



BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

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CUSTOMER	GSECL					
CONSULTANT	DCPL , KOLKATA					
PROJECTS	400KV SWITCHYARD EXTENSION AND 400KV GIS FOR 1X800MW FOR WANAKBORI THERMAL POWER STATION EXTN. UNIT #8 , Project code : 375					

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Section –I

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of PLCC equipment, site testing & recommissioning of existing indoor PLCC. No deviation from the requirements specified in various clauses of this specification shall be allowed. A certificate to this effect shall have to be furnished along with the offer.

The fitments offered shall be of Customer/GSECL approved make or its subsequent approval from Customer/GSECL shall be bidder's responsibility, with no commercial implications to BHEL. If any of the make offered by the bidder is not acceptable to Customer/GSECL, the bidder has to supply alternate Customer approved make, meeting the specification, with no commercial implications to BHEL.

Wherever bidder offers any item/spare in lieu of the same being "Built-in feature" of any fitment or the same being "Not applicable" is subject to approval by Customer/GSECL. No price implication will be entertained by BHEL at contract stage if any separate item is insisted by Customer to meet the contract requirement.

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

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Customer : GSECL

Project : 400kV GIS & 400kV Switchyard (Extn.) at Wanakbori TPP

Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

Refer Annexure-I to Section 1

1.2.1 SCOPE:

PLCC Equipments and associated power cables, communication cables for both ends of the following line-

- a) 400kV T/L : 107 Km
- b) 400kV Tie D/C Line : 4 Km
- c) Bidder to decide the wattage of its PLC terminals to ensure that the Power output (PEP) at HF terminal shall be 20/40/80Watt as per the specification and offer accordingly .Any input, if required, to validate the offered wattage of its PLC terminal shall be arranged by the bidder.
- d) It is bidders sole responsibility to correctly offer the complete PLCC system, get requisite approval of drawing/document , successfully commission and handover the PLCC system to BHEL/Customer .It is to be noted that if at any stage the wattage of the offered PLC terminals is found inadequate , the PLC terminal shall be modified /replaced with higher wattage terminal without any price implication to BHEL .
- e) Any additional item as per the specification is required to be supplied by bidder for completion of the PLCC system over and above the items indicated in BOQ.

1.3 QUALIFYING REQUIREMENTS

- a) The bidder shall submit the documentary evidence that equipment of similar rating has been manufactured by him and are in successful operation for more than two (2) years in two or more projects of similar nature on the date set for opening of the bid
- b) Necessary information about the financial and technical resources, organization and experience to undertake the manufacturing and supply of such equipment shall be supplied by the Bidder as an evidence of his capability for satisfaction of the Owner / Purchaser.
- c) The Bidder shall submit along with his bid a list of major contracts for supply of similar equipment executed/being executed by him during last 5 years giving detailed particulars such as quantity, equipment rating, contract value, name of the Owner / Purchaser, year of commissioning etc.
- d) Notwithstanding anything stated above, the Owner / Purchaser reserves the right to assess bidder's financial and other capabilities to execute the contract.

1.4 BILL OF QUANTITY

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

1.5 LIST OF DOCUMENTS TO BE SUBMITTED

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

1.6 TYPE TESTS

All equipment/cables shall be of proven design and type tested as per relevant standard. Type test certificates/specific type tests shall furnished/conducted, if asked for with reference to any specific equipment in the respective sub-section of the Specification. However, bidder may note the following :

A) For short circuit test, proto-type, similar design of same capacity of higher documentary evidence shall be submitted for customer approval.

B) For new designed equipment, type test to be conducted at CPRI or Government approved laboratory at bidder's cost.

Bidder to note that submitted Type Test Certificates for any electrical equipment shall not be older than five (5) years from the date of inspection, otherwise Type tests shall be conducted of the equipment without any price implication.

1.7 SPECIAL TOOLS AND TACKLES :

The bidder shall include in his proposal the deployment of all special tools and tackles required for erection , testing commissioning and maintenance of the equipment .The Special tools and tackles shall only cover items which are specifically required for the

equipment offered and are proprietary in nature. A list of all such devices shall be furnished.

1.8 SERVICES :

1.8.1 SUPERVISION OF COMMISSIONING & SITE TESTING-

The erection, testing and commissioning of PLCC system shall be done under the supervision of the Equipment manufacturer (Bidder).

1.8.2 FREQUENCY PLANNING , SNR CALCULATIONS & COMPUTER STUDY-

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

Please Note : The bidder shall be responsible for preparing compliances & obtaining approval of their drawings, frequency planning , Calculations etc , from the Customer/utility such as GETCO /Powergrid etc. No price implication in this regard will be entertained after placement of order.

Price for obtaining engineering , frequency allocation etc is deemed to be included in equipment price.

Annexure-I

BILL OF QUANTITY
PLCC -Wanakbori Project

SN	Description of Item	Unit	At Wanakbori AIS End of Tie Line	At Wanakbori GIS End of Tie Line	At Wanakbori End Line Feeder	At Remote End (only Supply)	Total Quantity
1	Coupling device (Phase to Phase) 650W	Nos.	2	2	2	2	8
2	HF cable 75 Ohms unbalanced	m	1000	500	500	2000	4000
3	Carrier equipment (for speech + protection) (Analogue type)	Nos.	4	4	4	4	16
4	Carrier equipment (for speech +data) (Analogue type)	Nos.	1	1	1	1	4
5	Analogue Protection coupler	Nos.	4	4	4	4	16
6	4 wire telephone instrument(Along with associated accessories & telephone wiring)						
6a	4 wire telephone set with connecting cables	Nos.	4	2	2	2	10
6b	5 Pair Telephone Cables, armoured ,0.5mm dia annealed copper conductor and petroleum jelly filled with polyethene outer jackets	m	1000	500	500	1000	3000
7.	Print test kit for Testing & maintenance of PLCC equipment.	Set	1	1	NIL	1	3
8.	EPAX (24/8) with 24Nos telephones, cables , accessories etc.	Set	NIL	1	NIL	NIL	1
8a.	2 Wire Telephone set with connecting cables	Nos.	NIL	24	NIL	NIL	24
8b.	2 Pair Telephone cables (Tinned Copper)	M	NIL	500	NIL	NIL	500

Annexure-I

BILL OF QUANTITY
PLCC -Wanakbori Project

SN	Description	Unit	At Wanakbori AIS End of Tie Line	At Wanakbori GIS End of Tie Line	At Wanakbori End Line Feeder	At Remote End (only Supply)	Total Quantity
9	Mandatory Spares						
9a	Coupling device (Phase to Phase) 650W	Set	NIL	1	NIL	NIL	1
9b	Set of all plug- in modules of power line carrier terminals, EPAX (of Each Type)	Set	NIL	1	NIL	NIL	1
9c	4 wire telephone set with connecting cables	Set	NIL	1	NIL	NIL	1
10	Services : System engineering including Computer study , frequency planning and SNR Calculations	Lot	NIL	1	NIL	NIL	1
10	Services : Supervision of pre-commissioning (panel wise)	Nos.	5	5	5	5	20
11	Services : Supervision of Testing and commissioning (link wise)	Nos.	1	Nil	1	NIL	2

Note-

1. Cut lengths of HF cable & 5 pair telephone cable shall be finalized during detailed engineering .

SECTION - II

SECTION: PLCC

1. GENERAL

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

2. Standard And Drawing

- 2.1 The IEC/IS Specifications and international publication relevant to the equipment covered under this specification ~~shall include but not be limited to the list given at Annexure 'C' of Section - GTR.~~

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~~ ^(BIDDER) shall be responsible for coordinating the equipment supplied by him with the already existing carrier equipment at the respective sub-stations. ~~Contractor~~ ^(BIDDER) 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 along with 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 along with 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 (Bidder) 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 (Bidder) 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 (Bidder) for carrying out the computer studies and frequency planning. The Contractor (Bidder) 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 ^(Bidder)
The ~~Contractor~~ shall have to check and prove through the results of his computer studies that attenuation due to transpositions in the EHV lines is within limits and the offered equipment will perform satisfactorily.

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

6. LINE TRAP (NOT IN BIDDER'S SCOPE OF SUPPLY)

- 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 arrester 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 arrester is recommended by them.

