**PRASAR BHARATI**
**DIRECTORATE GENERAL : ALL INDIA RADIO**
**( *TELECOM DIVISION*)**
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## SPECIFICATIONS COVER SHEET

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|---|---|---|
| TITLE | : | Augmentation of CES at various AIR Stations |
| SPECIFICATION NO. | : | TC/SPEC/ 11/103/DTH/2010 |
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| SCHEME | : | Augmentation of uplink/downlink at various AIR Stations for inclusion of programmes in DTH under 11th Plan. |

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**TC/SPEC/ 11/103/DTH/2010**

**SUBJECT : SPECIFICATION FOR AUGMENTATION OF DIGITAL UPLINK/DOWNLINK SYSTEM AT VARIOUS AIR STATIONS FOR INCLUSION OF PROGRAMMES IN DTH**

## 1. INTRODUCTION :

The Doordarshan's bouquet of DTH channels, apart from video channels, is carrying 21 Nos. of All India Radio's audio channels. Program content of these channels is at present are being transported from DTH contributory AIR Stations through interim arrangement made at existing Captive Earth Stations (CES) of these Stations. These programs are received at DTH Uplink center at Todapur, New Delhi before being inserted into the DTH bouquet.

Now it is proposed to equip the CES at these contributory AIR Stations with regular setup and do away with the interim arrangement. To facilitate this it is necessary to augment the existing Captive Earth Stations by providing additional digital Uplink subsystems. The augmentation is based on number of channels that these Stations are contributing to the DTH bouquet.

CES at Borivali, VBS Mumbai is an important establishment as it Uplinks Vividh-Bharathi Programs which are widely taken by most of the AIR Stations. This channel is also one of the prime channels in the DTH Bouquet. Hence it is required to replace all the equipments in the CES Digital chain except PDA.

Contributory DTH programs produced/collected at these stations will be Uplinked through these augmented Digital Uplink systems and then received at DTH Uplink center at Todapur, New Delhi.

These additional Digital Uplink subsystems will be integrated with the already existing Captive Earth Station at AIR Stations. No additional site is required.

The General specifications/requirements are detailed in Section 'A'.

The technical specification/requirements are detailed in Section 'B'.

The Draft ATP for CES equipment is given in Section 'C'

## 2. SCOPE:

The Captive Earth Stations should be capable of uplinking signals to the satellite conforming to AIR's specifications and its antenna radiation pattern to conform to all relevant International Standards like CCIR/ ITU-RS 580-V without causing any interference to other services sharing the same frequency band. The signal uplinked in C-band by the Captive Earth Station should be as per AIR RN-System parameters and be compatible with the existing Radio Networking Receive terminal of AIR.

**2.1** The Scope of this tender includes:

i) Provision for supply, installation integration and commissioning of Digital Satellite Uplink subsystem at existing Captive Earth Stations at AIR stations
ii) Equipment as per specifications and requirements given in Section 'A' and Section 'B' as detailed in the tender.
iii) Acceptance testing of the equipment as per ATP given in Section 'C'.
iv) Installation, integration, testing and commissioning of the complete system incl. electrical earthing etc.
v) Provision shall be made for feeding programme from Control Room to Equipment Room of Captive Earth Station for feeding augmented Digital Uplink System at existing CES.

**2.2** The tenderer shall also provide full

i) Detailed configuration of the equipment being supplied.
ii) Details of input/output requirements of the equipment being supplied.
iii) Details of power supply and air-conditioning requirements.
iv) Mechanical mounting/installation details of the equipment.

**2.3** The tenderer shall ensure that the equipments/items offered fully incorporate the standard feature for safety and protection.

**2.4** All the offered equipment shall be field proven and from reputed manufacturers. A list of clients with their contact details, to whom similar equipment has been supplied, shall be furnished. **Tenders without such client list would be liable for rejection.**

**2.5** Tenderer's proposal shall also contain the details of the sub-contractor, if any, proposed to be awarded by the tenderer for some part of the system or subsystem to another supplier, like profile of such a supplier, their experience in executing similar type of system / subsystem for which the sub-contract is being awarded, etc. Proposals without the above mentioned details will not be evaluated and will be rejected without any further communication to the tenderer.

