

ANNEXURE-32

TECHNICAL SPECIFICATION FOR POWER LINE CARRIER COMMUNICATION EQUIPMENTS:-

1.1 **SCOPE**

This specification covers manufacture, assembly and testing at manufacturer's work, stage inspection, testing, packing and delivery of line carrier communication equipments. The specifications covers supply of outdoor as well as indoor equipments required for providing, power line carrier communication between two sub-stations. The scope covers supply of multipurpose carrier cabinet with latest technology suitable for speech, tele-protection, signalling, telemetry, and telex / fax transmission.

1.2 **LIMITS OF CONTRACTS:**

1.3.1 **OUTDOOR EQUIPMENTS:-**

The contractor's scope of supply shall include the outdoor apparatus required for carrier system such as Wave trap, Coupling capacitor, Line matching unit along with protective device (Drainage coil, surge arrestor & earth switch etc).

1.3.2 **INDOOR EQUIPMENTS**

The scope of supply shall also include all the indoor equipments required, viz Carrier panel, Protection couplers, Electronic private automatic exchange and Telephones. HF Coaxial cable interconnecting the outdoor and indoor apparatus shall be included in this section.

1.4 **REQUIREMENTS:-**

The power line carrier communication equipment to be supplied and erected under this contract shall be suitable to provide the following services:-

- a) Speech communication between the stations.
- b) EHV line protection signal transmission/reception through Carrier equipment.
- c) VFT facilities for data communication.

The supplier shall provide Power Line Carrier Cabinet sharp cut-off filter, speech compression & expansion (componder) facility & transit band pass filter. The equipment shall be immune to corona & other noises which are predominantly present in EHV S/Stns. The Carrier cabinet shall work on Amplitude modulation principal however advanced versions working on QAM (Quadrature Amplitude Modulation) shall also be acceptable. The carrier equipment shall support 600 Baud data transmission rate along with speech transmission & 1200 Baud without speech.

Presently AF coupler unit (carrier protection unit) is not required; however, the Carrier Cabinet should be compatible to be connected with protection coupler working on coded command principle. Coded commands for direct tripping & fixed frequency/ combination of frequency commands for permissive trip may be added in future.

1.5 **COMMUNICATION SYSTEM:-**

Contractor may offer power line carrier equipment according to their standard practice to fulfil the requirement of this specification. The equipment offered should be the single side band fixed frequency type. The equipments shall have full scope for further extension and alteration.

It is to be noted that the existing 220 KV & 132 KV system of the CSPTCL already has a power line carrier communication system, based on the details of the existing equipments and existing frequencies network which will be furnished to successful

contractor. The contractor if desired shall be responsible for proposing suitable frequencies for section on which PLC equipments are to be installed. In choosing the frequency for the proposed sections, the contractor shall pay due attention to the frequencies already in use.

For the protection signalling separate carrier frequency is not required. The 4 KHz. AF Band of PLC cabinet shall carry speech from 0- 2 KHz & rest of the portion of band can be utilized for protection signalling data transmission.

The equipment would be used on 132 KV transmission line. For selection of frequency, due consideration should be given to the transposition aspect as the signal attenuation is likely to be substantially affected by transposition of phases and other parameters. The contractor will have to carry out the necessary studies and furnish the required calculations and conclusion drawn there from for satisfaction of the customer. The details of the transposition shall be furnished to the successful contractors. In any case the frequencies to be finally adopted will be subject to approval by the Government of India and the contractor shall agree to modify the frequencies in accordance with the final requirement without any extra cost. The requirement will have to be complied with, without any extra charges to us even if the approved frequency plan calls for utilisation of fractional frequencies.

1.5.1 **FACILITIES REQUIRED:-**

The communication system shall be used for speech transmission/reception in duplex mode, data transmission & protection signalling. The carrier cabinet will be compatible to be connected with EPAX. The EPAX must support E&M signalling in addition to other facilities. Thus the local subscriber of exchange will be able to make local as well as trunk calls.