- 6.3 The lightning arrester 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 arrester 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 9.2 of GTR .
- 1.)Return loss test.
 - 2.)Composite loss test.
 - 3.)Distortion and inter modulation test .
 - 4.)Impulse voltage test.
 - 5)Tests on Arrestors

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

8. **High Frequency Cable**

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

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

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

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

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

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

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

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

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

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

9. **Power Line Carrier Terminal**

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

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

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

- 9.3 The salient features are detailed out below :

a)	Mode of transmission	Amplitude Modulation single side band with suppressed carrier or reduced carrier.
b)	Carrier frequency	40 to 500 kHz range
c)	Nominal carrier frequency band in either direction of transmission	4.0 kHz
d)	Power output (PEP) 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. Bidder Bidder
- 9.12 All the panels shall be protected against moisture ingress and corrosion during storage. Panels shall be properly dried before they are installed and energized.

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

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

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

9.15 Reports for the following type tests for PLC Terminals shall be submitted as per clause ~~9.2 of GTR~~ 1-6 of Section 1.
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 impedance, Return loss & Tapping loss
- i) Return loss, A inputs/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~~ Bidder.
- 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~~ Bidder. 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~~ Bidder.
- 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 10^{-5}
(Noise burst of any amplitude)

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

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 ^{Bidder} 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 ^{1.6 of section 1} ~~9.2 of GTR~~ shall be submitted for approval for protection coupler and the relays associated with PLCC equipment for network protection signaling equipment and interface unit with protective relay units if any :

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

a) Power supply variation

b) Power supply interruption

c) Reflected noise

d) Reverse polarity

e) Interference by discrete frequency

f) Transmission time

g) Interference by frequency deviation. (Wherever applicable)

h) Alarm function

g) Security

h) Dependability

i) Voltage withstand test

j) Insulation test.

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

k) HF disturbance test (along with carrier terminal)

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

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

n) Environment test (as per IS 9000)

:

2. **Relays.**

- a) Impulse voltage withstand test as per Clause 5.1 of IS:8686 (for a test voltage appropriate to Class III as per Clause 3.2 of IS:8686).
- b) High Frequency Disturbance test as per Clause 5.2 of IS:8686 (for a test voltage appropriate to Class III as per Clause 3.2 of IS:8686).

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.

SECTION-3

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification. The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under other respective sections and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

a)	Customer/ Purchaser/ Owner	Gujrat State Electricity Corporation Ltd. Vadodara
b)	Consultant	Development Consultants Pvt. Ltd., Kolkata - 700 091
c)	Project Title	400kV Switchyard Extension and 400 kV Switchyard for GIS for 1x800 MW Supercritical Thermal Power Project
d)	Location	Wanakbori is connected with roads by the National Highway, NH-8 (about 10 km from plant -Dakor-Godhra) and state highway SH-59 (about 2 km from plant -Balasinor- Sevalia). Wanakbori is connected with railways by Ahmedabad-Vadodara main Broad Guage line of Western Railway (about 8 km from Sevalia). Nearest Airports are Vadodara at distance of 85 Km from site and Ahemedabad at a distance of 100 Km from the Site.
e)	Elevation above MSL	72.0 meters
f)	Transport Facilities	Road/Rail, Nearest railway station is Sevalia. Nearest Airports are Vadodara at distance of 85 Km from site and Ahemedabad at a distance of 100 Km from the Site.
g)	Postal Address	To follow
METEOROLOGICAL DATA OF SITE IS GIVEN BELOW		
a)	Max. daily average temp	34 °C
b)	Min. daily average temp	11.7 °C
c)	Max. Ambient air temp. (daily)	34°C
d)	Max. Ambient air temp. (yearly)	30°C
e)	Max. Ambient air temp.	42°C
f)	Wet bulb temperature	28°C
g)	Design ambient temp. for all electrical equipment	50°C
h)	Wind Design	Basic Wind Speed, Vb = 39m/s

i)	Pollution Severity	Highly Polluted
j)	Seismic Criteria	III
k)	Relative Humidity	100%
l)	Average annual rainfall	750 mm

SITE PROFILE

Location	Wanakbori, District-Kheda, Gujarat
Access by – nearest railway station	Ahmedabad – Vadodara Main Broad Gauge line, Sevaliya (8 KM)
Nearest Airport	Ahmedabad and Vadodara
Nearest sea port	Kandla
Access by Road	10KM from Godhra NH No.8; 02 KM from Balasinor-Sevaliya SH No.59
Major Towns / Cities	13KM from Balasinor and 10KM from Sevaliya
Availability of Land	Within existing Thermal Power Station
Latitude	22° -52'N
Longitude	73° -21'E
Altitude	80Meters from mean sea level for existing Units 70Meters from mean sea level for 800MW Unit 8

3.2 EVACUATION OF POWER

For evacuation of power through outgoing line feeders, 400 KV transmission lines established by GETCO between the proposed power plant and existing 400 KV substation of GETCO. The interface point between this switchyard and 400 KV transmission lines of GETCO will be at the take off gantry structures inside the switchyard fence.

Following title block shall be included in all documents for submission

3.4 SYSTEM PARAMETERS

Nominal system voltage	400 kV
Highest system voltage	420 kV
Rated lightning impulse withstand voltage	a) ± 1425 kVp between live terminals and earth. b) ± 1665 kVp impulse on one terminal and other terminal earthed (across isolating distance).
Rated one minute power Frequency withstand voltage	630kVrms
Rated switching impulse withstand voltage	1050 kVp (Phase to earth) 1575 kVp (Phase to Phase)
Corona extinction voltage	320 kV
Frequency	50 Hz
Rated short time withstand current capacity	40 kA for 3 sec
Creepage distance	31mm/kV
System Earthing	Effectively Earthed

3.5 AUXILIARY POWER SUPPLY

3 phase A.C power supply	415V, 50 Hz, 3-phase 4 wire, solidly earthed with variation in frequency of +3/-5% and variation in voltage +/-10%. For motors above 200W up to 160 KW. Fault level 50 KA symm.
1 phase A.C power supply	240V, 50 Hz, 1-phase, 2 wire, AC supply with variation in frequency of +/-5% and variation in voltage +/-10%. For motors up to 200W, Lighting, space heating, A. C. control & protective devices.
D.C. power supply	220V(variation from 190V to 240V) , 2-wire ungrounded 50V, 2 wire system (+) earthed. D.C. Supply Voltage : 187 to 242 Volt for 220VDC. For D.C. alarm, control & protective devices. Fault level 25* KA (Minimum) * Indicative only; the actual value will be decided by the bidder, after substantiating the same by calculation.
Combined variation of voltage and frequency for AC supply shall be +/- 10%	

3.6 GENERAL CONDITIONS

3.6.1 NAME PLATES (RATING PLATES)

Instruction plates, name plates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name,

type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.

Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.

All trade nameplates and labels shall be in English language. All The size and location of nameplates shall be subject to approval of the Engineer.

3.6.3 Latent Defects:

Notwithstanding the issue of the Take Over Certificate, the Contractor shall be responsible for making good with all possible speed any Latent Defect in any Works /equipment of the plant which appears at any time before the expiry of defect liability period. And shall remedy such defect at its own cost and expense. The latent defect liability period shall be a minimum of 5 years from the end of defect liability period. The defects to which this applies are defects in design, materials or workmanship or defects arising from any act or omission of the Contractor done or omitted prior to Take-over of the portion of the Plant affected by the defects or during the Warranty Period which a reasonable examination at the end of the Warranty Period would not have disclosed.

3.8 OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS

- 3.8.1 Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He shall also furnish details of availability records in plants stated in his experience list.
- 3.8.2 Ample space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.
- 3.8.3 Motorized lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part having weight in excess of 3000 Kg. Suitable beams, hooks etc. for this purpose shall be provided in the buildings. No lifting arrangement is necessary for part having weight less than 500 Kg. Hoist shall be well protected by environment. Suitable painting and coating covering hoist at outdoor shall be provided. Lifting devices like lifting tackles, slings, etc. to be

connected to hook of the hoist/crane shall be provided by the Bidder for lifting the equipment, accessories covered under this specification.

- 3.8.4 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

3.9 MATERIALS

- 3.9.1 In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.
All materials shall be new, and shall be of the quality most suited to the proposed application.

- 3.9.2 In as far as is possible; materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the Engineer to assess the suitability of the material for the particular application. All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

- 3.9.3 Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.
- 3.9.5 All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.
- 3.9.6 All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.

3.10 PACKAGING & MARKING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of railway wagon sizes in India

should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing. As per the information available, the dimensions of OD consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below:

- a) Width of the Package: 3.2 Meters (from centre-line of rails- 1.6 meters on both sides)
- b) Height of the package from rail top: 4.47 Meters

The above indicates the dimensions which can be normally transported on the wagons without infringement of the "moving gauge". This is however not indicative of the consignment which can be carried out with infringement of "moving gauge" duly authorized and approved by the Indian Railways. There may be difference between the "moving gauge" and the "fixed structure gauge" and consignments infringing the "moving gauge" can be moved after investigation regarding possible infringement with the fixed structures. As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly brought out in the proposal wherever transport of over dimensional equipment is involved.