**2.6 Technical/General Details** : The tender/offer shall include the following details without which tender shall be liable to be rejected:

i) Sufficient information to technically evaluate the offer and to assess full merits/demerits of the same.

ii) Apart from printed technical data/specs of the equipment from the OEM, Block schematic upto the sub-system, interconnection and wiring diagram and the photograph etc.

**2.7** Tenderer may be asked to demonstrate the equipment(s) within one month of opening of technical bids.

**One no. Encoder, Digital modulator and Digital receiver each shall have to be submitted to AIR within one month of opening of technical bids for testing compatibility in the existing setup.**

**2.8 Inspection:**

a) i) After the acceptance of the tender by the indenter, the supplier shall submit the ATP on the guidelines of Draft ATP as per Section - C for approval. After the approval of ATP, the entire equipment shall be inspected as per this approved ATP at supplier's works/site in India by engineer(s) of All India Radio. The supplier shall make all the arrangements including electric energy, consumable materials, tools, test & measuring instruments, labour and assistance of every kind for carrying out Inspection before delivering the items at site.

ii) All the equipment shall be offered for pre-dispatch inspection in one lot.

iii) Final inspection will be carried out at site after the supplier completes the installation work. During this inspection workmanship along with link level measurement, measurements related to Antenna etc shall be carried out.

b) Supplier shall give intimation to the indenter for carrying out Inspection at supplier's Works at least 6 weeks in advance. Following charges if any are to be quoted separately.

i) Inspection charges.
ii) Any other charges.

Expenses on to and fro journey, boarding and lodging as per norms in respect of AIR Engineers deputed for inspection will be borne by AIR.

**2.9** Only those firms having experience in the field of installation & commissioning of Earth Stations shall quote. The tenderer therefore, shall furnish the list of customers with contact details where similar job has been carried out by the tenderer.

**2.11 INSTALLATION & COMMISSIONING**

Installation will include all the equipments within the wired racks, hoisting of the parabolic dish antenna, routing of the wave guide/RF cable from the PDA to indoor system and providing earth pits as per AIR Specifications (earth resistance of less than one ohm) at site. Racks and all the equipment must be earthed.The workmanship of the entire Installations shall be of high professional standard. PDA foundation will be done by the tenderer as per the design given by its OEM and as per soil bearing capacity, which will be conducted by the successful tenderer through authorized agencies and got certified and a copy of the report submitted to Dte. for record.

The firm shall have to arrange all the installation material required for installation and insure all the personnel associated in the installation work at their own cost. Installation schedule at Station has to be intimated at least 3 weeks in advance.

Complete Installation at the station shall thereafter be offered for Site Acceptance Test and Inspection at site shall be conducted by the representatives of DG: AIR.

The successful tenderer shall make good all damages to the purchaser's buildings, property, equipment, article and departmental personnel during the course of installation and throughout the guarantee period

The successful tenderer shall indemnify and hold harmless the purchaser, against all claims in respect of damages to buildings, property, articles, situated nearby not belonging to the purchaser, and public personnel arising from the erection of the PDA during the course of such erection or mounting and throughout the guarantee period.

The successful tenderer shall indemnify and hold harmless the purchaser against claims in respect of injury to any personal howsoever arising from the erection of the PDA in the course of such erection or mounting and throughout the guarantee period.

The successful tenderer shall fully discharge all obligations under the Indian Workmen's Compensation Act in so far as it affects the workmen under his employment.

The tenderer shall be responsible for safe erection of the PDA and other accessories etc. The tenderer shall take all necessary safety measures and precautions during the SITC .Installation work shall be got done at site under the supervision of qualified representative of the firm.