1.5.2 **FREQUENCIES TO BE ADOPTED:-** The frequencies to be used shall be chosen from PLC band i.e. 50 - 500 KHz. Higher frequencies can be adopted for smaller sections and lower for longer sections. For this purpose it is obligatory for the contractor to furnish frequencies plan for all sections in the tender.

1.5.3 **COUPLING TO HIGH TENSION LINES:-** For all the line sections covered by this specifications phase to phase coupling shall be adopted. On 132 KV line sections 132 KV class Coupling Capacitors are to be provided. However, carrier panels LMU with protective device and drainage coil for 132 KV section are included in this specifications.

1.5.4 **MODULATIONS:-** Carrier equipments working on Amplitude modulation technique may be offered however equipments working on QAM & Digital modulation techniques are also acceptable.

1.5.5 **PHYSICAL LAYOUT OF EQUIPMENTS**

The following equipments will be installed in the outdoor switchyard.

- i) Wave trap.
- ii) Coupling Capacitor
- iii) Line Matching Unit along with protective device.

All the remaining equipments viz. Carrier transmitter receiver set, emergency power supply equipment etc., will be installed inside the control building adjacent to switchyard. The lead of coaxial cable connecting the Line Matching Unit and the carrier set will be lead in underground cable ducts. It may be necessary to lay part of the coaxial cable in ducts as well as direct in ground. The cable should thus be suitable to embedded in ground.

The cabinet should be suitable for transmission of speech and data at 1200 Baud. The carrier cabinet should be designed in such manner that programming of AF speech band, pilot, line filter, transmit frequency, & receive frequency is possible on site. The cabinet should have remote loop testing facility.

1.5.6 STANDARD.

The PLCC equipments shall comply with the latest issue of I.S. and IEC standard as mentioned below:-

| S. No. | Name of equipment | IEC no. | IS no. |
|--------|--------------------|---------|--------|
| 1 | Wave trap | 353 | 8792 |
| 2 | Coupling device | 481 | 8793 |
| 3 | Carrier set | 495 | 8997 |
| 4 | Protection coupler | 834-1 2 | --- |

1.5.7 POWER LINE CARRIER COMMUNICATION CABINET:

PLCC terminals shall use amplitude modulation (QAM in case of Digital PLCC panel) and shall have SSB transmission mode. The carrier cabinet shall work on fixed frequency & Duplex mode. The PLCC terminal shall comprise of HF hybrid & high quality, sharp filters & crystal generated highly stable frequency.

The various printed circuit board of carrier set shall be housed in heavy gauge steel (12/14 gauge) indoor cabinet for floor mounting type with adequate arrangements for ventilation and screening of the same to avoid dust getting in and to avoid any adverse effect from moisture during rainy season. The cabinet shall be finished with paints of suitable colour coated inside and outside.

Screw clamp type terminals shall be provided for inter connection wiring. The cabinet shall be suitable for bottom cable entry.

All individual parts of set shall be accessible from the front to permit testing and repair. The front shall have hinged doors, equipped with handles and locks. Necessary testing and indication device shall be provided on the front panel to enable checking of important functions and circuits. The whole circuit shall be mounted on one panel which is hinged at top and bottom of the cabinet. This will facilitate approach to backside of the circuit. The cabinet shall be provided on the outer side with visual and audio alarm indications to announce failure of power supply, absence of carrier signal for both receiver and transmitter etc. the audio alarm would be provided for this purpose which should be audible from 8 metres distance. The carrier set shall be suitable for operation with EPAX i.e. E&M signalling. In addition, two telephone sets shall be provided with each carrier set (one jack telephone, and one four wire telephone), for testing purpose and for carrying on emergency conversion without the help of the associated automatic exchange.