Bidder to consider unloading of material delivered through rail transportation, at near by railway station/site unloading siding. The subsequent transportation up to project work place shall be considered by road only. All unloading and handling equipment both at railway station siding and at project

site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services if the Bidder. Bidder may consider entire material delivered up to site through rail transportation only. The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of

the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the

office placing the contract, nomenclature of contents and Bill of Material. For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.

3.11 PROTECTION

Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts,

bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Female threaded openings shall be closed with rough usage covers or forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of piping, tubing and conduit shall be sealed and taped. Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

3.12 PAINTING

3.12.1 GENERAL

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least

two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the approval of the Owner. All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the approval of the Engineer. The quality and vendor of the paints shall require approval of the Owner.

All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

All primers shall be well marked into the surface, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray

painting shall be carried out by operators trained and thoroughly experienced in the use of the equipment. If the drying interval between successive coats, which should not exceed one week, has been so long as to endanger the adhesion of the following coat, the paint already applied shall be lightly rubbed down with fine abrasive paper before putting on the next coat. Paint spraying on large surfaces shall not normally be done indoors, except with the approval of the Engineer. Spray guns shall not be used outdoors in

windy weather or near unprotected surfaces of a contrasting color and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment. Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use. Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel.

The Contractor shall furnish sufficient touch-up paint for one complete finish coat on all exterior

factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting

instructions shall be furnished. Shop primer for steel and iron surfaces which will have a continuous operating temperature below 35 Deg.C shall be selected by the Contractor, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35 Deg.C. The colour scheme shall be submitted during execution of contract for approval by the Purchaser/Engineer.

3.12.2 PREPARATION

Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying. Surfaces to be shot blasted shall be cleaned to Swedish Standard SA 2.5 or equivalent, and all dust remaining after cleaning shall be removed. The priming coat shall be applied without delay.

3.12.3 DAMAGED PAINTWORK

Any damaged paintwork shall be made good as follows:

- a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.
- b) A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the original damage.
- c) The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

3.12.4 PAINTING SYSTEMS

The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as stated below, unless otherwise specified elsewhere in this specification.

- a) Surfaces Subject To Weathering
All surfaces shall have a minimum of four coats of paint made up as follows:
Primer coat: 35 micron DFT
Tie coat: 35 micron DFT
Finishing coat (2 Nos.): 35 micron DFT per coat
The total minimum DFT shall be 140 micron.
- b) Surfaces Inside Buildings
All surfaces shall have a minimum of three coats of paint made up as follows:
Primer coat : 35 micron DFT
Tie coat : 35 micron DFT
Finishing coat (2 Nos.) : 25 micron DFT per coat
The total minimum DFT shall be 120 micron.
The type and colour of primer & finish coat shall be selected by the Contractor after approval by the Owner.

For detail painting on building & structural steel elements refer Section-IIG/1 & IIG/2 of this

specification.

3.12.5 COLOUR CO-ORDINATION & FINISH

- 3.12.5.1** Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.
- 3.12.5.2** Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be colour coded for ease of identification.
- 3.12.5.3** All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.
- 3.12.5.4** Final colours and finishes shall be to the Approval of the Engineer.

3.13 NOISE LEVEL REQUIREMENT

The plant will be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

- a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source.
- b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, 'Ambient Air Quality Standards' in respect of noise.
- c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the contractor shall comply with the requirement.

3.14 INSPECTION AND TESTING

3.14.01 Inspection and Tests during Manufacture

- 3.14.02** The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.
- 3.14.03** The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.
- 3.14.04** Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

- 3.14.05** Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results. The Contractor shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Distribution of six (6) copies of Test Certificates for approval will be two(2) copies to owner and four(4) copies to consultant. These four(4) copies will be further distributed by consultant after approval to owner, site and bidder. One copy will be retained with the consultant for record purpose. Further, nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. Distribution of nine (9) copies of Shop Test Certificates for approval will be Two (2) copies to owner, Three (3) copies to site, Two (2) copies to consultant, Two (2) copies to owner's library /record.
- 3.14.06** Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.
- 3.14.07** All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.
Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Contractor shall allow for trial assembly prior to dispatch from place of manufacture.
- 3.14.08** All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser as per Owner's approved QAP. The certificates shall include tests for mechanical properties and chemical analysis of representative material.
- 3.14.09** All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.
- 3.14.10** All necessary non-destructive examinations shall be performed to meet the applicable code requirements.
- 3.14.11** All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME

Boiler and

Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/recommended by the applicable code. At least 10% of all major butt welding joints shall be radio graphed.

- 3.14.12** Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR jurisdiction) shall also be made by the Bidder. In such case Contractor's scope shall also be extended to preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.

3.15 PERFORMANCE TESTS AT SITE

- 3.15.01** The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Contractor on site under normal operating conditions. The Contractor shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.
- 3.15.02** The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.
- 3.15.03** The Contractor shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre commissioning to tests on completion and commissioning of the complete system/equipment.
- 3.15.04** For details of specific tests required on individual equipment refers to respective section of this specification

3.16 PACKING FOR SHIPMENT

- 3.16.01** The equipment complete with its accessories, spares, special tools and tackles shall be suitably protected by respective packing for shipment considering handling during transit, distance and weather conditions involved. The Contractor shall submit the packaging method for shipment to be adopted by him, if so desired by the Owner / Purchaser.
- 3.16.02** Each consignment shall be marked with Equipment name, Owner /Purchaser's name & address, Project details, handling instruction etc. It shall be complete with part list and identification details. The copies of the part list of each consignment shall also be furnished to the Owner / Purchaser after dispatch.

- 3.16.03** Equipment shall be packaged for transportation so as to meet the space and weight limitation of transport facilities. The contractor shall obtain approval from concerned authorities for transportation of over dimensioned consignment/package, if any, before starting manufacture of such equipment.

3.17 TYPE & RATING OF EQUIPMENT

- 3.17.01** The number of types and sizes of motor, controls, and other electrical equipment shall be kept to a minimum so that the requirement of spares is minimized.
- 3.17.02** Equipment shall be rated for the load and duty cycle of the intended service Circuit breakers and fuses shall be rated to withstand and interrupt the maximum fault current at the point of application in the circuit.

3.18 TROPICAL PROTECTION

- 3.19.01** All electrical equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.
- 3.19.02** Fine mesh screen of corrosion resistant material shall be furnished on all ventilating openings to prevent entry of insects.

3.20 ELECTRICAL SWITCH BOARDS

3.20.01 GENERAL

Switchboards shall be dead-front, free-standing, vertical, cubicle/panel type, completely wired, having access doors with concealed hinges and locking type latches.

- 3.20.02** Panels shall be fabricated from minimum 1.6mm thick for non-load bearing members & 2 mm thick for load bearing members, CRCA (cold rolled continuously annealed) sheet steel, free from any surface imperfections and suitably reinforced to provide a sturdy and rigid assembly. Load bearing wall/covers/back covers shall be 2 mm thick and for non-load bearing the wall/cover/back cover shall be 1.6 mm thick.
- 3.20.03** Panels shall be adequately sized for installation of field cables and access for maintenance. The working zone shall be limited between 300 mm and 1800mm from floor level.
- 3.20.04** Each panel shall be provided with internal illumination lamp operated by door switch, thermostat controlled space heater with miniature circuit breaker (MCB) unit, and plug socket with MCB for hand lamp.
- 3.20.05** Removable eye bolt/lifting lugs shall be furnished on all panels.
- 3.20.06** Unless otherwise stated, equipment rating and module sizes shall be as per annexure B. Module selection chart is specified for guidance of bidder in respect to requirement of module space and

component ratings.

3.21 EQUIPMENT MOUNTING

- 3.21.01** All instruments, switches etc. mounted on the front face of the panels shall be of flush type.
- 3.21.02** All equipment shall be so mounted that removal and replacement may be accomplished individually without interruption of service to others.
- 3.21.03** All equipment inside the panel shall be so located that their terminals and adjustments are readily accessible for inspection and maintenance. Adequate ventilation shall be provided in enclosed panel.
- 3.21.04** At least 20% with a minimum of one spare feeders of each type & rating shall be provided in MCC/Switch Board.

