (rms) respectively. For 765kV, RIV shall not exceed 1000 micro volts at 508kV(rms).

6.13.6 ~~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.~~

6.13.7 ~~Clamps/connectors shall conform to type test as per IS:5561. Type Test reports shall also be submitted for following additional type tests :~~

~~a) Visual Corona Extinction Test~~
~~b) Radio Interference Voltage Measurement~~

6.13.8 ~~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 clause 9.2 of Section III

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) at HF terminal	20/40/80 Watt
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.

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 clause 9.2 of Section III
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.

10.2 **Electronic Private Automatic Exchange (EPAX)**

10.2.1 The 24 line Electronic Private Automatic Exchange (EPAX) wherever specified shall be connected to minimum six trunk routes thorough PLCC channels (speech panel) with Four-wire E/M' interface unit. This 4-wire interface unit either shall form an integral part of the 'EPAX' system or be suitable for mounting/housing in the carrier panel. The exchange will have its own ringing current and tone generator etc. The exchange shall be suitable for working on 48 V DC Power Supply (positive pole earthed).
The exchange shall be fully automatic, solid state, and of modular construction and shall have multiple switching routes (minimum 4-routes).

10.2.2 'EPAX' shall also be provided with two (2) additional interface units and operate exclusively with OWNER's leased subscriber lines, of Department of Telecommunication (DOT) and compatible with 2 wire full duplex, voice grade mode of operation.

The details of communication protocol, for interfacing of the 'DOT' leased lines, shall be coordinated by the Contractor, with the licensing authority (DOT).

10.3 **Remote End Four Wire 'E/M' Interface & Subscriber Unit or Equivalent EPAX (4x4)**

10.3.1 The remote end four wire 'E/M' interface & subscriber units, wherever specified, shall be of electronic type and be suitable for working on fixed frequency power line carrier systems with E & M signaling. This shall be housed in the carrier set and be fully wired to the power line carrier terminal equipment.

10.3.2 This unit shall receive and register various signals, on PLCC Channels, from remote end exchanges or other remote end subscriber units and associated four wire interface unit.

10.3.3 The four wire interface unit shall be equipped for routing transit calls and shall be supplied pre-wired to handle calls for minimum eight directions, in a form suitable for transmission over PLCC.

10.3.4 The bidder shall also indicate the total number of trunk-line capacity, available with each four-wire interface unit.

The unit shall be suitable for connecting two-wire telephone sets. Further, the associated telephone cables for locating two subscriber lines, within the control room is in the scope of this specification.

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

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 clause 9.2 of ~~CTR~~ Section III 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).

11. **Mandatory Testing & Maintenance Equipment**

Print testing kit for PLCC terminal, E/M interface & subscriber unit, Protection coupler & EPAX —

comprising of following items of reputed make in addition to any other special items required for testing and maintenance of this equipment packed in a carrying brief case:

1. Screw driver set with multi up fixing feature
2. Nose pliers
3. Cutting pliers
4. Ordinary Pliers
5. Adjustable wrench
6. Soldering iron with tip earthed

a) 150 watts - 1 No.

b) 35 Watts - 1 No

c) 10 watts - 1 No.

operated with isolated (step down) transformer having provision for interchangeable taps.

7. Desoldering pump
8. Print extender
9. Print puller
10. Large selection of test leads

11. Solder wire

12. Large selection of plugs, jacks & pistol probes compatible with equipment supplied

13. Dummy load

14. Interface card/print for Tx to Rx loop-back

15. Test oscillator/tone generator with indicating meters - either built in or separate

16. ESD wrist band

17. ESD conducting mat

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.

Annexure II

SPECIFICATION FOR DIGITIAL PROTECTION COUPLER

1.0 Digital protection coupler for protection signalling through optical fibre cable system.

1.1 The Digital protection signalling equipment is required to transfer the trip commands from one end of the line to the other end in the shortest possible time with adequate security and dependability. It shall also monitor the healthiness of the link from one end to the other and give alarms in case of any abnormality. The protection signalling equipment shall have a proven operating record in similar application over EHV systems and shall operate on 48V DC (+15%/-20%). It shall provide minimum four commands. These commands shall be suitable for Direct tripping, Intertripping and Blocking protection schemes of EHV lines.

The protection signalling equipment shall communicate to the remote end interfacing with SDH terminal equipment at its 2Mbps port. It shall provide suitable interfaces for protective relays, which operate at 220V DC. Power supply points shall be immune to electromagnetic interface.

1.2 Principle of operation

During normal operation, protection signalling equipment shall transmit a guard signal/code. In case Protection signalling equipment is actuated by protective relays for transmission of commands, it shall interrupt the guard signal/code and shall transmit the command code to the remote end. The receiver shall recognize the command code and absence of the guard code and will generate the command to the protective relays.

All signal processing i.e. generation of tripping signal and the evaluation of the signals being received shall be performed completely digital using Digital Signal Processing techniques.

1.3 Loop testing

An automatic loop testing routine shall check the teleprotection channel.

It shall also be possible to initiate a loop test manually at any station by pressing a button on the front of the equipment.

Internal test routine shall continuously monitor the availability of the protection signaling equipment.

Proper tripping signal shall always take the priority over the test procedure.

The high speed digital protection signalling equipment shall be designed and provided with following features.

- Shall work in conjunction with SDH terminal equipment.
- It shall communicate on G 703 (E1,2 Mbps)
- Full Duplex operation
- Auto loop facility shall be provided
- Shall meet IEC 60834-1 standard
- Shall be able to transmit upto 4 commands with trip counter simultaneously or sequentially in one 2Mbps channel

Bidder shall quote for protection signalling equipment suitable for 4 commands with separate trip counters for transmit and receive. With regard to trip counters alternate arrangement .i.e. Laptop along with software & all accessories to download events including carrier receipt and transmit shall be acceptable. Laptop for the above shall be supplied at each substation under substation package.

