BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

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CUSTOMER	**Power Grid Corporation of India Ltd.**
PROJECTS	**400KV Karaikudi, Pugalur, kalavinthapattu & Abhishekpatty substations**

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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.

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 Limited**

Name of the project : **Extension of 400kV Karaikudi, Pugalur, Kalivanthapattu & Abhishekpatty Substation**

Refer Section - 3 for Project Details and General Specifications.

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

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 TRANSMISSION LINES:

a) Karaikudi – Kaythar 400kV D/C line -approximately 180 Km.
b) Pugalur-Karaikudi 400kV D/C line -approximately 150 Km.
c) Pugalur-Kalivanthapattu 400kV D/C line with 80MVAR Shunt reactors at both end-approximately 360 Km.
d) Kalivanthapattu - Shollinganallur 400kV D/C line -approximately 20 Km.
e) Abhishekpatty- Kanarpatty 400kV S/C line -approximately 150 Km.

f) 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.

g) 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 .

1.2.2 The offered PLCC drawings shall be as per POWERGRID approved standard drawings.

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. **(17.05.2013)**.

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 as per the format enclosed in Section III **(Annexure C)** 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.

1.4 TRAINING :

a. The supplier shall impart the necessary training in the field of design aspect of PLCC in the form of tutorial to 5 (five) Employer personnels at each substation.

b. The supplier shall also impart training to Employer's personnel at each sub-station site in the field of erection, testing, operation and maintenance of PLCC for one (1) day.

c. 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.
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

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

1.8.2 FREQUENCY PLANNING , SNR CALCULATIONS &COMPUTER STUDY

Frequency Planning, SNR Calculations & Computer Study is in the scope of bidder.

1.9 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

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.
The reports for all type tests as per technical specification shall be furnished by the Contractor along with 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 (17.05.2013). 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 the purchaser.

Annexure-I

SN	Item Description as per BPS	Unit	Karaikudi S/S	Kaythar S/S	Pugalur S/S	kalivanthapattu S/S	Shollingnallur S/S	Abhishekpatty S/S	Kanarpatty S/S	Total Quantity
1	**Coupling device(Phase to Phase)**	Nos.	4	2	4	4	2	1	1	18
2	**HF cable**	m	1000*	500*	1000*	1000*	500*	250*	250*	4500*
3	**Carrier equipment (for speech + protection and speech +data) (Analogue type)**									
3a	**Single Channel PLC terminal for Speech + Protection**	Nos.	4	2	4	4	2	1	1	18
3b	**Single Channel PLC terminal for Speech + Data**	Nos.								
4	**Protection Coupler**	Nos.	4	2	4	4	2	1	1	18
5	**Digital Protection Coupler**	Nos.	4	2	4	2		1	1	14
6	**4 wire telephone instrument(along with telephone wiring)**									
6a	4 wire telephone set with connecting cables	Nos.	2	1	2	2	1	1	1	10
6b	5 Pair Telephone Cables, armoured ,0.5 sq. mm annealed copper conductor and petroleum jelly filled with polyethene outer jackets	m	1000*	500*	1000*	1000*	500*	500*	500*	5000*
7	**Testing & maintenance equipment(print test kit only)**	Set	1	1	1	1	1	1	1	7

Annexure-I

SN	Item Description as per BPS	Unit	Karaikudi S/S	Kaythar S/S	Pugalur S/S	kalivanthapattu S/S	Shollingnallur S/S	Abhishekpatty S/S	Kanarpatty S/S	Total Quantity
8	**Mandatory Spares**									
8a	Set of prints for carrier terminal (analogue type)	Set	1		1	1		1		4
8b	Set of prints for protection coupler (Analogue type)	Set	1		1	1		1		4
8c	Set of prints for Digital protection coupler	Set	1		1	1		1		4
9	**Services : System engineering including Computer study , frequency planning and SNR Calculations**	Lot	1		1	1		1		4
10	**Services: Supervision of pre-commissioning (panel wise)**	Nos.	8	4	8	8	4	2	2	36
11	**Services : Supervision of Testing and commissioning (link wise)**	Nos.	4		2	2		1		9
12	**Services: Training Charges**	Lot	1		1	1		1		4

Note-

1. ***-Lengths of HF Cable and 4-wire telephone cable are not finalised, may vary ± 30%. Exact lengths will be given at the time of detailed engineering to the successful bidder.**
2. **Digital protection coupler shall be used as one of the two teleprotection channel for the lines having OPGW. Specification of digital protection coupler is enclosed as Annexure-V. SDH equipments on OPGW link are installed in existing control room building. All cabling between SDH and DPC panel including any interface hardware required is in the scope of bidder.**
3. **Digital Protection Coupler will be mounted in the separate panel.**

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-cnd 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 GTR .