3.22 PANEL WIRING

- 3.22.01** All panels shall be fully wired at the factory to ensure proper functioning of all control, protection and interlock schemes. All wiring for external connections shall be brought to terminal blocks and numbered.
- 3.22.02** Panel wiring shall be carried out with flexible, 1100 grade, heat as well as fire resistance type PVC insulated stranded copper wire of minimum 2.5 Sq.mm(7/0.67mm) cross section.
- 3.22.03** Solder less compression/clamp type connection shall be used for wire terminals. Wiring shall be continuous between terminals without splicing. Each wire shall be identified at both ends with permanent markers having wire numbers as per approved wiring drawings.
- 3.22.04** All spare contacts of relays, aux. relays, contactors, aux. contactors, switches, push buttons etc. shall be terminated up-to external terminal block.
- 3.22.05** Terminal blocks shall be Box clamp type with marking strip. Not more than two wires shall be connected to one terminal. Spare terminal equal in number to 20% of active terminals shall be furnished.

3.23 GROUNDING

A copper ground bus for HT Switchgear and GI ground bus for LT boards, sized to carry maximum short circuit current, shall run along the entire length of panel structure and shall have terminal connector at each end for connection to station ground grid. Minimum size of ground bus shall be 75 X 10 sq. mm.

3.24 PAINTING

All metal surface shall be cleaned, phosphated and given two coats of rust-resistant primer followed by two coats of epoxy based finish paint. The shades for different equipment shall be as follows:

- a) For switchgears, MCCs, Distribution boards and other panels-Light Grey RAL 7032.
- b) For transformer –Battle ship Grey shade 632 of IS-5.
- c) For motors-Battle ship grey shade 632 of IS-5
- d) For generator isolated phase Bus duct enclosure –Inside shall be Matt Black & outside will be light grey shade RAL 7032 for indoor part and battle ship gray shade 632 of IS-5 for outdoor. All supporting steel structures shall be galvanised.HT and LT Bus duct shall be same as generator Bus duct.

3.25 NAME PLATE

Name plate of approved design shall be furnished on each panel and for each instrument or device mounted on panel. The material for name plate shall be 3 mm thick lamicoid or approved equal, with white letters on black background.

3.26 TESTS

Each panel shall be completely assembled, wired, adjusted and tested at the factory prior to shipment. The test shall include wiring continuity tests, insulation tests and functional tests to ensure satisfactory operation and control of individual equipment.

3.27 SPECIAL CABLES

Special cables for specific purpose, as required, shall be supplied and installed by the EPC Contractor.

3.28 CONDUITS

- 3.28.01** Conduits shall be of heavy gauge rigid steel, hot-dip galvanized, cut square, reamed, threaded and screwed tight at all joints.
- 3.28.02** Conduit entrances to pull boxes and switches shall have double lock nuts &insulating bushings. No running thread shall be used.
- 3.28.03** Flexible metallic conduit shall be used for connection to equipment, which are subject to vibration, and also for connection to level/limit/pressure switches.
- 3.28.04** HDPE PVC pipes shall be used for single core power cables.

3.29 SPECIFIC REQUIREMENT - SERVICES (DESIGN & INSTALLATION)

- 3.29.01** Methods and Workmanship
- 3.29.02** All equipment shall be installed in a first class, neat workmanlike manner by mechanics/electricians skilled in the trade involved.
- 3.29.03** The erection work shall be supervised by competent supervisors holding relevant supervisory license

from the Government.

3.29.04 All details on installation shall be electrically and mechanically correct.

3.29.05 The installation shall be carried out in such a manner as to preserve access to other equipment installed.

3.30 PROTECTION OF WORK

3.30.01 For protection of this work, the Contractor shall provide fencing and lighting arrangement, connect space heaters and provide heating arrangement as necessary or as directed by the Owner/Consultant.

3.31 ANNEXURE-B: MODULE SELECTION

MOTOR FEEDER

Type Motor Rating MCCB Rating Contactor Cable size

AU/AR 0 - 5.5 KW 32A 16A 3/c – 2.5 Sq.mm - Cu

BU/BR 5.6 - 11 KW 63A 32A 3/c - 16 Sq.mm - Al

CU 11.1 - 22 KW 63A 63A 3/c - 35 Sq.mm - Al

DU 22.1 - 50 KW 100A 100A 3/c - 95 Sq.mm - Al

EU 50.1 - 75 KW 200A 160A 3/c - 185 Sq.mm - Al

FU 75.1 - 110 KW 400A 300A 2 x 3/c - 185 Sq.mm - Al

NOTE :

1. MCCB with short circuit release, thermal overload relay with SPP feature, Contractor are to be co-ordinate (Type-2) with motor rating by the Contractor.

2. “U” stands for Undirectional and “R” for Reversible drives.

OUTGOING FEEDER

Type MCCB Rating Cable Size

AF 32A 4/c – 16 Sq.mm - Cu

BF 63A 4/c – 35 Sq.mm - Al

CF 100A 3.1/2 – 95 Sq.mm - Al

DF 200A 3.1/2 – 300 Sq.mm - Al

EF 400A 4 x 1/c – 630 Sq.mm - Al

Note: Cable sizes as indicated above are indicative. However EPC contractor shall submit the sizing calculation of cable and select the cable accordingly.

3.32 ANNEXURE-C: TECHNICAL PARAMETERS FOR ELECTRICAL SYSTEM

L.V. SYSTEM DATA

1	Nominal 3 phase voltage to be selected for L.V. system	415 V
2	Type of Breaker to be selected	Air break
3	Type of outgoing feeder switching device in L.T. MCC	MCCB

4	M.C.C. type	Single front/Double front Fully draw out type
5	Short circuit level for 1 sec	50 KA

DC. SYSTEM DATA

1	Nominal voltage to be selected for DC system	220 V
2	Type of Incoming / outgoing feeder switching device	Double pole Switch-Fuse
3	DCDB type	Single front/Double front Fully draw out type
4	Short circuit level for 1 sec	To be decided by Bidder 25 KA (minimum)

UPS SYSTEM DATA

1	Nominal voltage to be selected for UPS system	240 V, 1-Ph, 50 Hz, AC
2	Type of Incoming / outgoing feeder switching device	MCCB
3	UPSDB type	Single front, Fixed type, Modular construction
4	Short circuit level for 1 sec	To be decided by bidder 25 KA (minimum)

3.33 CODES AND STANDARDS

All materials and equipment shall generally comply in all respect with the latest edition of relevant international electro-technical commission (IEC) or any other internationally accepted standard which ensure equal or better quality or relevant Indian standard(IS) mentioned against each equipment and this specification.

3.34 MATERIAL/WORKMANSHIP

3.34.01 General Requirement

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment it is understood that the same must be new, of highest grade of the best quality of their kind conforming to best engineering practice and suitable for the purpose for which they are intended.

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

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made

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

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor shall apply all operational lubricants to the equipment installed by him. All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

3.34.02 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

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

3.34.02 COLOUR SCHEME AND CODES FOR PIPE SERVICE

All steel structures, plates etc shall be painted with non-corrosive paint on a suitable primer. It may be noted that normally all electrical equipment in switchyard are painted with shade 631 of IS-5. All The indoor cubicles shall be of same colour scheme and for other miscellaneous items, colour scheme will be approved by the purchaser.

3.34.03 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other

damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.34.04 FUNGISTATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.

3.34.05 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or other wise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external painting shall be as per shade no. 631 of IS:5.

3.34.06 GALVANIZING

All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support channels, structures, shall be hot dip galvanised conforming to latest version of IS:2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvanized. Minimum weight of zinc coating shall be 610 gm/sq.mm and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM.

3.34.07 PACKING

The following details are to be clearly indicated in the material forwarding documents:

- a) Name and address of the consignee.
- b) Purchase order number.
- c) Name of supplier/s.
- d) Description of equipment / material.
- e) Net weight.
- f) Gross weight.

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the purchaser, the Contractor shall also submit packing details/associated drawing for any equipment material under his scope of supply, to facilitate the purchaser to repack any equipment/ material at a later date, in case the need arises. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost. The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbol i.e. fragile, handle with care, use no Hooks etc.

3.34.08 HANDLING, STORING AND INSTALLATION

Contractor may engage manufacturer's Engineers to supervise if required for unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

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.

Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. Any demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. The Contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure

satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

3.34.09 DEGREE OF PROTECTION

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

- a) Installed out door: IP-55
- b) Installed indoor in air conditioned area: IP-31
- c) Installed in covered area IP:52
- d) Installed indoor-in non air-conditioned area where possibilities of entry of water is limited:IP-41
- e) For LT switchgear (AC & DC distribution Boards): IP-54

The degree of protection shall be in accordance with IS:13947, (Part-1)/IEC-947(Part-1). Type test report/or degree of protection test on each type of the box shall be submitted for approval.