## 3. CONFIGURATION:

The augmentation of Captive Earth Station at AIR will be as per the configuration given in Annexure-I (Representative diagram). The supply shall include material listed in 'Section A'

## 4. LOCATION FOR SUPPLY & INSTALLATION:

**A)**

| **Stations where Uplink System will be augmented:** | | |
|---|---|---|
| 1. BH Mumbai | 7. AIR,Cuttuck | 13. AIR,Kohima |
| 2. Srinagar | 8. AIR, Chennai | 14. AIR, Itanagar |
| 3. NBH Delhi | 9.AIR, Trivandrum | 15. AIR, Aizwal |
| 4.AIR, Hyderabad | 10. AIR, Jallandhar | 16. AIR, Imphal |
| 5.AIR, Ahmedabad | 11. AIR, Guwahati | 17. AIR, Agartala. |
| 6.AIR,Kolkatta | 12. AIR, Shillong | 18. AIR, Bangalore |
| **Station where downlink system will be augmented:** | | |
| DTH Uplinking center, National Channel, Todapur, New Delhi. | | |

**B)** Augmentation of Uplink System at **Borivali, Mumbai.**

## 5.0 GENERAL REQUIREMENTS

### 5.1 ENVIRONMENTAL & POWER SUPPLY

All equipment shall operate satisfactorily under the following environmental conditions (except where specified separately).

a) Ambient Temperature : 0°C to +50°C

| | | | |
|---|---|---|---|
| b) | Relative Humidity | : | 95% non condensing |
| c) | Warning systems | : | Alarm for over or under level of R.F. power at the output of HPA and other warning system for trouble free operation of the system. |
| d) | Safety | : | Standard features for safety & protection. |
| e) | Power supply | : | 230 V AC±10%, 50±2 Hz, single phase |

**5.2 Manual:** ***Original copy of manuals*** (Both Soft copy and hard copy) for installation, operation, maintenance & Servicing of complete system along with sub-system and accessories, drawings & wiring diagram for the layout, etc., are to be supplied as per quantity detailed below**:**

1 Sets for each AIR station
2 Sets for Directorate
2 Sets for each Zonal office.
1 Set for STI(T), Delhi
1Set for R&D, Delhi

**5.3 Spares(Optional)**

Tenderer should quote for recommended essential spares including their quantities and cost (per unit). One complete unit of Upconverter,Encoder,Digital Modulator each in stand alone mode must be offered under “Spares”. Essential spares of SSPA shall also be quoted as per B.12.

**5.4 Training**

Five working days O&M and Equipment Servicing training for engineers at each zone shall be arranged by the Supplier. Training on Equipment Servicing shall be imparted by OEMs.

**5.5 Compliance**

While complying with these specifications, it may please be noted that just mentioning ‘complied’ will **NOT** suffice. The compliance shall be supported by proper printed data/documentation from original equipment manufacturer duly signed by them, substantiating the compliance in respect of the specifications. Deviations, if any, shall be brought out clearly in the compliance statement. Copies of performance reports on similar equipment shall be submitted with the tender.

**5.6 Schedule of Material**

A comprehensive schedule of material offered shall be attached with the offer in the technical bid in the same format as price bid minus the price.

**5.7 Maintenance support**

Maintenance support including availability of spares is to be ensured for at least 10 years.

### 5.8 General Clauses

(i) The supplier shall intimate the source of supply and technical parameters for major and critical components/ spares so that no difficulty is encountered later on in procuring the spares for maintenance or repair of these equipment. Authorization from the principal's i.e. OEM is a must.

(ii) If at any stage during next 10 years, the manufacturer intends to stop production of this equipment, he shall intimate AIR in advance to enable AIR to stock the critical items of spares for the life of the equipment.

(iii) Successful tenderer shall submit general wiring diagram and get it approved by DG AIR.

(iv) Warranty and guarantee clause will be as per the terms and conditions specified in the commercial section of the tender in this respect.

### 5.10 Optional items

Tenderer should quote separately for recommended optional items including their quantities minus cost in the technical bid.

### 5.11 Delivery Period

The delivery period for supply of all the items shall be four months from the date of order and delivery period for completion of SITC shall be six months from the date of order.