A monitoring and checking system shall be provided on the panel with selector switch to indicate all important levels. (DC, VF, IF and HF). The PLCC terminal should be provided with facility on 2 wire conversation on Express mode with the help of pilot shifting (necessary print for this type of conversation should be provided).

| S.No. | Particulars | Description |
|-------|--|---|
| 1. | Operating mode | Single side band with suppressed carrier, with multiple conversion i.e. preferably 3 stage modulation & 4 stage demodulation to suppress noises present in electrical network & maintain high receiver selectivity. |
| 2 | Carrier frequency range a. Overall b. Programmable | 40 KHz. To 500 KHz. 50 KHz. To 500 KHz. |
| 3 | Nominal band with a. Single channel b. Twin channel | 4 KHz. 8 KHz. |
| 4 | Maximum Line Attenuation a. Single Channel b. Twin Channel | 60 dB 54 dB |
| 5 | Effective working on the line attenuation excluding line noise level a. Single Channel b. Twin Channel | 35 to 40 dB 30 to 35 dB |
| 6 | Nominal output impedance | 75 or 125 Ohm unbalanced |
| 7 | Return Loss Tolerance in Transition band | ≥ 12 dB |
| 8 | Carrier frequency stability | $\leq +5$ Hz. |
| 9 | Useful A.F. Band width | 300 to 3840 Hz. |

1.5.8 ALLOWABLE ATTENUATION DISTORTION OF A.F. CHANNEL

| | | |
|---|---|---|
| A | Broad band repeater, operation 0.3 KHz. to 3.84 KHz. | i. 0.3 to 0.4 KHz. $-0.9/+1.7$ dB ii. 0.4 to 3.7 KHz. $-0.9/+0.9$ dB iii. 3.7 to 3.84 KHz. $-0.9/+1.7$ dB |
| B | Broad band repeater operation 0.3 KHz. To 3.6 KHz. (with low pass filter) | i. 0.3 to 0.4 KHz. $-0.9/+1.7$ dB ii. 0.4 to 3.7 KHz. $-0.9/+0.9$ dB iii. 3.4 to 3.6 KHz. $-0.9/+1.7$ dB |
| C | Speech band 0.3 to 3.4 KHz. Without compander | Comply with IEC 495 |
| D | Speech band 0.3 to 3.4 KHz. Without compander | Comply with IEC 495 |

1.5.9 TELEMETRING BAND

| | | |
|----|---------------------|--|
| 1. | Tele Control Inputs | Minimum 3 inputs precoupled, independently adjustable 600 ohms |
|----|---------------------|--|

| | | |
|----|---|---|
| 2. | Broad Band repeater operation 0.3 to 3.6 KHz. (with low pass filter) | i. 0.5 to 0.6 KHz. ≤ 3.0 ms. ii. 0.6 to 1.0 KHz. ≤ 1.5 ms. iii. 1.0 to 2.6 KHz. ≤ 0.5 ms. iv. 2.6 to 3.4 KHz. ≤ 1.5 ms. V. 3.4 to 3.6 KHz. ≤ 5.0 ms. |
| 3. | Speech Bands. a) 0.3 KHz to 3.4 KHz. b) 0.3 KHz. TO 2.4 KHz. c) 0.3 KHz. TO 2.0 KHz. | Comply with IEC 495 |

1.5.10 FILTER CHARACTERISTICS:-

| | | |
|----|--|--------------------------------|
| 1. | Allowable ripple for Band pass, High pass & Low pass filters | + 0.9 dB/-0.9 db |
| 2 | Rejection | ≥ 50 dB |
| 3 | Filter Frequencies | Programmable |
| 4 | Selectivity | ≥ 50 dB/120 Hz. |
| 5 | Band Stop Attenuation | 50 dB |
| 6 | Band Pass Attenuation | Flat in a band of ± 0.9 dB |

1.5.11 COMPANDER CHARACTERISTICS

It should comply with C.C.I.T.T.-G-162.