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

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

6.11 Welding

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

6.12 Line Trap Mounting

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

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

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

6.13 Terminal Connectors

6.13.1 The line traps shall be suitable for connecting to 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 8.0 of ~~GTR~~ 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 8.0 of GTR 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 8.0 of ~~GTR~~ 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-V

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 220V DC (+10%, -10%). 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) Tele-protection system performance tests

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°C for 8 hours)
- Low temperature test (-5°C for 8 hours)
- Damp heat test (40°C/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 220V DC +10%, -10%

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)	Customer	**Power Grid Corporation of India Limited**			
b)	Project Title	400kV Bay extension at Karaikudi, Pugalur, Kalivanthapattu and Abhishekpatty substation			
c)	Site	Karaikudi	Pugalur	Kalivanthapattu	Abhishekpatty
d)	Name of state	Tamilnadu	Tamilnadu	Tamilnadu	Tamilnadu
e)	Nearest rail head	Karaikudi	Pugalur	Chennai	Tirunelveli
SITE CONDITIONS					
a)	Altitude above sea level	Less than 1000m	Less than 1000m	Less than 1000m	Less than 1000m
b)	Ambient air temp. (Max)	50°C	50°C	50°C	50°C
c)	Special corrosion conditions	No	No	Yes See note below	No
d)	Snow fall	Nil	Nil	Nil	Nil
e)	Seismic zone	As per IS 1893			
f)	Wind zone	As per IS 875 (also see note below)			
g)	Pollution Severity	High Pollution level (25mm/kV)	High Pollution level (25mm/kV)	Very High Pollution level (31mm/kV)	High Pollution level (25mm/kV)

Note:-

Following additional requirements shall be met for Kalivanthapattu substion extension:

1) All switchgears/ equipments, insulator strings, bushings, BPIs shall be designed for minimum creepage distance of 31mm/kV instead of 25mm/kV for other three stations.
2) The rate of zinc coating for galvanized lattice and pipe structures (excluding foundation bolts and fasteners) shall not be less than 900gm/sq. m instead of 610gm/sq. m for other three stations.
3) Outdoor atmosphere around the substation is highly polluted coupled with coastal pollution. Suitable paint and corresponding primers etc. as recommended by paint manufacturer shall be used to withstand the outdoor atmospheric condition.
4) Kalivanthapattu substation falls under high wind zone and basic wind speed shall

be considered as 50m/sec.

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.

e) Auxiliary supplies as described below would be available at site.

Normal Voltage	Variation in Voltage	Frequency in HZ	Phase/Wire	Neutral connection
415V	± 10%	50 ± 5%	3/4 Wire	Solidly Earthed.
240V	± 10%	50 ± 5%	1/2 Wire	Solidly Earthed.
220V	190V to 240V	DC	-	Isolated 2 wire System
110V	95V to 120V	DC	-	Isolated 2 wire System
48V	_	DC	_	2 wire system (+) earthed

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

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.

j) All drawings, schedules, annexures appended to this specification shall form part of the specification.

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

a) The support structures should be hot dip galvanised with minimum 610 gram/m^2 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 Contractor shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered

in conjunction with specific IS/IEC. 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 Employer's approval.

5.0 ENGINEERING DATA AND OTHER REQUIREMENTS

5.1 The furnishing of engineering data by the Contractor shall be in accordance with the Schedule for each set of equipment as specified in this Technical Specification and the data furnished under the Schedule of Data Requirements (DRS). The review of these data by the Employer 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 overall layout. This review by the Employer 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 Employer 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.

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

5.3 The equipment offered shall also comply to the following:-

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

b) The reports for all type tests and additional type tests as per technical specification shall be furnished by the Contractor alongwith equipment / material drawings. 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 accredition body of the country where laboratory is located) or witnessed by the representative(s) of POWERGRID or Utility. The test reports submitted shall be of the tests

conducted within last 5 (five) years prior to the date of bid opening. In case the test reports are of the test conducted earlier than 5 (five) years prior to the date of bid opening, the contractor shall repeat these test(s) at no extra cost to the purchaser.