## SECTION 'A'

### (A) List of Consolidated Equipment For Augmentation of Uplink/Downlink System at Various AIR stations

| S.No | Item | Quantity | |
|---|---|---|---|
| 1. | IF to C-Band Up-converter | 18 Nos. | B.3 |
| 2. | Digital Encoder – 1Nos<br>Digital IF Modulator with – 1Nos<br>Auto-changeover Unit | 50 Set. | B4.1<br>B.4.2 |
| 3. | Laptop for Controlling and Monitoring Digital Encoder, Digital IF Modulator, Upconverter and Digital Receiver | 18 Nos | B.12.2 |
| 4. | 6.1M Parabolic receive antenna with feed & accessories | 1 no. | B.1, 1.a |
| 5. | IF Combiner 4:1 – 2Nos | 18 Sets | ------ |
| 6. | Digital SCPC Receiver with L-Band input | 50 Nos | B.9.2 |
| 7. | C-Band LNBC - 2Nos | 19 Sets | B.9.1 |
| 8. | Audio Wired racks | 21 Nos. | B.6 |
| 9. | L-Band Splitter 1:4 with only one port dc pass – 2Nos | 19 Sets | ----- |
| 10. | L-Band Splitter 1:8 with only one port dc pass – 4Nos | 1 set | ---- |
| 11. | Low loss L-Band cable, connectors, adopters and other accessories | 19 Sets | B.1.b |
| 12. | L-Band line Amplifier – 2Nos | 2 Sets | B.9.4 |
| 13. | Dehydrator with accessories like tubing etc. complete | 4 Nos. | B.8 |
| 14. | Installation, Testing & Commissioning at site | 19 Job | |
| 15. | Earthing system | 19 Job | |
| 16. | Inspection | 19 Job | |

### II. OPTIONAL ITEMS

| Sl.No. | Item | Quantity |
|---|---|---|
| 1 | Spares | 1 set |
| 2 | Five working days O&M Training | 1 job |

**III**. Details of other items, if any required for complete integration & operation of equipment (not included in these specifications) may be furnished with the tender and must be quoted in the commercial bid. Subsequently no payment on account of any missing item which is required to complete the system specified, shall be admissible.

**B) List of equipment for Augmentation of Uplink System For Borivali, Mumbai.**

| S.No | Item | Quantity | Reference |
|---|---|---|---|
| 1 | Digital Encoder (1+1)<br>Digital IF Modulator (1+1)<br>Auto-changeover Unit | 2 set | B4.1<br>B.4.2 |
| 2 | IF to C-Band Up-converter (1+1)with auto-changeover unit | 1 set | B.3 |
| 3 | C-band HPA 50W (1+1)with auto-changeover Unit | 1 set | B.2 |
| 4 | Inter-facility link including Wave guide, coupler, RF cables and other accessories for Antenna connection to HPA. | 1 Set | B.5 |
| 5 | IF Combiner 4:1 | 2 Nos | --- |
| 6 | Wired racks to house indoor electronics. | 2 Nos | B.6 |
| 7 | Cables connectors and other accessories including Audio Distribution Amplifier for integration of the complete system - 1 set | Lump sum as per requirement | --- |
| 8 | Dehydrator with accessories like tubing etc. complete | 1 Nos | B.8 |
| 9 | On-Line UPS | 1 set | B.10 |
| 10 | Receiving system: | | |
| | 1) C-Band LNBC | 2 Nos | B.9.1 |
| | 2) Digital SCPC Receiver with L-Band input | 2 Nos | B.9.2 |
| | 3) Interconnecting cables, connectors & accessories including Power Dividers | 1 Set | B.9.3 |
| 11 | Automatic on-line performance measurement and network management system (NMS) consisting of :<br>Laptop/Work station with necessary add-on cards like digital I/O, Data Acquisition etc., NMS software and LaserJet Printer for hardcopy output of measurement results | 1 set | B.12 |
| 12 | Measuring Equipments-<br>a)Spectrum Analyser – 1 no.<br>b)Digital transmission analyser – 1 no. | 1 Set | B.11.2<br>B.11.1 |
| 13 | Installation, Testing & Commissioning at site | 1 Job | |
| 14 | Earthing system | 1 Job | |
| 15 | Inspection | 1 Job | 2.8 |

## II. OPTIONAL ITEMS

| Sl. No. | Item | Quantity |
|---|---|---|
| 1 | Spares | 1 set |
| 2 | Five working days O&M Training | 1 job |

**III**. Details of other items, if any required for complete integration & operation of equipment (not included in these specifications) may be furnished with the tender and must be quoted in the commercial bid. Subsequently no payment on account of any missing item which is required to complete the system specified, shall be admissible.