High security and dependability shall be ensured by the manufacturer. Probability of false tripping and failure to trip shall be minimum. Statistical curves/figures indicating above mentioned measures shall be submitted along with the bid.

The DPC can be either housed in offered Control & Protection Panel / PLCC Panel or in separate panel.

Reports of the following tests as per clause 9.2 of Section-GTR shall be submitted for approval for protection signalling equipment and relays associated with the protection signalling equipment and interface unit with protective relay units, if any.

i) <u>General equipment interface tests</u> :

a) Insulated voltage withstand tests
b) Damped oscillatory waves disturbance test
c) Fast transient bursts disturbance test
d) Electrostatic discharge disturbance test
e) Radiated electromagnetic field test
f) RF disturbance emission test

ii) <u>Specific power supply tests</u>

a) Power supply variations
b) Interruptions

c) LF disturbance emission
d) Reverse polarity

iii) <u>Tele-protection system performance tests</u>

a) Security
b) Dependability
c) Jitter
d) Recovery time
e) Transmission time
f) Alarm functions
g) Temperature and Humidity tests (As per IEC 68-2)
- Dry heat test (50℃ for 8 hours)
- Low temperature test (-5℃ for 8 hours)
- Damp heat test (40℃/95%RH for 8 hours)

All the above tests at i, ii & iii (except temperature & humidity tests) shall be as per IEC 60834-1 and the standards mentioned therein.

iv) Relays

a) 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)
b) 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)

The protection signalling equipment shall be of modular construction and preferably mounted in the Relay panels. Cabling between the protection signalling equipment & Protection relays and between protection signalling equipment & Communication equipment shall be in the scope of bidder.

The input/output interface to the protection equipment shall be achieved by means of relays and the input/output rack wiring shall be carefully segregated from other shelf/cubicle wiring.

The isolation requirements of the protection interface shall be for 2kV rms.

1.4 Major technical Particulars

The major technical particulars of protection signalling equipment shall be as follows.

i) Power supply 48V DC +15% /-20%

ii) Number of commands 4 (four)

iii) Operating time <7 ms

iv) Back to back operate time without propagation delay ≤ 8 ms

v) Interface to Protection relays

	Input:	Contact Rating:	
	Rated voltage	:	250 volts DC
	Maximum current rating:	5 amps	
Output:	Contact Rating:		
	Rated voltage	:	250 volts DC
	Rated current	:	0.1 A DC
	Other parameters :	As per IEC-255-0-20	

vi) Alarm contact

Rated voltage	:	250 volts DC
Rated current	:	0.1 A DC
Other parameters :	As per IEC-255-0-20	

vii) Digital communication interface: G 703(E1)

SECTION-3

PROJECT DETAILS & GENERAL SPECIFICATION

SITE INFORMATION

	Particular	Details
a)	Owner	POWERGRID
b)	Customer	POWERGRID
c)	Project Title	765kV/400Kv/220kV Banaskantha (New) Substation and Extn. of 400kV Sankhari (GETCO) Substation
d)	Location	Banaskantha, Gujrat Sankhari , Gujrat
e)	Transport Facilities	RAOD/TRAIN, For both Site Nearest Rail Head: Palanpur
	SITE CONDITIONS	
a)	Max. ambient air temp.	50°C
b)	Min. ambient air temp.	0°C
c)	Max. design ambient temp.	50°C
d)	Design reference temp.	50°C
e)	Average Humidity	Max. 100%
f)	Special corrosion conditions	No
g)	Solar Radiation	1.2kW/sqmtr
h)	Atmospheric UV radiation	High
i)	Altitude above sea level	Less than 1000meter
j)	Pollution Severity	High Polution (25mm/kV)
k)	Seismic Zone	As per the seismic zone defined in the relevant BIS but not less than 0.3g horrizontal
	WIND DATA	
	Wind velocity	As per IS
	Average No. of thunderstorm days per annum	As per IS

	Main Electrical Parameters:	
	Fault Levels:	**For Banaskantha** **765kV: 50kA for 1 sec** **400kV: 63kA for 1 sec** **220kV: 40kA for 1 sec** **For Sankhari** **400kV: 40kA for 3 sec**
	Creepage Distance	**25mm/kV**

1.0 GENERAL

This Chapter covers Technical Requirements and requirements of auxiliary items.

a) 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 unless included in the list of exclusions.

b) Material and components not specifically stated in this specification but which are necessary for satisfactory operation of the equipment and accessories specified in this specification shall be deemed to be included unless specifically excluded and shall be supplied at no extra cost.

c) Whenever a material or article is specified or described 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.

d) In case any Deviation Schedule, Bid Proposal Sheet, Schedule of Data Requirements (DRS), test reports or any other document/information are not furnished along-with the bid, the bid is liable to be rejected. Unless brought out clearly, the Bid will be deemed to conform to the specification scrupulously. All deviations from the specification shall be clearly brought out in the respective deviation schedule.

Auxiliary supplies as described below would be available at site.

Normal Voltage (Volts)	Variation in voltage	Frequency (Hz)	Phase	Neutral connection

415	+ 10 %	50 + 5 %	3 Ph- 4wire	Solidly earthed
240	+ 10 %	50 + 5 %	1 Ph-2wire	Solidly earthed
220	+ 10 %	DC		Isolated(2 wire system)
48		DC		Isolated(2 wire system) (+ Earthed)

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f) The Bidder shall clearly indicate in the bid, the specific standards in accordance with which the works will be carried out.

g) The equipment must be new, of highest grade, the best quality of their kind, to best engineering practice and latest state of art, and in accordance with purpose for which they are intended and ensure satisfactory performance throughout the service life.

h) All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same materials and workmanship as the corresponding parts of the equipment. Where feasible, common components, units shall be employed in different pieces of equipment in order to optimize the spare part stock-up and utilization.

i) The requirement regarding external RIV as specified for equipment shall include the terminal fittings and the equipment shall have been tested preferably with fittings, if any.