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 additional type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser.

c) The Purchaser intends to repeat the type tests and additional type tests on Capacitors for which test charges shall be payable as per provision of contract. The price of conducting type tests and additional 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.

d) Four (4) copies of all test reports shall be submitted for approval before shipment of equipment. The reports shall indicate clearly the standard values specified for each test, to facilitate checking of the test reports. Six (6) bound copies of test reports shall be submitted after approval of test results.

e) Six (6) copies of documentation of test certificate/ test result alongwith the relevant drawing (wherever applicable) from the raw material stage to final stage as per approved Quality Plan (QP) will be furnished by supplier for each and every equipment immediately after shipment of equipment.

f) 1 RTF and 8 copies of all drawings for each substation plus 6 copies and one RTF of each drawing for corporate office shall be furnished after approval of drgs. 6 copies of instruction/operation manuals for each substation and corporate centre shall also be furnished after approval of manuals.

g) The following program shall be followed for approval of drawings/manuals :

i. Initial comments/approval by Employer within 4 (four) weeks of receipt of drawings.

ii. Resubmission of drawings/manuals within 4 (four) weeks of comments (including both ways postal time).

iii. Approval of drawings/manuals within 3 weeks of receipt of resubmission. Within 21 days of approval, stipulated number of copies and reproducibles in case of drgs shall be furnished by Contractor.

NOTE : The contractor may please note that all resubmissions must incorporate all comments given in the prior submission by the Employer failing which the submission of documents is likely to be returned.

h) Six (6) No. of copies of drawings, Schedule of Data Requirements (DRS) and other documents shall be sent for approval. First submission shall be made within 4 weeks of LOA.

i) All exposed ferrous parts shall be hot dip galvanised as per IS : 2633 & IS : 4579.

j) All current making and breaking contact surfaces shall preferably be silver plated.

k) The equipment name plate/ wiring diagram plate should preferably be of stainless steel. In case of aluminium it should be atleast 2 mm thick. The inscription on the name plate/wiring diagram plate shall be engraved and no punching shall be accepted except for equipment Sr. No. and year of manufacture.

l) Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, the unit designation, the specifications title, the specification number and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

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

n) 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 Employer. Approval of Contractor's drawing of work by the engineering shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

6.0 DESIGN IMPROVEMENTS

6.1 The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes, the specification shall be modified accordingly.

6.2 The Bidder should however note that changes proposed by him will have to be supported with applicable type test reports.

6.3 If any such agreed 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.

7.0 QUALITY ASSURANCE PROGRAMME

7.1 To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's Works or at his Sub-contractor's premises or at the Employer's site or at any other place of Work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Employer after discussions before the award of Contract. A quality assurance programme of the contractor shall generally cover the following :

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

b) System for Document and Data Control.

c) Qualification and Experience data of 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) System for Control of non-conforming products including Deviation Dispositioning, if any and system for corrective and preventive actions based on the feed back received from the Customers and also internally documented system for Customer complaints.

g) Inspection and test procedure both for manufacture and field activities.

h) System for Control of calibration of testing and measuring equipment and the indication of calibration status on the instruments.

i) System for indication and appraisal of inspection status.

j) System of Internal Quality Audits and Management review and initiation of corrective and Preventive actions based on the above.

k) System for authorising release of manufactured product to the Employer.

l) System for maintenance of records.

m) System for handling storage and delivery.

n) A quality plan detailing out the specific quality control measures and procedure adopted for controlling the quality characteristics relevant to each item of equipment furnished and /or service rendered.

o) System for various field activities i.e. unloading, receipt at site, proper storage, erection, testing and commissioning of various equipment and maintenance of records". In this regard, the Employer has already prepared Standard Field Quality Plan for Switchyard Civil Works Document Code No. CC/QA&I/SFQP/SS/03/970905/Rev.1 which is required to be followed for associated civil works. Field Quality Plan pertaining to receipt, storage, erection, testing and commissioning shall be mutually discussed and agreed upon before placement of order.

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

7.2 Quality Assurance Documents

The Contractor shall be required to submit the following Quality Assurance Documents.

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

ii) Welder and welding operator qualification certificates.

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

iv) Raw Material test reports on components as specified by the specification and/or agreed to in the quality plan.

v) The manufacturing Quality Plan indicating Customer Inspection Points (CIPs) at various stages of manufacturing as mutually agreed upon, and

methods used to verify that the inspection and testing points in the quality plan were performed satisfactorily.

vi) Stress relief time temperature charts.

vii) Factory test results for testing required as per applicable codes/mutually agreed quality plan/standard referred in the specifications.

viii) Stress relief time temperature charts/oil impregnation time temperature charts.

8.0 INSPECTION, TESTING & INSPECTION CERTIFICATE

8.1 The Employer, his duly authorised representative and/or outside inspection agency acting on behalf of the Employer shall have at all reasonable times access to the Contractor's 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 and if part of the Works is being manufactured or assembled at other premises or works, the Contractor shall obtain for the Employer 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. The equipment if found unsatisfactory as to workmanship or material is liable to be rejected.