HARMONIC DISTORTION: 350 Hz. Speech Signal

| | | |
|---|---------------------------------------|--|
| 1 | 4- Wire | $\leq (-)$ dBm for each component at $(-)$ 3 dBm without attenuation |
| 2 | 2-Wire | $\leq (-)$ 30 dBm for each component at $(-)$ 3 dBm with compander |
| 3 | Tele control signal | ≤ 1 % at maximum gain |
| 4 | Near & Far end cross talk | $\leq (-)$ 50 dBm |
| 5 | Near & Far end cross talk attenuation | ≥ 50 dB |

1.5.12 SUPERVISION ALARMS: Should come under following conditions:-

| | | |
|----|---|-------|
| 1. | Loss of Transmitter signal. | |
| 2. | Loss of Receiver signal (2 to 5 dB below the AGC range) | |
| 3. | Low SNR in speech & tele control channels | 15 dB |
| 4. | Low of Auxiliary supply | |
| 5. | Excessive impulse interference. | |

1.5.13 A.F. MUTING

| | | |
|----|--------------------------------------|--|
| 1. | Slow Muting Rx signal strength alarm | 2 to dB below the AGC range. |
| 2. | Fast Muting alarm for burst noise | Pick up delay < 10 ms at a burst noise level of > 0 dBm/SNR < 0 dB |

1.5.14 R.F. OUTPUT POWER

| | | |
|----|---|------------------|
| 1. | Peak envelope power including pilot signal under normal load conditions at c0-axial o/p | 40 Watt (+46 dB) |
| 2. | Spurious Signal suppression at the limits of the band width for Single & Twin channel | ≥ 60 dB |
| 3. | Harmonic suppression for Single & Twin channel | ≥ 80 dB |
| 4. | Suppression of unwanted side bands | ≥ 80 dB |

1.5.15 RECEIVER REQUIREMENTS:-

| | | |
|----|---|--|
| 1. | R.F. sensitivities with reference to test tone level at R.F.I/P | (-) 24 dBm |
| 2. | Image Rejection | ≥80 dB |
| 3. | I.F. rejection | ≥ 80 dB |
| 4. | A.G.C. | A.F. Output level should remain within ± 0.5 dB for variation of + 14 dB to (-) 26 dB in R.F. Input level. |
| 5. | A.G.C. Time constant | 0.5 dB/Sec For level increase/ decrease |
| 6. | Frequency response equalization range | + 6 dB |

1.5.16 TELEPHONE INTERFACES:

| | | |
|----|---|--|
| 1. | 2/4 Wire P.A.X. interface | Should be provided |
| 2. | Remote & Local loop testing facilities for A.F. Signals | Should be provided |
| 3. | 2/4 wire Input & output level | Adjustable in steps of 0.25 dB |
| 4. | Input Range-Nominal | (-) 20 dB to + 10 dB in steps of 0.25 dB |
| 5. | Balance referred to ground | ≥ 56 dB |
| 6. | Return Losses | ≥ 20 dB |

1.5.17 TELECONTROL OUTPUTS

| | | |
|----|----------------------------------|--|
| 1. | Telecontrol Output | Minimum 3 nos Decoupled, independently adjustable 600 ohms balances. Programmable as transit filter or Board band outputs. |
| 2. | Nominal Output level | 0 dBr, 600 ohms balances. |
| 3. | Output level range (Single Tone) | (-) 20 dBr to + 10 dBr in steps of 0.25 dB across 600 ohms |
| 4. | Maximum Output Level (PEP) | + 14 dBm across 600 ohms |
| 5. | Balance referred to ground | ≥ 56 dB |
| 6. | Return Losses | ≥ 20 dB |