3.34.10 RATING PLATES, NAME PLATES AND LABELS

Type or serial number together with details of the loading conditions under which the item of the substation in question has designed to operate and such diagram plates as may required by the Purchaser. The rating plate of each equipment shall be according to IEC requirements.

All such nameplate instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternately two separate plates one with Hindi and other with English inscriptions may be provided.

3.34.11 EARTHING

Circuit breakers, LA, Isolator, CVT , CT , BPI shall be provided with two grounding pads suitable for connection to galvanized steel flat. Control panels, Relay panel, outdoor marshalling boxes, Junction boxes, Lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

3.34.12 TERMINAL BLOCKS AND WIRING

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

Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece complete with insulated barriers stud type terminals, washers nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type equivalent to Elmex type CATM4, Phoenix cage clamp type of Wedge or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

Terminal block for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

The terminal shall be that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable. 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 fully enclosed with removable covers of transparent, non deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

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

All circuits except CT circuits :	Minimum of 2 nos. of 2.5 sq.mm, copper flexible.
All CT circuits :	Minimum of 4 nos. of 2.5 sq.mm, copper flexible..

The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live. At least 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

There shall be a minimum clearance of 250mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm. The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connection (where applicable) as well as between phases and common terminal

boxes or control cabinets.

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

3.34.13 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable and the clause given below.

Control cabinet, Junction boxes, Marshalling boxes & Terminal boxes shall be made of sheet steel or aluminium and shall be dust, water and vermin proof. Sheet used shall be least 2.0 mm cold rolled or 2.5mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminium enclosed box the thickness of aluminium shall be such that it provides adequate rigidity and long life as comparable with sheet of specified thickness. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

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

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

All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting atleast 150 mm above from the base of the Marshalling Kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland. The gland shall project atleast 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required

3.34.14 SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater.

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

The heaters shall be suitably designed to prevent any contact between the heater wire and air and shall consist of coiled resistance wire centered in metal sheath and completely encased in a highly compacted powder of Magnesium Oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of a resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and air. Alternatively, they shall consist of resistance wire mounted into a tubular ceramic body built into an envelop of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in glaze the surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments

3.35 DOCUMENTATION

3.35.01 LIST OF DOCUMENTS

The bidder shall submit a detailed list of drawings / documents along with the bid proposal which he intends to submit to the Employer after award of the contract.

The supplier shall necessarily submit all the drawings / documents unless any thing is waived.

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 this specification shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

3.35.02 DRAWINGS

All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearances and spaces required for installation and interconnection between various portions of equipments and any other information specifically requested in the specifications.

Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer,

name of consultant, the unit designation, GSECL contract no. , and the name of the Project .If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

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.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

3.35.03 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Employer would be discussed and finalized at the time of award. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer. The following schedule shall be followed generally for approval.

i.	Approval/comments/by employer on Initial submission	Within 2 weeks of receipt
ii.	Resubmission	Within 2 (two) weeks (whenever from date of comments required) Including both ways postal time.
iii.	Approval or comments	Within 2 weeks of receipt of resubmission
iv.	Furnishing of distribution copies	2 weeks from the date of last approval.

Note: The contractor may please note that all resubmissions must incorporate, all comments given in the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

The title block of drawings shall contain the following information incorporated in all contract drawings.

Customer: Gujarat State Electricity Corporation Ltd.

Consultant: Development Consultants Pvt. Ltd., Kolkata

Project: 400kV Switchyard (extn.) & 400kV GIS for 1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

NOA NO.

3.35.04 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

- 1) Drawings
- 2) Guaranteed Technical Particulars
- 3) Type Test Reports
- 4) Manufacturing Quality Plan

3.35.05 DOCUMENTATION SCHEDULE

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
				Prints	CDs
1	Drawings and Data Sheets	1	10	13	-
2	Drawings "As Built "	-	-	13	05
3	Type Test Reports	1	05	13	-
4	Erection Manuals	-	11	13	-
5	Operation and Maintenance Manuals	-	11	13	-
6	Manufacturing Quality Plan	1	11	13	-
7	Field Quality Plan	1	11	13	-
8	Inspection Test Reports	-	-	13	-

Drawings will also be submitted in mini cartridges in AUTOCAD Release -2008 package or any other CAD package along with conversion files for all major items.

Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top.

3.35.06 AS-BUILT DRAWINGS

The Contractor shall furnish drawings and document in as-built condition as stipulated in the specification.

On completion of the project, contractor should submit Three Sets of As commissioned drawings, Three Sets of as Installed Bill of Materials and Three Sets of As Commissioned Data/

Specification /Parameter Sheets Duly Signed by the Competent Authority.

3.35.07 DRAWINGS, DATA, INFORMATION AND MANUALS

3.35.08 Drawings, data, information & manuals shall be submitted as indicated below:

3.35.09 To be submitted after award of the Contract.

- a) Single line diagram giving rating of each equipment.
- b) Design calculations in support of selection of equipment rating and system design.
- c) Technical Data sheets, characteristic curves.
- d) Equipment layouts, layout of switchyard with sections.
- e) Grounding & lightning protection drawings and details.
- f) Cabling, cable trench and tray layouts with section and details with cable sizing calculation.
- g) Dimensional general arrangement drawing along with cross- sections for equipment.
- h) Foundation plan and loading data : design calculation and detail drawing of foundation.
- i) Design calculation and detail drawing for civil work related to this specification.
- j) Design calculation, GA drawing for GI structure and equipment supporting structure, and subsequently detailed drawings.
- k) Mounting details of equipment and structure.
- l) Fire fighting and sump arrangement.
- m) Control & operation write up/Block logic diagrams.
- n) Control schematic and wiring diagram.
- o) Cable schedule and interconnection and cable routing.
- p) Relay co-ordination.
- q) Civil & structural analysis, design calculations and working drawings including bar bending schedule and fabrication.
- r) Erection and maintenance manual.
- s) Any other drawings & data as required for satisfactory installation, operation & maintenance.

3.35.10 OPERATING MANUALS AND MAINTENANCE INSTRUCTIONS

- (i) The Contractor shall provide at least six (6) months before the time of commissioning and before taking over of the plant and equipment, all necessary maintenance manuals and operating instructions. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hardcopies.
- (ii) The information provided, which shall be contained in loose leaf stiff backed covers, shall include :
 - a) A complete inventory of all main items of plant, with identification details.
 - b) Service manuals for all plant and equipment giving full descriptions of the main items and auxiliary items such as power packs, hydraulic equipment, actuators, lubricating pumps, etc.
 - c) A separate electrical manual covering items such as switchgear, cabling, instrumentation, controls, cabling layouts and wiring diagrams.

d) A schedule of recommendations for routine maintenance of all electrical and mechanical equipment, recommended inspection point, information on detection, cause and rectifications of troubles & faults.

e) A lubrication schedule with all necessary drawings diagrams to identify the lubrication points.

f) Manufacturer's literature.

(iii) The instruction manual shall be subject to the approval of Owner.

3.35.11 PLANT HANDBOOK

The Contractor shall submit to the Engineer, a preliminary plant handbook preferably in A-4 size sheets which shall contain the design and performance data of various plant, equipment and systems covering the complete project including single line flow diagrams, within twenty four (24) months from the date of his acceptance of the letter of award. The final plant handbook complete in all respects shall be submitted by the Contractor six (6) months before start-up and commissioning activities. The plant handbook shall be submitted in the form of two (2) soft copy in CD (one to Owner and one to Consultant) and twenty five (25) hard copies in decent bound forms.

3.35.12 CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVALPROCEDURE

(i) Within fifteen (15) days of issue of Letter of Award (LOA) by the Owner, the Contractor shall furnish a schedule of drawings and design document to be submitted by him to the Owner/Engineer indicating dates against each document. The documents shall be divided into two categories:

a) for approval and

b)for information/further engineering and co-ordination by the Owner.

In preparing this schedule, the Contractor shall allow four (4) weeks from date of receipt for review and comments by the Owner/Engineer for each submission of a document.

This document submission schedule shall require approval by the Owner/Engineer.

(ii) All contract documents shall be marked, without fail, with the name of the Owner, the Project, the specification title and number and the unit designation. All dimensions shall be in metric units. All notes, markings etc. shall be in English.

(iii) Documents/Drawings, submitted during tender stage, shall be revalidated or revised as required and submitted as certified contract document for approval/ information of the Owner/Engineer.