2.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

a) The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc.

b) The equipment shall be able to withstand forces due to wind load, short circuit, system over voltages, fluctuations, frequency variations etc., all forces considered together.

3.0 SUPPORT STRUCTURES (If in the scope of Bidder)

a) The support structures should be hot dip galvanised with minimum 610 gram/m2 net of zinc.

b) The design calculations taking into account the environmental conditions of the substations shall be furnished for sizing of the structures.

4.0 STANDARDS

a) The equipment to be furnished under this specification shall conform to latest issue with all amendments of standard specified under respective Chapters of this Specification.The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other. The bidder 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.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.

b) Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards referred shall also be accepted.

c) In case governing standards for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in additional information schedule alongwith English language version of standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to POWERGRID's approval.

5.0 ENGINEERING DATA AND DRAWINGS

5.1 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 supplier shall necessarily submit all the drawings/ documents unless anything is waived.

5.2 The Contractor shall submit 4 (four) sets of drawings/ design documents /data / detailed bill of quantity and 1 (one) set of test reports for the approval of the Purchaser. The contractor shall also submit the softcopy of the above documents in addition to hardcopy.

5.3 Drawings

5.3.1 All drawings submitted by the Contractor 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 Drawings 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. POWERGRID has standardized a large number of drawings/documents of various make including type test reports which can be used for all projects having similar requirements and in such cases no project specific approval (except for list of applicable drawings alongwith type test reports) is required. However, distribution copies of standard drawings/documents shall be submitted as per provision of the contract. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in SI units.

5.3.3 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 provided under 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.

5.4 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.

5.5 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. The following schedule shall be followed generally for approval and for providing final documentation.

i)	Approval/comments/ Purchaser on initial	As per agreed by schedule submission
ii)	Resubmission (whenever required)	Within 3 (three) weeks from date of comments
iii)	Approval or comments	Within 3 (three) weeks of receipt of resubmission.
iv)	Furnishing of distribution copies (5 hard copies per substation and one scanned copy (pdf format) for Corporate Centre)	2 weeks from the date of approval
v)	Furnishing of distribution copies of test reports	
(a)	Type test reports (one scanned softcopy in pdf format per substationplus one for corporate centre & one hardcopy per substation)	2 weeks from the date of final approval
(b)	Routine Test Reports (one copy for each substation)	-do-
vi)	Furnishing of instruction/ manuals (2 copies per substation and one softcopy (pdf format) for corporate centre & per substation)	As per agreed schedule operation
(vii)	As built drawings (two sets of hardcopy per substation & one softcopy (pdf format) for corporate centre& per substation)	On completion of entire works

NOTE :

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

(2) All drawings should be submitted in softcopy form, however substation design drawings like SLD, GA, all layouts etc. shall also be submitted in AutoCAD Version. SLD, GA & layout drawings shall be submitted for the entire substation in case of substation extension also.

(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 supplier to BHEL/POWERGRID.

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

(6) All As-built drawings/documents shall be certified by site indicating the changes before final submission.

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 supplier.

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 BHEL/POWERGRID.

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 factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

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

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 POWERGRID 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 (for 132kV and above voltage level) procedures for equipments shall be in line with the procedure given at Annexure-A and B respectively.

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-air conditioned 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 240V 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,** shall be submitted for approval.

6.3 RATING PLATES, NAME PLATES AND LABELS

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.

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 supplier 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 supplier 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 supplier 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 supplier 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 POWERGRID Corporate Centre, Gurgaon (Haryana) 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 supplier'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 supplier shall adopt suitable quality assurance programme to control such activities at all points necessary. The detailed programme shall be submitted by the contractor after the award for reference. A quality assurance programme of the supplier 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.

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

8.2 Quality Assurance Documents

The supplier would be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of POWERGRID/BHEL inspection of equipment/material

9.0 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

9.1 All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections.

9.2 The reports for all type tests as per technical specification shall be furnished by the supplier alongwith equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID shall be applicable for all project with similar requirement. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by POWERGRID or representative authorized by POWERGRID or Utility or representative of accredited test lab or reputed consultant.

The test reports submitted shall be of the tests conducted within last 10 (ten) years prior to the date of bid opening i.e. 24.02.15. In case the test reports are of the test conducted earlier than 10 (ten) years prior to the date of bid opening, the contractor shall repeat these test(s) at no extra cost to BHEL.

However, in case of instrument transformers, the following type tests should have been conducted within 5 (five) years prior to the date of bid opening.

i) Lightning Impulse Test

ii) Switching ImpulseTest

iii) Multiple Chopped Impulse Test (For CT)

iv) Chopped Impulse Test (For CVT)

In case the test reports are of these tests (for instrument transformers) as mentioned above are conducted earlier than 5 (five) years prior to the date of bid opening i.e. 24.02.15, the contractor shall repeat these test(s) at no extra cost to the purchaser.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out

without any additional cost implication to the Purchaser.
The supplier shall intimate the BHEL/POWERGRID the detailed program about the tests atleast two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

Further, in case type tests are required to be conducted/repeated and the deputation of Inspector/Purchaser's representative is required, then all the expenses shall be borne by the supplier.

9.3 The Purchaser intends to repeat the type tests on Power Transformer and Shunt Reactor except Dynamic short circuit tests on transformers, for which test charges shall be payable as per provision of contract. The price of conducting type tests shall be included in Bid price and break up of these shall be given in the relevant schedule of Bid Proposal Sheets. These Type test charges would be considered in bid evaluation. In case Bidder does not indicate charges for any of the type tests or does not mention the name of any test in the price schedules, it will be presumed that the particular test has been offered free of charge. Further, in case any Bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected. BHEL/POWERGRID reserves the right to witness any or all the type tests. The BHEL/POWERGRID also reserves the right to waive the repeating of type tests partly or fully and in case of waival, test charges for the same shall not be payable.