8.2 The Employer reserves the right to witness any or all type, acceptance and routine tests specified for which at least 30 days notice in advance shall be given by the Contractor. Contractor shall ensure before giving notice for type test that all drawings and quality plans have been got approved. The equipment shall be dispatched to site only after approval of Routine and Acceptance test results and Issuance of Dispatch Clearance in writing by the Employer.

8.3 The Contractor shall give the Employer/Inspector Twenty one (21) days written notice of any material being ready for testing far each stage of testing as identified in the approved quality plan as customer inspection point. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Employer/inspector, unless witnessing of the tests is waived, will attend such tests within Twenty one (21) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector six copies of tests, duly certified.

8.4 The Employer or Inspector shall, within Twenty (21) 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 Employer/Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

8.5 When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the Employer/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 Employer/Inspector, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Employer/Inspector. Failure of the Employer/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 Employer to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract.

8.6 In all cases where the Contract provides for tests whether at the premises or 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 Employer/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 Employer/Inspector or to his authorised representative to accomplish testing.

8.7 The inspection and acceptance by Employer 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, or if such equipment is found to be defective at a later stage.

8.8 Material Inspection clearance certificate (MICC) shall be issued by the Employer after inspection of the equipment. Employer may waive off the presence of Employer's inspecting engineer. In that case test will be carried out as per approved QP and test certificate will be furnished by the supplier for approval. MICC will be issued only after review and approval of the test reports.

8.9 The Employer 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.

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

9.0 ENGINEER'S SUPERVISION

a) To eliminate delays and avoid disputes and litigation it is agreed between the parties to the Contract that all matters and questions shall be referred to the Engineer and without prejudice to the provision of Section GCC, the contractor shall proceed to comply with the Engineer's decision.

b) The work shall be performed under the direction and supervision of the Engineer. The scope of the duties of the Engineer, pursuant to the contract, will include but not be limited to the following :

i) Interpretation of all the terms and conditions of these documents and specifications ;

ii) Review and interpretation of all the Contractor's drawings, engineering data etc. ;

iii) Witness or authorise his representative to witness tests and trial either at the manufacturer's works or at site, or at any place where work is performed under the Contract ;

iv) Inspect, accept or reject any equipment, material and work under the Contract ;

v) Issue certificate of acceptance and/or progressive payment and final payment certificates ;

vi) Review and suggest modifications and improvements in completion schedules from time to time ; and

vii) Supervise the quality Assurance programme implementation at all stages of the Works.

10.0 TESTS

10.1 Charging

a) 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 Engineer 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 Chapte-TST and shall be included in the Contractor's quality assurance programme.

The pre-commissioning checks for various Switchyard Equipment shall be in line with the Pre-Commissioning checklist, Document code no. OS/T&C/BAY/95 (Rev. 0). Further, as regards to pre-commissioning checks for Series Capacitors and the overall system including Series Capacitor and other equipment, protection etc., shall be mutually discussed and agreed upon.

b) The Contractor's commissioning engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning

tests. On completion of inspection and checking and after the pre-commissioning tests are satisfactorily over, the complete equipment shall be placed on Initial Operation during which period the complete equipment shall be operated integral with sub- systems and supporting equipment as a complete substation.

10.2 **Commissioning Tests**

a) The available instrumentation and control equipment will be used during such tests and the Engineer will calibrate, all such measuring equipment and devices as far as practicable. However, unmeasurable parameters shall be taken into account in a reasonable manner by the Engineer, for the requirement of these tests.

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

c) The specific tests to be conducted on equipment have been brought out in the Chapter-TST.

10.3 **Test Codes**

The provisions outlines in the IS & IEC codes or other international and Indian approved equivalents shall generally be used as a guide for all the above test procedures unless otherwise specified in the Technical Specifications.

11.0 HANDLING, STORING AND INSTALLATION

a) In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Employer or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the electrical equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.

b) 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.

c) In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Employer. Contractor shall be held responsible for any

damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

d) Where assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.

e) The Contractor shall be fully responsible for the equipment/material until the same is handed over to the Employer in an operating condition after commissioning. Con tractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by Employer, as well as protection of the same against theft, element of nature, corrosion, damages etc.

f) Where material/equipment is unloaded by Employer before the Contractor arrives at site or even when he is at site, Employer 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.

g) Contractor shall be responsible for the proper storage and maintenance of all materials/equipment entrusted to him. He shall take all required steps to carry out frequent inspection of material/equipment stored as well as erected until the same is taken over by the Employer.

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

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

j) Clearances and spacings shall be provided as per relevant IS.