1.5.18 ALLOWABLE GROUP DELAY DISTORTION

| | | |
|----|---|--|
| 1. | Board band repeater operation 0.3 KHz. To 3.84 KHz. | i. 0.5 to 0.6 KHz. ≤ 3.0 ms. ii. 0.6 to 1.0 KHz. ≤ 1.5 ms. iii. 1.0 to 3.2 KHz. ≤ 0.5 ms. iv. 3.2 to 3.7 KHz. ≤ 3.0 ms. |
| 2. | Balance referred to ground | ≥ 56 dB |
| 3. | Return Losses | ≥20 dB |
| 4. | DC Resistance | ≥ 2 M Mega-ohms |
| 5. | Speech cutoff frequency adjustable | 1.8 KHz. _ 3.4 KHz. In steps of 200 Hz. |
| 6. | Telephony signalling | Pilot Oscillation Keying syste. E.M. Signalling mode. |

1.6 GUARANTEED TECHNICAL PARTICULARS FOR TWIN CHANNEL POWER LINE CARRIER COMMUNICATION EQUIPMENT

| SN | DESCRIPTION | TECHNICAL PARTICULARS |
|-----------|---|---|
| | Carrier Cabinet | |
| 1 | Mode of transmission | Single side band amplitude modulation |
| 2 | Carrier frequency range | 24 to 500 KHz |
| 3 | Nominal carrier frequency band width. | 8KHz |
| 4 | Oscillator for generating carriers | Crystal controlled oscillator with frequency divider |
| 5 | Frequency stability | Less than + /- 5 Hz |
| 6 | Effectively transmitted speech frequency band. | 300 Hz to 2000 / 2200/ 2400 / 2600 / 2800 / 3000 /3200 / 3400 Hz Upper limit programmable in steps of 200 Hz using plug- in jumpers. |
| 7 | Available band for superimposed signals. | Depends on the Speech cut off frequency. With Speech band of 300 Hz to 2000 Hz the available band for superimposed channels is 2160 Hz to 3600 Hz programmable in steps of 60 Hz. |
| 8 | Signalling frequency | 3780 + /- 30 Hz Pilot frequency is used for signalling (Programmable) |
| 9 | HF Power Output | 40 watt PEP. Adjustable output power |
| 10 | Nominal impedance i) Carrier frequency side ii) V.F. side | 75/ 125 Ohms Unbalanced and 150 Ohms Balanced (Optional) 600 Ohms |
| 11 | Relative VF levels across 600 Ohms (Balanced) i) 4 wire transit ii) 4 wire receive iii) 2 wire transit iv) 2 wire receive | -3.5 dBr.(Adjustable using DIP switches from- 20 dBr to +10 dBr) -3.5dBr.(Adjustable using DIP switches from - 20 dBr to +10 dBr) 0dBr.(Adjustable using DIP switches from - 16dBr to + 7 dBr) -7dBr. (Adjustable using DIP switches from - 16 dBr to +7dBr) |
| 12 | Details of power supply required. | 48V DC (Variation allowed +20%/15%) |
| 13 | Power consumption | 80 Watts approx. for Twin channel |
| 14 | Spurious emissions | As per IEC 495 |
| 15 | Receiver Sensitivity | -24 dBm referred to the Test Tone level at the RF I / P. |
| 16 | Automatic volume control | AF O/P level remains within + / - 0.5 dB for a + /-14/-26dB variation of RF I/P level. |
| 17 | Signal to Noise ratio over current carrier channels. | <40 dB |

| SN | DESCRIPTION | TECHNICAL PARTICULARS |
|-----------|---|---------------------------------------|
| 18 | Selectivity | 70 dB for 300 Hz 100 dB for 4 KHz. |
| 19 | Any other technical particulars not mentioned above, but considered necessary may please be also furnished. | - |

1.7 BILL OF MATERIAL OF TWIN CHANNEL CARRIER CABINET

Each Carrier cabinet shall consist of the following components:

- (1). 01 no. dummy load module.
- (2). 01 no. 2 wire telephone for each channel.
- (3). 01 no. 4 wire telephone set, push button type for each channel.
- (4). 01 no. jack telephone hand set for each channel.
- (5). 01 no. 125 ohm load.
- (6). Transit band pass filter.
- (7). Print puller.
- (8). Exhaust fan.
- (9). Test meter print.