The Purchaser shall bear all expenses for deputation of purchaser's representative(s) for witnessing the type tests under this clause except in the case of re-deputation if any, necessitated due to no fault of the purchaser.

For outdoor receptacles, trefoil clamps, diesel engine, alternator, motors, cable glands, lighting fixtures, ACSR/AAC conductor, IPS aluminum tube and junction boxes, type test reports are not required to be submitted for the makes indicated at Annexure-E /POWERGRID approved list of subvendors. For the new makes(other than those indicated at Annexure-E / POWERGRID approved list of subvendors), type test reports as per relevant standard shall be submitted for POWERGRID's approval.

9.4 The Purchaser, his duly authorised representative and/or outside inspection agency acting on behalf of the Purchaser shall have at all reasonable times free access to the Contractor's/sub-vendors premises or Works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the Works during its manufacture or erection if part of the Works is being manufactured or assembled at other premises or works, the Contractor shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, despatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

9.5 The supplier shall give the Purchaser /Inspector fifteen (15) days written notice for on-shore and six (6) weeks notice for off-shore material being ready for joint testing including contractor and POWERGRID. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Purchaser/inspector, unless witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed alone with the test which shall be deemed to

have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of tests in triplicate.

9.6 The Purchaser or Inspector shall, within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Purchaser /Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

9.7 When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the Purchaser/inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Purchaser /Inspector, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Engineer/Inspector. Failure of the Purchaser /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Purchaser to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of CIP by the Purchaser.

9.8 In all cases where the Contract provides for tests whether at the premises or at the works of the Contractor or of any Sub-Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Purchaser /Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Purchaser /Inspector or to his authorised representative to accomplish testing.

9.9 The inspection by Purchaser and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.

9.10 The Purchaser will have the right of having at his own expenses any other test(s)of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.

9.11The Purchaser reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipments for these tests shall be provided by the Purchaser.

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 correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests to be performed are given in 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 average thickness of coating shall be 86 microns for all items having thickness 6mm and above. 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.

12.2.4The 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 preferably 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 bematching with the existing panels in case of extension of a substation. Each coatof 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

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 powder (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 The contractor shall have to ensure that the hard and flat indoor and outdoor storage areas are in place prior to commencement of delivery of material at site. Contractor shall also ensure availability of proper unloading and material handling equipment like cranes etc. and polyester/nylon ropes of suitable capacity to avoid

damage during unloading and handling of material at site. All indoor equipments shall be stored indoors. Outdoor equipment may be stored outdoors but on a hard and flat raised area properly covered with waterproof and dustproof covers to protect them from water seepage and moisture ingress. However, all associated control panels, marshalling boxes operating boxes etc. of outdoor equipments are to be stored indoors only.Storage of equipment on top of another one is not permitted if the wooden packing is used. Material opened for joint inspection shall be repacked properly as per manufacturer's recommendations.During storage of material regular periodic monitoring of important parameters like oil level / leakage, SF6 / Nitrogen pressure etc. shall be ensured by the contractor.

13.4 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.

13.5 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 properoperation of circuit breakers,isolators and their operating mechanisms. All components shall beprotected 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.

13.6 Supplier 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.

13.7 The supllier 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.

13.8 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.

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

13.10The words 'erection' and 'installation' used in the specification are synonymous.

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

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
48V	_	DC	_	2 wire system (+) earthed

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

16.0 SUPPORT STRUCTURE (If in the scope of supplier)

16.1 The equipment support structures shall be suitable for equipment connections at the first level i.e 14.0 meter, 8.0 meter and 5.9 meter from plinth level for 765 kV,420 kV and 245 kV substations respectively. 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 Support structure shall meet the following mandatory requirements:

16.2.1 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 ACSR conductors	Aluminum alloy casting, conforming to designation A6 of IS:617 and all test shall conform to IS:617
b)	For connecting equipment terminals made of	Bimetallic connectors made from aluminum alloy casting, conforming to designation A6

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

17.2 Necessary clamps and connectors shall be supplied for all equipment and connections.The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings. 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.

17.4 Low voltage connectors, grounding connectors and accessories for grounding allequipment 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 or 2 mm thick bi-metallic strips shall be provided 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 suitable for both expansion or through (fixed/sliding) type connection of 4" IPS AL. tube as required. In both the cases the clamp height (topof the mounting pad to centre line of the tube) should be same.

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 to be corona controlled.

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 shall be submitted for approval as per clause 9.2 above except for sl. no.(ii) & (iii) for which type test once conducted shall be applicable (i.e. the requirement of test conducted within last ten years shall not be applicable).

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

ii) Short time current test

iii) Corona (dry) and RIV (dry) test (for 220 KV and above voltage level clamps)

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 or 2.5 mm hot rolled or alternately 1.6 mm thick stainless steel can also be used. 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 A canopy and sealing arrangements for operating rods shall be provided inmarshalling 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. 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 meanof 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 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 fluorescent tube or CFL of approximately 9 to 15 watts 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 MCB/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 Deleted.

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 650V 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 CT/PT circuits	Minimum of two of 2.5 sq mm copper flexible.
b)	All CT/PT 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 for outdoor ground mounted marshalling box and the clearance between two rows of terminal blocks shall be a minimum of 150 mm.

20.13 The supplier 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 surgewithstand 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 & SOCKETS

21.1 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.

21.2 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.

21.3 Switches and Fuses:

21.3.1 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.

21.3.2 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-62155/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 hollow insulators, conforming to IEC-61462.

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. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and 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.

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.

ANNEXURE-A

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1. General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 400kV & above) both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV) for 132kV and above.