(iv) Unless specified otherwise, the following categories of documents/drawings would require approval of the Owner/Engineer:

a) List of sub-vendors (from Owner only)

- b) System scheme and instrumentation diagrams
 - c) Design basis justifying selection of equipment & process parameters where not specified in the Contract
 - d) Equipment data sheets and general arrangement drawings
 - e) Materials of construction
 - f) Layout drawings.
 - g) Operation logic diagrams.
 - h) Typical control circuit.
 - i) Drawings of Instrumentation and control.
- (v) Unless specified otherwise, the following categories of documents/ drawings would be treated for information/further engineering by the Owner/Engineer. The Contractor shall, however, incorporate all additional information and clarifications in these documents / drawings as and when desired by the Owner/Engineer.
- a) Equipment foundation drawings.
 - b) Equipment cross-section drawings, product literature etc. which are of proprietary nature.
 - c) Predicted performance curves of equipment.
 - d) Various bills of quantity, schedules etc.
 - e) Piping fabrication drawings, isometrics etc.
 - f) Panel wiring diagrams.
 - g) Instruction/Operation manuals.
 - h) Service manuals and trouble shooting guide for C & I system including field instruments.
 - i) Cable schedule and interconnection chart.
 - j) Drive/feeder wise control scheme showing all external interfaces.

In essence, the Contractor is solely responsible for corrections and adequacy of design & engineering for documents under this category.

- (vi) Upon review, the Owner/Engineer shall put his remarks and one of the following action stamps on the drawing/document:

- a) Approved.
- b) Approved except as noted, forward final drawing
- c) Approved except as noted, resubmission required.
- d) Disapproved.
- e) For information/reference only.

For action stamps in category (c) & (d), documents must be resubmitted for review by the Owner/Engineer. For action stamp in category (b), further review by Owner/Engineer would not be necessary provided the Contractor agrees & incorporates the comments made on the document. Except for action stamp under category (c) & (d), the Contractor can proceed with manufacturing and other sequential activities for those areas of a drawing/document which do not have any review comment by the Owner/Engineer.

The Owner/Engineer may accord approval in category (c) or (d) in more than one submission of a document till he is satisfied that the intent of the specification has been fully complied with. The Contractor shall be responsible for delay in such cases and no extension of time shall ordinarily be allowed on such grounds. Approval of contract documents by the Owner/Engineer shall not relieve the Contractor of his responsibility for any errors and fulfillment of contract requirements. The Contractor's work shall be in strict accordance with the finally approved drawings and no deviation shall be permitted without written approval of the Owner/Engineer.

- (vii) Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.
- (viii) For review by the Consulting Engineer, the Contractor shall furnish softcopies of drawings & documents and three (3) prints of each drawing/document. Two (2) prints of such submission shall also be sent to the Owner. After review, comment/approval will be sent to the Contractor. Upon action under category (a) or (e), the Contractor shall directly distribute the documents to the various offices of the Owner and other agencies in number of copies as specified in the contract document. Such distribution copies shall be marked with the reference and date of the letter by which the Owner/Engineer has accorded his final approval. Penal action shall be taken against the Contractor for any unauthorized revision in the drawings so distributed from the drawings approved by the Owner/Engineer. The contractor shall furnish three (3) CDs of all as built/final drawings for Owner/Consultant site.
- (ix) In case of contradiction between the stipulations above and those stated elsewhere in the specification, the stipulations herein shall prevail.
- (x) For details of documentation for Civil, Structural and Architectural works, Vol.II-G may be referred.

3.36 QUALITY ASSURANCE

- 3.36.01** The Contractor shall follow his standard procedures for quality assurance and control. A copy of the said standard procedures shall be submitted to the Owner / Purchaser for his reference. However, Owner / Purchaser reserves the right to review the same and give his observations, if any, for compliance.
- 3.36.02** The procedures shall be in such a form as to clearly delineate the manufacturing sequence, inspection points, tests and test procedures, acceptable ranges / values, reference drawings etc.
- 3.36.03** The Owner / Purchaser shall inform the Contractor as to which of the inspection points and tests shall be witnessed. As a minimum, inspection and testing of the finished equipment shall be made prior to shipment, unless specifically waived by the Owner / Purchaser. The contractor shall give at least fifteen (15) days advance notice regarding readiness of the equipment.
- 3.36.04** Manufacturing and quality control procedures shall be available for audit to the Owner / Purchaser and/or its representative at the place of manufacture.
- 3.36.05** The Owner / Purchaser reserves the right to inspect the equipment at the point of manufacture and witness factory and other such tests as may be necessary to ensure conformance to the specification.
- 3.36.06** The Owner / Purchaser may inspect the Contractor's facilities prior to award of contract.
- 3.36.07** The Owner / Purchaser may witness any or all of the tests stipulated in the relevant standards and this specification.
- 3.36.08** The Owner / Purchaser may conduct surveillance of the Contractor's facilities for compliance to his standard procedures of Quality Assurance and Quality Control while work on the specified equipment is in progress.

3.36.01 QUALITY ASSURANCE REQUIREMENTS

1.00.00 QUALITY ASSURANCE PROGRAMME

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

- a) His organization structure for the management and implementation of the proposed quality assurance programme.
- b) Documentation control system.

- c) Qualification data for Bidder's key personnel.
- d) The procedure for purchase of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
- f) Control of non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and all site related works.
- h) Control of calibration and testing of measuring and testing equipments.
- i) System for quality audit.
- j) System for indication and appraisal of inspection status.
- k) System for authorizing release of manufactured product to the Owner.
- l) System for handling storage and delivery.
- m) System for maintenance of records.
- n) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed at Annexure-I to this section.

2.00.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE

- 2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Contractor for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Contractor's responsibility to draw up and implement such programme duly approved by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Authorized representative for approval. Schedule of finalization of such quality plans will be finalized before award.
- 2.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's Quality Control organization, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final

testing/performance testing.

- 2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control organization, during various stages of site activities from receipt of materials/equipment at site.
- 2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, Owner/Authorized representative shall identify customer hold points (CHP), test/checks which shall be carried out in presence of the Owners Engineer or his authorized representative and beyond which the work will not proceed without consent of Owner/Authorized representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorized representative for approval and dispositioning.
- 2.05.00 No material shall be dispatched from the manufacturer's works before the same is accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by Owner's Engineer/Authorized representative, and duly authorized for dispatch issuance of Material Dispatch Clearance Certificate (MDCC).
- 2.06.00 Materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report as per Owner's approved QAP. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.
- 2.07.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.
- 2.08.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the Owner.

All brazers, welders etc. employed on any part of the contract at Contractor's/Sub-Contractor's works or at site shall be qualified as per ASME Section-IX or BS-4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorized representative.

For welding of pressure parts and high pressure piping the requirements of IBR shall also be complied with.

- 2.09.00 All non-destructive examination (NDT) shall be carried out in accordance with approved international standard. The NDT operator shall be qualified as per SNT-TC-1A (of American Society of non-destructive examination). Results of NDT shall be properly recorded and submitted for

approval.

2.10.00 All the sub-vendors proposed by the Contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Contractor and finalized with the Owner shall be subject to Owner's approval. Quality Plans of the successful vendors shall be discussed, finalized and approved by the Owner/Authorized representative and form part of the Purchase Order between the Contractor and the Vendor.

2.11.00 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Contractor and finalized with the Owner shall be furnished to the Owner for comments and subsequent approval before orders are placed. Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-vendor's quality management and control activities. The Contractor shall provide all necessary assistance to enable the Owner carry out such audit and surveillance. Quality audit/approval of the results of tests and inspection will not prejudice the right of the Owner to reject an equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Contractor in earning satisfactory performance of equipment as per specification.

2.12.00 Quality requirements for main equipment shall equally apply for spares and replacement items.

2.13.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the approval of the Owner.

2.14.00 For quality assurance of all civil works refer to the specifications for civil works.

3.00.00 QUALITY ASSURANCE DOCUMENTS

3.01.00 The Contractor shall be required to submit two (2) copies and two (2) sets of microfilms of the following Quality Assurance documents within three (3) weeks after dispatch of the equipment:

- a) Material mill test reports on components as specified by the specification.
- b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
- c) Non-destructive examination results /reports including radiography interpretation reports.
- d) Factory tests results for testing required as per applicable codes and standards referred in the specification.
- e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.
- f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

g) Stress relief time temperature charts.

h) Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following will also be recorded :

i) When some important repair work is involved to make the job acceptable.

ii) The repair work remains part of the accepted product quality.

i) Letter of conformity certifying that the requirement is in compliance with finalized specification requirements.