Bidder shall confirm in their technical offer that all clearances and spacing as stated above will invariably be provided. Even though phase to earth clearance under normal conditions will be as above at certain points where there can be bird faults (i.e. a bird sitting on the earthed metal part coming in contact with the HT terminal) adequate clearance as required shall be provided between the HT terminal and nearest grounded metal part.

12.0 TAKING OVER

Upon successful completion of all the tests to be performed at Site on equipment furnished and erected by the Contractor, the Engineer shall issue to the contractor a taking over certificate as a proof of the final acceptance of the equipment. such certificate shall not unreasonably be withheld nor will the Engineer delay the issuance thereof on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

13.0 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with protecting device. All ends of equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

14.0 PRESERVATIVE SHOP COATING

14.1 All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall beforehand be treated and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scale, oxide and other coatings and prepared in the shop. The surfaces that are to be finish painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Transformers and other electrical equipment, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colours shall be selected and specified by the Employer at a later date.

14.2 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 deg.C. shall be selected by the Contractor, after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperatures higher than 95 deg.C. and such primers shall also be subject to the approval of the Employer.

14.3 All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer.

15.0 PROTECTIVE GUARDS

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

16.0 DESIGN CO-ORDINATION

The Contractor shall be responsible for the selection and design of appropriate equipment to provide the best coordinated performance of the entire system. The basic design requirements are detailed out in this Technical Specification. The design of various components, sub-assemblies and assemblies shall be so done so that it facilitates easy field assembly and maintenance. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical at or close to the operating range of the unit.

17.0 DESIGN CO-ORDINATION MEETING

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

18.0 BUS POST INSULATORS

The post insulators shall conform in general to latest IS:2544, IEC-168 and IEC-815.

CONSTRUCTIONAL FEATURES

18.1 Post type insulators shall consist of a porcelain part permanently secured in a metal base to be mounted on the supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand any shocks to which they may be subjected to by the operation of the associated equipment. Only solid core insulators will be acceptable.

18.2 Porcelain used shall be homogeneous, free from lamination, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

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

18.4 The insulator shall have alternate long and short sheds with aerodynamic profile. The shed profile shall also meet the requirements of IEC-815 for the specified pollution level.

18.5 When operating at normal rated voltage there shall be no electric discharge between conductor and insulators which would cause corrosion or injury to conductors or insulators by the formation of substance produced by chemical action.

18.6 The design of the insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.

18.7 All ferrous parts shall be hot dip galvanised in accordance with the latest edition of IS:2633 and IS :4579. The zinc used for galvanising shall be grade Zn 99.95 as per IS:209. The zinc coating shall be uniform, adherent, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust stains, bulky white deposits and blisters. The metal parts shall not produce any noise generating corona under the operating conditions.

18.8 If corona extinction voltage is to be achieved with the help of corona ring or any other similar device, the same shall be deemed to be included in the scope of the Contractor.

18.9 **Tests**

The post insulators shall be subject to type, acceptance, sample and routine tests as per IS:2544 and IEC-168.

18.10 TECHNICAL REQUIREMENTS FOR BUS POST INSULATORS

a)	Type	:	Solid Core
b)	Voltage class (kV)	:	420
c)	Dry & wet one minute power frequency withstand voltage (kV rms)	:	680
d)	Dry lightning impulse withstand voltage (kVp)	:	±1425
e)	Wet switching surge withstand voltage (kVp)	:	±1050
f)	Max. radio interference voltage (in microvolts) at voltage of 305 KVrms between phase to ground	:	1000
g)	Corona extinction voltage (kV rms)		320 (Min.)
h)	Total minimum cantilever strength (kg)		800
i)	Minimum torsional moment		As per IEC-273
j)	Total height of insulator (mm)		3650

k)	Pollution level as per IEC-815	Heavy (III)
l)	Minimum total creepage distance for heavy pollution (mm)	10500

19.0 REQUIREMENT OF AUXILIARY ITEMS

19.1 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS

a) Bushings shall be manufactured and tested in accordance with IS : 2099 & IEC : 137 while hollow column insulators shall be manufactured and tested in accordance with IEC:233/IS: 5621/IEC:61264, as applicable. The support insulators shall be manufactured and tested as per IS:2544/IEC:168 and IS:2099/IEC:273. The insulators shall also conform to IEC:815 as applicable.

b) 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.