2. Test Levels:

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

3. Test Methods for RIV:

3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 Mhz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

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

3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified.The specified RIV test voltage for 765kV, 400 kV, 220 KV is listed in the detailed specification together

with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noisel meter.

4. Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 110% of specified corona extinction voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, and 110%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

For recording purpose, modern devices utilizing UV recording methods such as image intensifier may also be used.

4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.

4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.

4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.

4.4 However, both test shall be carried out with the same test set up and as little time

duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5. Test Records:

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

a) Background noise before and after test.

b) Detailed procedure of application of test voltage.

c) Measurements of RIV levels expressed in micro volts at each level.

d) Results and observations with regard to location and type of interference sources detected at each step.

e) Test voltage shall be recorded when measured RIV passes through 100microvolts in each direction.

f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE-B

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (for 132kV and above)shall be carried out along with supporting structure.

The Bidder shall arrange to transport the structure from his Contractor's premises/POWERGRID sites for the purpose of seismic withstand test only.The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the POWERGRID.

SECTION-4
GUARANTEED TECHNICAL PARTICULARS
PLCC

COUPLING DEVICES

1 Name of Manufacturer and Country

2. Type, Model and Catalogue Number

3. Whether suitable for mounting Outdoor in Switchyard & Type of mounting

4. Maximum temperature limit for satisfactory operation of coupling device mounted outdoor

5. Net weight

6. Nominal Primary Side Impedance

7. Nominal secondary Side Impedance

8. Composite loss within Passband

9. Return loss within Passband

10. Available Bandwidth (with 4400/6600/ 8800 pF CVTs)

11. Nominal Peak Envelope Power (with Distortion and Intermodulation Products 80 dB Down)

12. Maximum number of PLC terminals that can be connected in parallel:
    (a) 20 W (P.E.P.) PLC terminals

    (b) 40 W (P.E.P.) PLC terminals

    (c) 100 W (P.E.P.) PLC terminals

13. Power Frequency Impedance between primary terminal and Earth Terminals of Coupling Device.

14. 1 Minute Power Frequency Insulation level between Primary and Secondary Terminals of Coupling Device

15. Impulse (1.2/50 micro-sec.) Withstand Level between Primary and Secondary Terminals of Coupling Device

16. Power Frequency Current Carrying Capacity of Drain Coil (or Primary Winding of Matching Transformer).
(a) Continuous current
(b) Short time current for 0.2 sec.
(c) Inductance of drain coil with
Tolerances (at 50 Hz)

17. Surge Arrester in Primary Side of Coupling Device:

(a) Type model & catalogue number

(b) Power frequency sparkover voltage

(c) Type of construction

(d) Maximum permissible arrestor
Discharge current with 8/20 micro
Sec. impulse discharge

(e) Maximum permissible short time
Current (2.2 micro sec.)

(f) Power frequency discharge current
For 0.2 sec.

(g) Impulse spark over voltage 1.2/50
Micro sec.

(h) Rated voltage

(i) Whether Site tunable

18. Surge arrestor in Secondary Side of Coupling Device

(a) Type model & catalogue number

(b) Power frequency spark over voltage

(c) Impulse spark over voltage (1.2/50
Micro sec.

19. Details of interlock provided with cover enclosed -

20. Overall dimensions

21. No of H.F. terminals provided for carrier

equipment. connection

HIGH FREQUENCY CABLE

1. Name of Manufacturer and Country
2. Type, Model and Catalogue No.
3. Applicable standards
4. Characteristic Impedance
5. Rated Capacitance
6. Service Voltage
7. Attenuation per km. of cable at various Carrier Frequencies in the Range of 50 to 500 KHz. (Typically at 50,100,200,300, 400,500 KHz)
8. Withstand Test Voltage (RMS) between conductor and Sheath
9. Details and particulars of Insulation
10. Loop Resistance per Km (Typical at 20°C)
11. Details of Armouring
12. Number and Diameter of Stranded Conductor
13. Overall Diameter of Cable
14. Net weight per Km.
15. Minimum bending radius
16. Earthing detail of H. F. Cable
17. Packing length per drum
18. Construction drawing, type test & performance reports enclosed or not

POWER LINE CARRIER TERMINAL FOR SPEECH & DATA TRANSMISSION

1. Name of Manufacturer and Country
2. Type, Model and Catalogue No.
3. Type of Modulation

4. Mode of transmission

5. Carrier Frequency Range

6. Nominal Carrier Frequency Band in either direction of transmission

7. Return loss within the Nominal Carrier Frequency Band

8. Effectively Transmitted V.F Band

9. Return Loss within the Effectively Transmitted Voice Frequency Band.

10. H. F. Oscillator Details

11. I. F. Oscillator Details

12. 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 variations.

13. Maximum H. F. Amplifier output with Single/Multiple tone keying (Peak Envelope Power).

14. Nominal carrier frequency Power (Peak Envelop Power) at output terminals.

15. H. F. Impedance at output of carrier terminals.

16. Stability of the carrier frequency.

17. Improvement in S/N due to compander

18. Whether carrier is suppressed or reduced during transmission of signal

19. Whether frequency locking between Tx/Rx provided.

20 Automatic gain control range and regulation

21 Level of spurious emission at

(a) Edge of nominal Carrier Frequency Band

(b) 4.0 KHz away from nominal carrier Frequency band.

(c) 8.0 KHz away from nominal carrier Frequency band.

22 Relative level at V. F. 4 wire terminating points:

(a) Send leg

(b) Receive leg

23. Permissible limits for level variation with frequency relative to 800 Hz in a speech channel (without companders) transmitted over a pair of terminals connected back to back

24. Level of telephone signalling channel:
a. Input level

b. Output level

25. Near and far end cross talk due to telephone signalling channel in a pair of PLC Terminals (without companders) connected back to back.

26. Pulse distortion of telephone signalling channel when operated at a signalling speed of 10 pps and with a mark to space ratio of 40/60 in PLC terminals connected back to back.