PROTECTION COUPLER – NSD50

| Sr. No. | Technical parameters | System Particulars |
|----------------|---|---|
| 1 | Name of Manufacturer and Country | ----- |
| 2 | Type, Model and Catalogue Number | NSD-50 |
| 3 | Whether equipment works on frequency shift principle of coded signal principle | Coded / Uncoded Principle |
| 4 | Whether Equipment is suitable for Independently Protecting Two Circuits | Yes |
| 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 | (a) Same as Pilot frequency of PLCC (b) Uncoded A 872 Hz B 1090 Hz A & B 1308 Hz (c) Coded C 654 / 1526 Hz D 654 / 1745 Hz C & D 654 / 1963 Hz (d) A & D 1745/ 1963 Hz |

| | System I&II) | B & C 1526 / 1745 Hz |
|----|---|---|
| 6 | Criteria used for command Transmission | Pilot Criterion & Command Criterion |
| 7 | Whether equipment is protected against tripping by spurious Signals. | Yes, Noise detector/blocking unit provided |
| 8 | Transmission time for protection signals | |
| | (a) Permissive trip code | 12ms |
| | (b) Direct trip code | 26ms |
| 9 | Whether in the presence of spurious signals as well as Protection Signals simultaneously, the equipment will initiate a Trip Command. | The equipment works on the following criteria for initiation of the command. |
| | | a) Absence of pilot/guard frequency |
| | | b) Presence of trip command |
| 10 | Mode of Transmission of guard signal | Pilot freq. 3780 Hz |
| 11 | Whether equipment is suitable for Direct Circuit Breaker tripping. | Yes |
| 12 | Maximum number of Noises Impulses pps in Presence of which the equipment will satisfactorily perform its duty. | 200ms Noise Burst / 1 sec pause. |
| 13 | Signal Delay with Two Terminals connected back to back | Not applicable since Carrier sets are used on point to point basis for protection only |
| 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? | Command is acknowledged by the Receiver and command is transmitted in the form of continuous code |
| 15 | Whether it is possible to alter the priority of commands of various codes at site. | Not required as coded has priority over uncoded |
| 16 | What are the performance based results under severe line noise conditions for | |
| | (a) False trip probability | Better than 10^5 |
| | (b) Fail to trip probability | Better than 10^2 |
| 17 | Transmitter Input Requirements (Contact Ratings) | |
| | (a) Voltage | 48V to 250V |
| | (b) Current | <10mA |
| | (c) Power | 0.25W |
| | (d) No. of Contacts | 2 Optocouplers used i.e. : 1 no. for start input & 1 no. for command input |
| 18 | Receiver Output (Contact Rating) | |

| | | |
|----|--|--|
| | (a) Voltage | 250V DC |
| | (b) Current | 2A |
| | (c) Power | 100VA |
| | (d) No. of Contracts | 1 no. Solid State (MOSFET) Relay. |
| 19 | Additional facilities provided in Receiver output | One Auxiliary Relay provide with a contact rating of 250VDC, 10W. |
| 20 | Supervisory and Alarm Contact Facilities | Two change over contacts |
| | (a) Current | 600 mA |
| | (b) Voltage | 250V |
| | (c) No. of contacts | Two |
| 21 | Installation | In slot provided in PLC terminal ETL |
| 22 | Power Supply | Power derived from ETL |
| | (a) Voltage | |
| | (b) Current | |
| | (c) Power | |
| 23 | Type and number of counter for recording the number of Trip Commands sent and number of Trip Commands received | Provided |
| 24 | Whether loop test is possible | Yes, automatic as well as manual |
| 25 | Insulation Level | Command signal input, output & alarm output to chassis 2kV, 50 Hz 1 min. |
| 26 | Whether the equipment is suitable for transmitting and receiving more than two independent commands | Yes, can go up to 4 commands |