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

d) 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.

e) 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.

f) 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.

g) 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.

h) **TESTS :**

In accordance with the requirements stipulated, bushings, 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.

i) Parameters of bushings/Hollow column insulators/support insulators :

a)	Rated Voltage	:	420 kV*
b)	Impulse withstand voltage (Dry & Wet)	:	± 1425 kVp*
c)	Switching surge withstand voltage(Dry & Wet)	:	± 1050 kVp*
d)	Power frequency with-stand voltage	:	630 kVrms*
e)	Total creepage distance	:	25mm/kV*
f)	Pollution level	:	Class-III : Heavy (as per IEC-71)

g) Insulator shall also meet requirement of IEC - 815, as applicable, having alternate long & short sheds.

NOTE : * The equipment rating is only indicative. Appropriate rating equipment may be supplied if so required in view of the series capacitor requirement.

19.2 **CONTROL PANELS, RELAY PANELS, CABINETS, JUNCTION BOXES, TERMINAL BOXES, MARSHALING BOXES AND MARSHALING KIOSKS:**

a) All types of boxes, cabinet/panels shall generally conform to IS : 5039, IS : 8623, IEC : 439, as applicable and the clauses given below :

b) Control cabinet/panels, junction boxes, Marshaling box & terminal boxes shall be sheet steel/Al. enclosed and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled/2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of Al. enclosed box the thickness of Al. shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.

c) The enclosures of all outdoor type control cabinets/panel, junction boxes, terminal box & marshaling boxes shall provide a degree of protection of not less than IP 55 as per IS : 13947 and the same for indoor type enclosures shall be IP 31 as per IS : 13947and one control cabinet/panel, junction box, terminal box & marshaling box of each type shall be tested for the same, if the type test reports submitted are not to the satisfaction of the owner.

d) Control cabinet/panels, junction boxes, marshaling box & terminal box shall be provided with padlocking arrangements.

e) All doors, removable covers and plates shall be gasketed all around with neoprene gaskets. The neoprene gasket shall be tested in the presence of Employer's representative.

f) All sheet steel work shall be degreased, pickled, phosphated and then applied with two coats of zinc chromate primer and two coats of finishing synthetic enamel paint. The colour of finishing paint shall be light admiralty grey in accordance with shade No. 697 of IS : 5 outside and inside shall be glossy white.

g) All terminal boxes, control cabinet/panels, junction boxes & marshaling boxes shall be designed for the entry of cable from bottom by means of weather proof and dust-proof connections. Boxes and cabinet/panels shall be so 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/panel. Suitable cable gland plate on the base of the box shall be provided for this purpose. Necessary number of cable glands of suitable sizes shall be supplied and fitted on this gland plate. This removable gasketted gland plate shall have provision for spare glands to be used in future. The glands shall project at least 25 mm above the gland plate to prevent the entry of moisture in the cable crutch. The roof of the outdoor cabinet/panels/boxes shall preferably be of sloping design to prevent stagnation of water.

h) Suitable heaters shall be provided in the cabinet/panel, junction boxes & marshaling boxes to prevent condensation. Heaters shall maintain cubicle temperature approximately 10°C above the outside air temperature. The heaters shall be suitable for 240 V AC supply voltage. On-off switch and fuse for this shall be provided.

i) **Terminal Block :**

All internal wiring to be connected to the external equipment shall terminate on terminal blocks, preferably vertically mounted on the side of cabinet/panel, junction box, terminal box and marshaling box.

The terminal blocks shall be made of moulded, non-inflammable thermosetting plastic. The material of terminal block moulding shall not deteriorate because of varied conditions of heat, cold, humidity, dryness, etc. that would be anticipated at the location where the equipment is proposed to be installed.

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. The terminal blocks shall be non- disconnecting stud type equivalent to Elmex type CAT - M4/CST.

The terminal blocks shall be of extensible design.

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

The terminal blocks shall be of ***650*** V grade and shall be rated to carry continuously the maximum current that is expected to be carried by the terminals.

The terminal blocks used for CT circuits shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulting barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

The terminals shall be provided with the marking tags for wiring identification.

All boxes shall be provided with 20 % spare terminals unless otherwise specified.

j) There shall be a minimum clearance of 250 mm between the first row of terminal block and the cable gland plate or side of the box. Also the clearance between two rows of terminal blocks or side of the box shall be a minimum of 150 mm.

k) 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/panel is live. Cabinet/panel wiring should be suitable for 60°C as the space heaters will keep the temperature 10°C higher than the ambient.

l) **Wiring :**

All wiring shall be carried out with ***650*** V grade, stranded copper wires. The minimum size of the stranded conductor used for internal wiring shall be as follows :
i)All circuits except CT circuits – 1.5/ 0.75.00.4 sq.mm (depending on the device current rating)

ii) CT circuits- 4sq mm; minimum no. of strands shall be 3 per conductor.

iii) Wrapping wires shall be used for electronic rack connection.

All internal wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals and terminal blocks.