27. Psophometric Noise contribution of a pair of PLC terminals connected back to back

28. Group delay distortion in the frequency band relevant to the transmission of protection signals.

29. Performance Under Noise condition:

a. Noise generated within terminal
b. Additional noise introduced when terminals are connected back to back at repeater station
c. Noise Bandwidth.

30. Power supply requirements:
(a) Voltage

(b) Permissible voltage variation

(c) Maximum current

(d) Quiescent Current

31. Installation details

32. Insulation level

33. Meters provided on Test Panel, their range and purpose.

34. Is the equipment suitable to work in Dust laden atmosphere?

35. Whether interior lamps with door switch is provided in cabinets

36. Over all dimensions (Cabinet)
(a) Length mm
(b) Width mm
(c) Height mm

37. Weight

38. Earthing detail of PLC Cabinet

39. Whether Tx/Rx loop-back facility is available for testing locally

40. Whether site tunable

POWER LINE CARRIER TERMINAL FOR NETWORK PROTECTION

1. Name of Manufacturer and country

2. Type, Model and Catalogue No.

3. Type of Modulation

4. Mode of transmission

5. Carrier Frequency Range

6. Nominal Carrier Frequency Band in either direction of transmission

7. Return loss within the Nominal Carrier Frequency Band

8. Effectively Transmitted V.F Band

9. Return Loss within the Effectively Transmitted Voice Frequency Band.

10. H. F. Oscillator Details

11. I. F. Oscillator Details

12. 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 variations.

13. Maximum H. F. Amplifier output with Single/Multiple tone keying (Peak Envelope Power).

14. Nominal carrier frequency Power (Peak Envelop Power) at output terminals.

15. H. F. Impedance at output of carrier terminals.

16. Stability of the carrier frequency.

17. Improvement in S/N due to compander

18. Whether carrier is suppressed or reduced during transmission of signal

19. Whether frequency locking between Tx/Rx provided

20. Level of spurious emission at

    (a) Edge of nominal Carrier Frequency Band

    (b) 4.0 KHz away from nominal carrier Frequency band

    (c) 8.0 KHz away from nominal carrier frequency band.

21. Whether frequency locking between Tx/Rx provided

22 Relative level at V. F. 4 wire terminating

points:

(a) Send leg

(b) Receive leg

23. Permissible limits for level variation with frequency relative to 800 Hz in a speech channel (without companders) transmitted over a pair of terminals connected back to back

24. Variation in overall loss of speech circit with a pair to PLC terminals connected back (without Companders & limiters) when voice frequency input level changes from 10 to 0 dBm

25. Psophometric Noise contribution of a pair of PLC terminals connected back to back

26. Noise frequency Band width

27. Group delay distortion in the frequency band relevant to the transmission of protection signals.

28. Signal Delay with Two PLC Terminals connected back to back

29. Power supply requirements:

(a) Voltage

(b) Permissible voltage variation

(c) Maximum current

30. Installation details

31. Meters provided on Test Panel, their range and purpose.

32. Is the equipment suitable to work in Dust laden atmosphere without air conditioning?

33. Whether interior lamps with door switch is provided in cabinets

34. Over all dimensions

(a) Length mm
(b) Width mm
(c) Height mm

35. Weight

36. Insulation level

37. Cabinet earthing details

38. Whether indication is available in sending end panel for receipt/execution of trip signal/command at remote end.

39. Whether Tx/Rx loop-back facility is available for testing locally

40. Whether site tunable

VF TRANSMISSION TERMINAL FOR NETWORK PROTECTION SIGNALS (PROTECTION COUPLER)

1. Name of Manufacturer and Country

2. Type, Model and Catalogue Number

3. Whether equipment works on frequency shift principle of coded signal principle

4. Whether Equipment is suitable for Independently Protecting Two Circuits

5. Frequencies used in the equipment for transmission of signal for coded Signal transmission

(a) Guard frequency

(b) Working frequency (Trip System - I)

(c) Working frequency (Trip System - II)

(d) Working frequency (Trip System I&II)

6. Criteria used for command Transmission

7. Whether equipment is protected against Tripping by Spurious Signals.

8. Transmission time corresponding to telegraph speed for transmission on PLCC channel of coded signal

   (a) 600 Bds.

   (b) 400 Bds.

   (c) 200 Bds.

9. Whether in the presence of spurious signals as well as Protection Signals simultaneously, the equipment will initiate a Trip Command.

10. Mode of Transmission of guard signal

11. Whether equipment is suitable for Direct Circuit Breaker tripping.

12. Maximum number of Noises Impulses pps in Presence of which the equipment will satisfactorily perform its duty.

13. Signal Delay with Two Terminals connected back to back

14. Whether the Command Signal is acknowledged at receiving end and in the event of non-receipt of the correct signal, the command is repeated or not by the transmitter?

15. Whether it is possible to alter the priority of commands of various codes at site.

16. What are the performance based results under severe line noise conditions for
    (a) False trip probability
    (b) Fail to trip probability

17. Transmitter Input Requirements (Contact Ratings)
    (a) Voltage

    (b) Current

    (c) Power

(d) No. of Contacts

18. Receiver Output (Contact Rating)

(a) Voltage
(b) Current
(c) Power
(d) No. of Contracts

19. Additional facilities provided in Receiver output

20. Supervisory and Alarm Contact Facilities

(a) Current
(b) Voltage
(c) No. of contacts

21. Installation

22. Power Supply
(a) Voltage
(b) Current
(c) Power

23. Type and number of counters for recording the number of Trip Commands sent and number of Trip Commands received

24. Whether loop test is possible

25. Insulation Level

26. Whether the equipment is suitable for transmitting and receiving more than two independent commands (please give full details)