4.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

4.01.00 The Engineer, his duly authorized representative and/or an outside inspection agency acting on behalf of the Owner shall have access 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 on other premises or works, the Contractor shall obtain for the Engineer and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

4.02.00 The Contractor shall give the Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Engineer/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection failing which the Contractor may proceed with test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of test reports in six (6) copies.

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

4.04.00 When the factory tests have been completed at the Contractor's or sub-contractor's works, the Engineer/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Engineer/Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Engineer/Inspector. Failure of the Engineer/Inspector to issue such certificate shall not prevent the Contractor from proceeding with the works.

The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.

- 4.05.00 In all cases where the contract provides for tests whether at the premises or works of the Contractor or 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 maybe reasonably demanded by the Engineer/Inspector or his authorized representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Engineer/Inspector or to his authorized representative to accomplish testing.
- 4.06.00 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 4.02.00, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

REQUIREMENTS OF SPARES, TOOLS & TACKLE, LUBRICANTS/OIL/CONSUMABLES

1.00.00 TOOLS & TACKLE

The Contractor shall supply with the equipment one complete set of special tools and tackles required for the erection, assembly, dis-assembly & maintenance of the equipment. These special tools will also include special material handling equipment, jigs & fixtures for maintenance and calibration/re-adjustment, checking & measurement aids etc. A list of such tools & tackles shall be submitted by the Bidder along with the offer. Detailed description of each tool/tackles, its function along with the equipment/part for which it is meant for and the price of each tool/tackles shall also be indicated in the offer. These tools & tackles shall be separately packed and sent to site before the first unit commissioning. The Bidder shall also ensure that these tools are not used for erection purpose.

2.00.00 SPARES

2.01.00 General

The Bidder shall indicate and include in his scope of supply all the necessary start-up, commissioning and recommended spares in addition to mandatory spares as specified elsewhere in the specification. The Owner reserves the right to buy any or all mandatory and recommended spares. The Contractor shall also state for each item of spares both mandatory and recommended, the normal expected service life.

- 2.01.01 All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended to replace. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site, e.g. small items shall be packed in sealed transparent plastic bags with desiccator's packs as necessary.
- 2.01.02 Each spare part shall be clearly marked or labeled on the outside of the packing with the description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside and a detailed list enclosed. All cases, containers and other packages must be

suitably marked and numbered for the purposes of identification.

2.01.03 All cases, containers or other packages are liable to be opened for examinations may be considered necessary by the Engineer.

2.01.04 All mandatory spares shall be delivered to site within one to three months prior to the scheduled date of the trial operation of the plant. However, they shall not be dispatched before the dispatch of the associated main equipment.

2.01.05 The Bidder shall also guarantee supply of spare parts, which will be made, based on manufacturer's drawings on special order from the Purchaser for 30years after commissioning of the plant.

2.01.06 Warranty period for all kinds of spares shall be six thousand (6000) hours of operation, except normal wear or eighteen (18) months from the date of receipt at site, whichever is later. In case of failure or non-conformance to specifications, the Contractor shall replace them free of cost.

2.02.00 Recommended Spares

2.02.01 The Contractor shall provide a list of recommended spares giving unit prices and total prices for 2 years of normal operation of the plant for spares of indigenous origin, and for 5 years of normal operation for spares of non-indigenous origin. This list shall take into consideration the mandatory spares specified elsewhere in the specification and should be a separate list.

2.02.02 The price of recommended spares will not be used for the evaluation of bids. The price of these spares shall remain valid for a period as specified elsewhere in the specification from the date of Award of the Contract. Where the recommended spares are the same as mandatory spares, the prices shall be the same. The prices of any recommended spares, which are not common with mandatory spares, shall be subject to review by the Owner, and shall be finalized after mutual discussion.

2.03.00 Start-up Commissioning Spares

2.03.01 Start-up commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used until the plant is handed over to the Owner shall come under this category. Said spares, properly marked, shall be supplied together with the main equipment and shall be used by the Contractor, if needed, during erection & commissioning stage. All such spares which remain unused till issuance of Taking Over Certificate by the Owner, along with an equipment-wise quantitative consumption report shall be returned to the Owner during time of handover. The list of commissioning spares to be brought by the Contractor to ensure smooth commissioning of the plant shall be subject to the Engineer's approval.

2.03.02 The Contractor shall submit a complete list of all such start-up spares. Costs of the above spares, which are consumed before the handing-over of the plant, shall be deemed to have been included in the lump sum proposal price of the package, and the Contractor shall have no claim on this account to the Owner.

2.04.00 Mandatory Spare Parts

- 2.04.01 The Owner considers some of the spares are essential for running the equipment irrespective of whether they are included in the list of recommended spares by the Bidder as mentioned above. Since the components involved can not be foreseen at the bidding stage, only broad requirements of the Owner in this respect are outlined hereinafter. The bidder shall include his proposal, on the basis of this guideline, an item-wise list of all components and the quantity, unit prices & total price thereof, offered as mandatory spares for each and every equipment. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage.
- 2.04.02 Since the components involved can not be foreseen at the bidding stage, only broad requirements of the Owner in this respect are outlined hereinafter. The Bidder shall include in his proposal, on the basis of these guidelines, an item wise list of all components and the quantity, unit prices & total price thereof, offered as mandatory spares for each and every equipment. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage.
- 2.04.03 The mandatory spares should be supplied to the Owner at least one month before the trial run. The dispatch programme is subject to approval of the Owner/Consultant after award of contract.

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 arrester 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 arrester 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 circuit with a pair to PLC terminals connected back (without Companders & limiters) when voice frequency input level changes from 10 to 0 dBm
25. Psophometric Noise contribution of a pair of PLC terminals connected back to back
26. Noise frequency Band width
27. Group delay distortion in the frequency band relevant to the transmission of protection signals.
28. Signal Delay with Two PLC Terminals connected back to back
29. Power supply requirements:
 - (a) Voltage
 - (b) Permissible voltage variation
 - (c) Maximum current
30. Installation details
31. Meters provided on Test Panel, their range and purpose.
32. Is the equipment suitable to work in Dust laden atmosphere without air conditioning?
33. Whether interior lamps with door switch is provided in cabinets
34. Over all dimensions

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

- 35. Weight
- 36. Insulation level
- 37. Cabinet earthing details
- 38. Whether indication is available in sending end panel for receipt/execution of trip signal/command at remote end.
- 39. Whether Tx/Rx loop-back facility is available for testing locally

- 40. Whether site tunable

**VF TRANSMISSION TERMINAL FOR NETWORK PROTECTION SIGNALS
(PROTECTION COUPLER)**

- 1. Name of Manufacturer and Country
- 2. Type, Model and Catalogue Number
- 3. Whether equipment works on frequency shift principle of coded signal principle
- 4. Whether Equipment is suitable for Independently Protecting Two Circuits
- 5. Frequencies used in the equipment for transmission of signal for coded Signal transmission
 - (a) Guard frequency
 - (b) Working frequency (Trip System - I)
 - (c) Working frequency (Trip System - II)
 - (d) Working frequency (Trip System I&II)
- 6. Criteria used for command Transmission

7. Whether equipment is protected against Tripping by Spurious Signals.
8. Transmission time corresponding to telegraph speed for transmission on PLCC channel of coded signal
 - (a) 600 Bds.
 - (b) 400 Bds.
 - (c) 200 Bds.
9. Whether in the presence of spurious signals as well as Protection Signals simultaneously, the equipment will initiate a Trip Command.
10. Mode of Transmission of guard signal
11. Whether equipment is suitable for Direct Circuit Breaker tripping.
12. Maximum number of Noises Impulses pps in Presence of which the equipment will satisfactorily perform its duty.
13. Signal Delay with Two Terminals connected back to back
14. Whether the Command Signal is acknowledged at receiving end and in the event of non-receipt of the correct signal, the command is repeated or not by the transmitter?
15. Whether it is possible to alter the priority of commands of various codes at site.
16. What are the performance based results under severe line noise conditions for
 - (a) False trip probability
 - (b) Fail to trip probability
17. Transmitter Input Requirements (Contact Ratings)
 - (a) Voltage
 - (b) Current
 - (c) Power

- (d) No. of Contacts
- 18. Receiver Output (Contact Rating)
 - (a) Voltage
 - (b) Current
 - (c) Power
 - (d) No. of Contracts
- 19. Additional facilities provided in Receiver output
- 20. Supervisory and Alarm Contact Facilities
 - (a) Current
 - (b) Voltage
 - (c) No. of contacts
- 21. Installation
- 22. Power Supply
 - (a) Voltage
 - (b) Current
 - (c) Power
- 23. Type and number of counters for recording the number of Trip Commands sent and number of Trip Commands received
- 24. Whether loop test is possible
- 25. Insulation Level
- 26. Whether the equipment is suitable for transmitting and receiving more than two independent commands (please give full details)

EPAX

- 1 Name of manufacuturer
- 2 Type of Model
- 3 Number of subscriber lines
 - (a) Wired for
 - (b) Equipped for
- 4 Number of trunk lines provided
 - (a) Wired for
 - (b) Equipped for

- 5 Whether the facility to bar subscriber's access to the carrier lines is provided during maintenance?
- 6 Whether P.G. lockout facility provided along with alarm?
- 7 Whether alarm type fuse provided for audio and visual indications?