Wire terminations shall be made with solderless crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires and shall not fall off when the wire is disconnected from terminal blocks.

All wires directly connected to trip circuit breaker shall be distinguished by the addition of a red coloured unlettered ferrule. Number 6 & 9 shall not be included for ferrule purposes.

All terminals including spare terminals of auxiliary equipment shall be wired upto terminal blocks. Each equipment shall have its own central control cabinet in which all contacts including spare contacts from all poles shall be wired out.

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

For illumination of Control cabinet/panel a 20 Watts Fluorescent Tube/Incandescent Lamp shall be provided.

All control switches shall be of rotary switch type or push button type and toggle/piano switches shall not be accepted.

In accordance with the requirements stipulated under this Chapter control cabinet/panels, junction boxes, terminal boxes & marshaling boxes shall conform to type tests and shall be subjected to routine tests in accordance with IS : 5039. In addition to the type tests, verification of the degree of protection as per IS : 13947, shall be conducted, if the type test reports submitted by the Contractor are not to the satisfaction of the owner. After protection degree tests on control cabinet/panel, power frequency voltage of 2.0 kV rms for 1 minute shall be applied for checking insulation resistance and functional test shall also be conducted.

m) **Earthing :**

Positive earthing of the cabinet/panel shall be ensured by providing two

separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of star or self etching washers. Earthing of hinged door shall be done by using a separate earth wire.

19.3 **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 conform to type tests and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

19.4 **TERMINAL CONNECTORS AND CLAMP CONNECTORS :**

The Terminal Connectors of all types shall meet the following requirements:

a) Terminal connectors shall be manufactured and tested as per IS: 5561.

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

c) No part of a clamp shall be less than 10 mm thick.

d) All ferrous parts shall be hot dip galvanised conforming to IS: 2633.

e) For bimetallic connectors, copper alloy liner of minimum thickness of 2 mm shall be provided.

f) Flexible connectors shall be made from tinned copper/ aluminium sheets or cables.

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

h) Connectors shall be designed to be corona free in accordance with the requirements stipulated in IS: 5561.

i) All test/checks on terminal connectors shall be as per IS: 5561.

19.5 **AUXILIARY SWITCH :**

The type test reports or the following tests on auxiliary switch shall be furnished :

a) Electrical endurance test - A minimum of 2000 operations for 2A DC with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/visual defects/temperature rise test.

b) Mechanical endurance test - A minimum of 1,00,000 operations with a subsequent checking of contact pressure test/visual examination.

c) Heat run test on contacts.

d) IR/HV test etc.

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 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 100 microvolts 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 alongwith 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 Purchaser.

5. FORM OF JOINT DEED OF UNDERTAKING BY THE COLLABORATOR/ PARENT COMPANY ALONGWITH THE BIDDER/MANUFACTURER [In line with Clauses 24.6 to 24.8 of Section GTR of Technical Specifications, Volume-II (Applicable for 400KV, 220KV & 132KV)]

(ON NON-JUDICIAL STAMP PAPER OF APPROPRIATE VALUE)

THIS DEED OF UNDERTAKING executed this ..... day of ..... Two Thousand and ..... by M/s. ....., a Company incorporated under the laws of ..... and having its Registered Office at ..... (hereinafter called the "Collaborator" which expression shall include its successors, executors and permitted assigns), and M/s. ....., a Company incorporated under the laws of ..... having its Registered Office at ..... (hereinafter called the "Manufacturer" which expression shall include its successors, executors and permitted assigns) and Ms/. ....., a Company incorporated under the laws of ..... having its Registered Office at ..... (hereinafter called the "Bidder" which expression shall include its successors, executors and permitted assigns) in favour of ..... (insert names of the Employer) ....., a Company incorporated under the Companies Act of 1956 having its registered office at .....(insert registered address of the Employer)..... (hereinafter called the "Employer" which expression shall include its successors, executors and permitted assigns)

WHEREAS the "Employer" invited Bid as per its Specification No. ..... for the execution of .....(insert name of the package alongwith project name).....

AND WHEREAS Clause No. ....., Section ....., of ....., Vol.–... forming part of the Bid Documents inter-alia stipulates that the Bidder and/or Manufacturer alongwith its Collaborator must fulfill the Qualifying Requirements for the *..... and be jointly and severally bound and responsible for the successful performance of the *..... offered in the event the Bid submitted by the Bidder is accepted by the Employer resulting in a Contract.

AND WHEREAS the Bidder has submitted its Bid to the Employer vide Proposal No. ..... dated ..... based on the collaboration/association of the Collaborator with the Bidder/Manufacturer.