EPAX

1 Name of manufacturer

2 Type of Model

3 Number of subscriber lines
(a) Wired for
(b) Equipped for

4 Number of trunk lines provided
(a) Wired for
(b) Equipped for

5	Whether the facility to bar subscriber's access to the carrier lines is provided during maintenance?
6	Whether P.G. lockout facility provided along with alarm?
7	Whether alarm type fuse provided for audio and visual indications?
8	Whether suitable for satisfactory operation in conjunction with PLCC system
9	Signalling Pulse Width (a) Engage Pulse (B) Priority Pulse (C) Digit pulse (D) Inter digit pause (E) Release Pulse
10	Operating voltage
11	Power requirement
12	Overall dimensions (W x D x H)
13	Mounting arrangement
14	Weight
15	Type of switching
16	Whether four-wire interfaces are built-in
17	In case four-wire interfaces are built-in maximum number of PLC terminals which can be connected to a single EPAX
18	Whether self-diagnostics and monitoring features are built-in
19	Whether the following facilities are built-in (a) Priority cutting (b) Conference (c) Alternate routing (d) Call transfer
20	Maximum loop resistance permissible (a) For trunk line (b) subscriber lines

21 Whether suitable to work in conjunction with electromechanical PAX

22 Whether suitable to work with DOT leased lines as per specification

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

S.No.	Parameters	Data	Yes / No	Remarks
1.	Applicable Standard	IEC 60495	Yes / No	
2.	Type			
3	Type of Modulation	Amplitude Modulation	Yes / No	
3	Mode of Transmission	Single Side band	Yes / No	
4	Carrier frequency range	40 - 500 kHz	Yes / No	
5	Nominal carrier frequency band in either direction of transmission	4 kHz	Yes / No	
6	Return Loss within the nominal carrier frequency band	10 dBmin	Yes / No	
7	Return Loss within the effectively transmitted voice frequency band	Not more than 14 dB	Yes / No	
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	Yes / No	
9	Power Output at HF terminal	20W/40 W / 80W for S/C	Yes / No	
10	Nominal carrier frequency power (peak envelope power) at output terminal	40 watt / 80W	Yes / No	
11	H.F. Impedance at output of carrier terminals	75 ohms (unbalanced) or 150 ohms (balanced)	Yes / No	
12	Stability of carrier frequency	< ±10 Hz	Yes / No	
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.	Yes / No	
15	Improvement in S/N due to compander	15 dB	Yes / No	
16	Whether carrier is suppressed during transmission of signal	Yes	Yes / No	
17	Whether frequency locking between Tx/Rx provided	Yes	Yes / No	
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	Yes / No	

		signals shall be less than 1 dB.		
19	Level of spurious emission at			
(a)	Edge of nominal carrier frequency	As per IEC 495	Yes / No	
(b)	4.0 kHz away from nominal carrier frequency band	As per IEC 495	Yes / No	
(c)	8.0 kHz away from nominal carrier frequency band	As per IEC 495	Yes / 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	Yes / No	
21	Psophometric noise contribution of a pair of PLC terminals connected back to back	Less than or equal to - 55 dBmop	Yes / No	
22	Group delay distortion in the frequency band relevant to the transmission of protection signals	As per CCITT recommendation G.232	Yes / No	
23	Performance under noise condition			
(a)	Noise generated within terminal	As per IEC 495	Yes / No	
(b)	Additional noise introduced when terminals are connected back to back at repeater station	As per IEC 495	Yes / No	
(c)	Noise bandwidth	As per IEC 495	Yes / No	
24	Power supply requirements			
(a)	Voltage	48 V DC	Yes / No	
(b)	Permissible voltage requirement	15 %, - 10% (positive pole earthed)	Yes / No	
25	Insulation level	2 kV for all AC circuits 500 V DC for all signal points	Yes / No	
26	All solid state equipment /system panels subjected to heat soaking as per clause 9.16 of Section II		Yes / No	
27	Powergrid approved standard drawing/Type test reports/GTP are available for approval extension		YES	

II. B) TYPE TESTS

i)Whether type test reports of the following test conducted earlier as per IEC 495 on identical or similar material are available(test reports are of the test conducted not earlier than 10 (ten) years prior to the date of bid opening). **(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 / NO)**

III. A) PROTECTION COUPLER

S.No.	Parameters	Data	Yes / No	Remarks
1.	Applicable Standard	IEC 60834	Yes / No	
2.	Type			
3	Principle of working for transmission / reception of protection signal	Frequency shift keying / coded signal	Yes / No	
4	Each protection signaling equipment shall provide	Transmission facilities for minimum three protection signals and reception facilities for minimum three protection signals.	Yes / No	
5	The equipment shall be suitable for	Transmission of direct and permissive trip signal as well as blocking signals	Yes / No	
6	The overall time of PLC,VFT and transmission path for permissive trip / blocking	20 msec.or less	Yes / No	

7	The overall time of PLC,VFT and transmission path for direct trip	30 msec.or less	Yes / No	
8	Under no circumstances protection channel should share power	Yes	Yes / No	
9	Whether loop facilities is provided for operational reliability	Yes	Yes / No	
10	Whether built in counters for counting the number of trip command sent and number of trip command received is provided	Yes	Yes / No	
11	Whether equipment is suitable for direct circuit breaker	Yes	Yes / No	
12	Transmitter input requirements (contact requirements)			
(a)	Voltage	660 volts	Yes / No	
(b)	Current	5 amps	Yes / No	
(c)	Power	1250 W/VA	Yes / No	
(d)	No. of contacts	2 No. potential free NO contact	Yes / No	
13	Receiver output requirements (contact requirements)			
(a)	Voltage	250 V (DC)	Yes / No	
(b)	Current	0.1 A (DC)	Yes / No	
(c)	Power	As per IEC-255--25	Yes / No	
(d)	No. of contacts	2 No. potential free NO contact	Yes / No	
14	Supervisory and alarm contact facilities			
(a)	Current	0.1A(DC)	Yes / No	
(b)	Voltage	250 V(DC)	Yes / No	
(c)	No of contacts	2 number potential free change over contact	Yes / No	
15	Power Supply			
(a)	Voltage	48 V DC , + 15 % - 10% (Positive pole earthed)	Yes / No	
16	Whether loop test is possible	Yes	Yes / No	
17	Insulation level	As per IEC 60834	Yes / No	
18.	Powergrid approved standard drawings available for approval extension		Yes	