- 8 Whether suitable for satisfactory operation in conjunction with PLCC system

- 9 Signalling Pulse Width

- (a) Engage Pulse
- (B) Priority Pulse
- (C) Digit pulse
- (D) Inter digit pause
- (E) Release Pulse

- 10 Operating voltage

- 11 Power requirement

- 12 Overall dimensions (W x D x H)

- 13 Mounting arrangement

- 14 Weight

- 15 Type of switching

- 16 Whether four-wire interfaces are built-in

- 17 In case four-wire interfaces are built-in maximum number of PLC terminals which can be connected to a single EPAX

- 18 Whether self-diagnostics and monitoring features are built-in

- 19 Whether the following facilities are built-in
 - (a) Priority cutting
 - (b) Conference
 - (c) Alternate routing
 - (d) Call transfer

- 20 Maximum loop resistance permissible
 - (a) For trunk line
 - (b) subscriber lines

- 21 Whether suitable to work in conjunction with electromechanical PAX
- 22 Whether suitable to work with DOT leased lines as per specification

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

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

BHEL ENQUIRY. NO:

BIDDER:OFFER REFERENCE:

I. A) CARRIER EQUIPMENT

S.No.	Parameters	Data	Yes / No	Remarks
1.	Applicable Standard	IEC 60495	Yes	
2.	Type			
3	Type of Modulation	Amplitude Modulation	Yes	
3	Mode of Transmission	Single Side band	Yes	
4	Carrier frequency range	40 - 500 kHz	Yes	
5	Nominal carrier frequency band in either direction of transmission	4 kHz	Yes	
6	Return Loss within the nominal carrier frequency band	10 dB min	Yes	
7	Return Loss within the effectively transmitted voice frequency band	Not more than 14 dB	Yes	
8	Frequency difference between the V.F. input and V.F. output of a pair of terminals connected back to back for permissible ambient temperature and supply voltage variation	Will not exceed 2 Hz	Yes	
9	Power Output at HF terminal	20W/40 W / 80W 100W	Yes	
10	Nominal carrier frequency power (peak envelope power) at output terminal	40 watt / 80W	Yes	
11	H.F. Impedance at output of carrier terminals	75 ohms (unbalanced) or 150 ohms (balanced)	Yes	
12	Stability of carrier frequency	< ± 10 Hz	Yes	
13	Whether compander is provided	Provided		
14	Compression and expansion ratio of compander	At least 2:1 compression ratio with a corresponding expansion ratio of 1:2.	Yes	
15	Improvement in S/N due to compander	15 dB	Yes	
16	Whether carrier is suppressed during transmission of signal	Yes	Yes	
17	Whether frequency locking between Tx/Rx provided	Yes	Yes	
18	Automatic gain control range and regulation	For 40 dB change in carrier frequency signal level within the regulation range change in VF receive levels of both speech and other	Yes	

		signals shall be less than 1 dB.		
19	Level of spurious emission at			
(a)	Edge of nominal carrier frequency	As per IEC 495	Yes	
(b)	4.0 kHz away from nominal carrier frequency band	As per IEC 495	Yes	
(c)	8.0 kHz away from nominal carrier frequency band	As per IEC 495	Yes	
20	Near and far end cross talk due to telephone signaling channel in a pair of PLC terminals (without companders) connected back to back	Less than or equal to 55 dBmop	Yes	
21	Psophometric noise contribution of a pair of PLC terminals connected back to back	Less than or equal to 55 dBmop	Yes	
22	Group delay distortion in the frequency band relevant to the transmission of protection signals	As per CCITT recommendation G.232	Yes	
23	Performance under noise condition			
(a)	Noise generated within terminal	As per IEC 495	Yes	
(b)	Additional noise introduced when terminals are connected back to back at repeater station	As per IEC 495	Yes	
(c)	Noise bandwidth	As per IEC 495	Yes	
24	Power supply requirements			
(a)	Voltage	48 V DC	Yes	
(b)	Permissible voltage requirement	15 %, - 10% (positive pole earthed)	Yes	
25	Insulation level	2 kV for all AC circuits 500 V DC for all signal points	Yes	
26	All solid state equipment /system panels subjected to heat soaking as per clause 9.16 of Section II		Yes	

II. B) TYPE TESTS

i) Whether type test reports of the following test conducted earlier as per IEC 495 on identical or similar material are available (test reports are of the test conducted not earlier than 5 (FIVE) years prior to the date of inspection).
(YES)

S.No.	TESTS	REPORT NO.	Date	Conducted at accredited laboratory or witnessed by independent authority
1	Voltage Variation			
2	Carrier frequency range & band			
3	Frequency accuracy			
4	Transmit / Receive frequency difference			
5	Automatic gain control			

6.	Harmonic distortion			
7	Selectivity			
8	Output impedance, Return loss & Tapping loss			
9	Return loss, Af inputs/outputs			
10	Balance to ground			
11	Limiter action			
12	Spurious emission			
13	Carrier frequency levels and levels			
14	Attenuation distortion			
15	Noise generated within terminal			
16	Near and far end cross talk			
17	Group delay distortion			
18	Conducted noise			
19	Telephone signaling channel			
20	Speech levels			
21	Voltage withstand test			
22	Insulation test			

ii) If type test reports are not acceptable to BHEL/Customer due to non compliance of technical specification then above tests shall be conducted by the bidder free of cost .

(YES)

III. A) PROTECTION COUPLER

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

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

III. B) TYPE TESTS

III. B.1) PROTECTION COUPLER :

i) Whether type test reports of the following test conducted earlier as per IEC 60834-1 on identical or similar material are available (test reports are of the test conducted not earlier than 5 (FIVE) years prior to the date of inspection). (YES)

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

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

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

i) Whether type test reports of the following test conducted earlier as per IS 8686 on identical or similar material are available (test reports are of the test conducted not earlier than 5 (FIVE) years prior to the date of inspection). **(YES)**

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

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

IV. A) COUPLING DEVICE

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

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

IV. B) TYPE TESTS

i) Whether type test reports of the following test conducted earlier on identical or similar material are available (test reports are of the test conducted not earlier than 5 (FIVE) years prior to the date of inspection). (YES)

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

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

V. A) H.F.CABLE

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

9	Whether suitable to work with DOT leased lines	Yes	Yes	
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V. ADDITIONAL REQUIREMENTS:

1.	The PLCC manufacturer meets the Qualifying requirements specified in Section-I , 1.3 of this Technical Specification.		Yes	
2	Confirmation to type test requirement of Technical specification.		Yes	
3	List of Deviations if any , is attached along with offer		Yes	
4	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	
5	Bidder to submit details of freq. planning done (including computer studies carried out and facilities available) for PLCC links on EHV lines in the past along with this offer		Yes	
6	One copy of computer study result done in past attached along with this offer.		Yes	
7	Following Documents are attached along with the offer :			
	a. Filled Checklist.		Yes	
	b. Filled GTP		Yes	
	c. Drawings & technical Literature		Yes	
8	Construction dwg. of HF cable with Mechanical & Electrical parameters , enclosed with offer		Yes	
9	All terminals for speech shall be with transit band pass filter, tunable at site & wired for addition of VFT's in future		Yes	

Date:
Bidder

Signature of the authorized representative of

Company Seal

PROJECT TITLE BLOCK

CUSTOMER	Gujarat State Electricity Corporation Limited, Vadodara , Gujarat				
CONSULTANT	Development Consultants Pvt. Ltd , Kolkata				
PROJECT	400kV Switchyard and 400kV GIS for 1x800MW for Wanakbori Thermal Power Station Extn. Unit #8				
BHEL P.O. No.		PROJ. DOC. No.		REV. No.	
CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED				
VENDOR'S STANDARD TITLE BLOCK					

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