NOW THEREFORE THIS UNDERTAKING WITNESSETH as under:

1.0 In consideration of the award of Contract by the Employer to the Bidder (hereinafter referred to as the "Contract") we, the Collaborator and the Bidder/Contractor and/or manufacturer do hereby declare that we shall be jointly and severally bound unto the ..... (insert name of the Employer) ....., for the successful performance of the *..... and shall be fully responsible for the design, manufacture, testing, supply on FOR destination

delivery at site basis and supervision of unloading at site, storage, erection, testing & commissioning and successful performance of the *..... in accordance with the Contract Specifications.

2.0 Without in any way affecting the generality and total responsibility in terms of this Deed of Undertaking, the Collaborator in particular hereby agrees to depute their technical experts from time to time to the Bidder's/ Contractor's/ Manufacturer's Works/ Employer's Project site as mutually considered necessary by the Employer, Bidder/ Contractor, Manufacturer and the Collaborator to ensure proper design, engineering, manufacture, testing, supply on FOR destination delivery at site basis and supervision of unloading at site, storage, erection, testing & commissioning and successful performance of the equipment in accordance with Contract Specifications and if necessary, the Collaborator shall advise the Manufacturer/ Contractor suitable modifications of designs and implement necessary corrective measures to discharge the obligations under the contract.

3.0 This Deed of Undertaking shall be construed and interpreted in accordance with the laws of India and the Courts in Delhi shall have exclusive jurisdiction in all matters arising under the Undertaking.

4.0 As a security, the Collaborator/ Manufacturer shall apart from the Contractor's performance guarantee, furnish a Contract Performance Guarantee from its Bank in favour of the Employer in a form acceptable to the Employer. The value of such guarantee shall be equivalent to 10% of the cost of such equipment(s) from the parent company/collaborator as identified in the Contract awarded by the Employer to the Bidder/Contractor and it shall be part of guarantee towards the faithful performance/compliance of this Deed of Undertaking in terms of the Contract. The guarantee shall be unconditional, irrevocable and valid for the entire period of the Contract, namely till the end of the Defect Liability Period of *..... under the Contract. The Bank Guarantee amount shall be payable to the Employer on demand without any reservation or demur.

5.0 We, the Collaborator/ Bidder/ Contractor and/or Manufacturer agree that this Undertaking shall be irrevocable and shall form an integral part of the Contract and further agree that this Undertaking shall continue to be enforceable till the Employer discharges it. It shall become operative from the effective date of Contract.

IN WITNESS WHEREOF the Collaborator, the Manufacturer and/or the Bidder/Contractor have through their Authorised Representatives executed these presents and affixed Common seals of their respective Companies, on the day, month and year first above mentioned.

WITNESS	(For Collaborator)
Signature	
Name	(Signature of the authorized representative)
Office Address	Name .....
	Common Seal of Company .....
WITNESS	(For Bidder)
Signature	
Name	(Signature of the authorized representative)
Office Address	Name .....
	Common Seal of Company .....
WITNESS	(For Manufacturer)
Signature	
Name	(Signature of the authorized representative)
Office Address	Name .....
	Common Seal of Company .....

Note:

1. The non-judicial stamp papers of appropriate value shall be purchased in the name of executant(s).

2. The Undertaking shall be signed on all the pages by the authorised representatives of each of the partners and should invariably be witnessed.

3. In the event the Bidder is a Manufacturer and the Collaboration is between Collaborator and the Bidder, then the Joint deed of undertaking shall be modified accordingly.

4. *The name(s) of equipment for which Joint deed of undertaking is to be submitted is to be inserted.

5. The manufacturer may be having ongoing collaboration agreement or had collaboration agreement in the past with the collaborator.

6. Cost of Equipment shall be Ex-works/CIF Price.

7. In case the bid is submitted by a Collaborator/Parent Company, either individually or as a partner of Joint Venture, the additional performance guarantee of 10% under the provision of para 4.0 of the undertaking shall not be applicable

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)

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.

I. Requirements

S.No.	Description		Yes/No	Remarks
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 8.0 of Section –III and clause 1.9 of section – I 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 1.7 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 ~~shall be furnished~~ at contract stage.		Yes/No	
9	One copy of computer study result done in past shall be furnished at contract stage.		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 Mechanical & Electrical parameters , shall be furnished at contract stage.		Yes/No	
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	
17	Standard drawing / GTP / Type Test Report for following items attached for approval extension a) PLCC items b) Protection coupler (Analog type) c) Digital protection coupler		Yes/No	

II. 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 i.e. 17-05-2013). **(YES / NO)**

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

Date:

Signature of the authorized representative of Bidder

Company Seal