III. B) TYPE TESTS

III. 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(test reports are of the test conducted not earlier than 10 (ten) years prior to the date of bid opening). (**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 / NO)**

III. 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(test reports are of the test conducted not earlier than 10 (ten) years prior to the date of bid opening). (**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 / NO)**

IV. A) COUPLING DEVICE

S.No.	**Parameters**	**Data**		**Yes / No**	**Remarks**
1.	Applicable Standard	IEC 481, IS 8998		Yes / No	
2.	Type, Model Number				
	Type of Coupling device (indentor to tick)	Phase to Phase √	~~Phase to earth~~	Yes / No	
3	Type of mounting	Outdoor		Yes / No	
4	Maximum temperature limit for satisfactory operation	50 ^{0}C (Satisfactory operation upto 65 ^{0}C)		Yes / No	
5	Nominal line side Impedance	240 ohms for 765kV and 400kV Quad bundle conductor line		Yes / No	
6	Nominal equipment side impedance	75 ohm (unbalanced)		Yes / No	
7	Composite loss within passband	Not more than 2 dB		Yes / No	
8	Return loss within passband	Not less than 12 dB		Yes / No	
9	Available bandwidth	40 to 500 kHz		Yes / No	
10	Nominal peak Envelope Power (with distortion and inter modulation products 80 dB down)	Not less than 650 watt		Yes / No	

11	Power frequency impedance between primary terminal and Earth terminals of coupling device	Less than 20 ohms	Yes / No	
12	1 Minute power frequency insulation level between primary and secondary terminals of coupling device	5 kVrms	Yes / No	
13	Impulse (1.2/50 micro-sec.) withstand level between primary and secondary terminals of coupling device	As per IEC 481	Yes / No	
14	Power frequency current carrying capacity of drain coil (or primary winding of matching transformer)	As per IEC 481	Yes / No	
15	Whether Surge arrester in primary side of coupling device as per IEC 481 provided	Provided	Yes / No	
16	No. of H.F terminals provided for carrier equipment	At least 2	Yes / No	

IV. B) TYPE TESTS

i)Whether type test reports of the following test conducted earlier on identical or similar material are available(test reports are of the test conducted not earlier than 10 (ten) years prior to the date of bid opening). **(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 / NO)**

V. A) H.F.CABLE

S.No.	Parameters	Data	Yes / No	Remarks
1.	Applicable Standard	IEC 60096-2,BS:2316, IS;5082	Yes / No	
2.	Type			
3	Characteristic Impedance	75ohm unbalanced	Yes / No	

4	Attenuation per km. of cable at various carrier frequencies in the range of 40 to 500 kHz	1 to 5 dB/Km	Yes / No	
5	Details and particulars of insulation			
6	Withstand test voltage (rms) between conductor and outer sheath	4 kV for 1 min.	Yes / No	
7	Conductor resistance of cable	Not exceed 16 ohms /Km at 20 ^{O}C Cent	Yes / No	
8	Minimum bending radius	15 cms	Yes / No	
9	Packing length per drum	1000 meter.	Yes / No	

V. B) TYPE TESTS

i)Whether type test reports of the following test conducted earlier on identical or similar material are available(test reports are of the test conducted not earlier than 10 (ten) years prior to the date of bid opening). **(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 / NO)**

VI. A) Electronic Private Automatic Exchange (EPAX)

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

9	Whether suitable to work with DOT leased lines	Yes	Yes / No	

V. ADDITIONAL REQUIREMENTS:

1.	The PLCC manufacturer meets the **Qualifying requirements** specified in Section-I , 1.3 of this Technical Specification.		Yes/No	
2.	Training shall be imparted to employer's personnel As per Section-I , 1.4 of this Technical Specification		Yes/No	
3.	Valid Type test reports as per Section-II , is attached along with this offer.		Yes/No	
4	Confirmation to clause 9.0 of Section – III pertaining to TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE		Yes/No	
5	List of Deviations if any , is attached along with offer		Yes/No	
6	List of all special tools and tackles as per Clause 1.9 of Section-I of this technical Specification and scope thereof of BHEL/Supplier is attached along with offer .		Yes/No	
7	Confirmation to the undertakings to be submitted at contract stage, as per Annexure C attached along with section III.		Yes/No	
8	Bidder to submit details of freq. planning done (including computer studies carried out and facilities available) for PLCC links on EHV lines in the past along with this offer		Yes/No	
9	One copy of computer study result done in past attached along with this offer.		Yes/No	
10	Following Documents are attached along with the offer :			
	a. Filled Checklist.		Yes/No	
	b. Filled GTP		Yes/No	
	c. Drawings & technical Literature		Yes/No	
11	Compliance to Cl. 5.11 of Section II. Reqd. details shall be submitted at contract stage .		Yes/No	
12	Construction dwg. of HF cable with		Yes/No	

	Mechanical & Electrical parameters , enclosed with offer			
13	Details as per cl. 10.1(d) of Section II shall be furnished at contract stage		Yes/No	
14	All terminals for speech shall be with transit band pass filter, tunable at site & wired for addition of VFT's in future		Yes/No	
15	Compliance to cl. 10.4.2 of Section II. Reqd. data shall be furnished at contract stage		Yes/No	
16	Mandatory testing & maintenance equipment as per cl. 11 , page 21/23 section II , included in offer		Yes/No	

Date:

Signature of the authorized representative of Bidder

Company Seal