# SECTION - B

## TECHNICAL SPECIFICATIONS/REQUIREMENTS

**MAIN EQUIPMENT SPECIFICATIONS :**

### B.1 Specification for 6 M C- BAND PDA

**Electrical Specification:**

| | | |
|---|---|---|
| 1) | Diameter | Diameter should be 6 Meter(nominal) should meet the technical requirements mentioned below. |
| 2) | Frequency Range | 3.7-4.2 GHz |
| 3) | Receive gain at 4GHz | ≥46 db |
| 4) | Receive G/T | Better than 24.5 db/ K |
| 5) | Pointing Accuracy | Better than $\pm 0.25^0$ |
| 6) | Side Lobe Level/GAIN pattern | As per ITU-RS-580-V or its latest amendment. |
| 7) | Tracking mode | Manual (motorised may be quoted as optional). The Antenna should have calibrated marking for Elevation & Azimuth angle indication. |

**Mechanical Specification:**

| Sl No | Parameter | Specification |
|---|---|---|
| 1 | Reflector Structure: | The reflector should be made of perforated aluminum sheet mounted as panels/segments over reflector supporting structure.<br>The reflector supporting structure should be made from aluminum or steel tubes/angles and mounted over trusses emanating from the central hub. |
| | i) Reflector Material: | Perforated Aluminum sheet with thickness of at least 2.0mm |
| | ii) Coated with: | Non metallic anti corrosive paint to avoid concentration of heat at focal point (mention the paint used) |
| | iii) Reflector supporting structure: | Should be made from Aluminum /Steel material.<br>It should be coated with anti corrosive paint |
| 2 | Antenna Stand: | |
| | Mount: | Kingpost |
| | Material: | Heavy duty, made with hot dip Galvanized steel and coated with anti corrosive paint. |
| 4 | Steerability: | |
| | Elevation: | 15° to 85° |
| | Azimuthal: | ≥ ± 55°(continuous, without change of mount position |
| 5 | Wind Load: | |
| | Operational: | 80 KM/Hr |

| | | |
|---|---|---|
| | Survival: | 150 KM/Hr |
| 6 | **I)** Environmental : | |
| | Temperature: | 0° to +50°C |
| | Relative Humidity: | 95% non condensing at 40°C |
| | Rain: | Up to 10 cm/hr |

NOTE: The tenderer (as per drawings and recommendations by the original manufacturer of the antenna) will provide Foundation of antenna. One no of proper earth pit will have to be provided for earthing the lightening arrester of the antenna. The resistance of earth pit should be 1 ohm or less.

**B.1a) DETAIL OF THE FEED**

| | | |
|---|---|---|
| i) | Type of Mounting | Prime Focus. The provision for adjustment of the feed from the ground itself should be made. It should have calibrated polarization angle indication and adjustable smoothly for optimization. |
| ii) | Ports | Two (Orthogonal) |
| iii) | Polarisation | Linear (adjustable, $\pm$ 90°) |
| iv) | Freq. Range | 3.7 - 4.2 GHz |
| v) | Return loss at Centre freq. | $\geq$ 17 dB |
| vi) | Connector | Wave-guide WG229G |
| vii) | Cross-Polarization discrimination | $\geq$ 30 db |

**NOTE:** Feed of C-Band antenna would be two port(orthogonal). One LNBC would mount over each of the port. At a time only one LNBC output would be connected to the input of power divider/L band line amplifier. The other LNBC mounted over orthogonal port will serve as cold standby. Arrangement should be provided so that by rotating the feed by $90^0$, the standby LNBC could be brought into the circuit.

**B.1.b) Cable**

Only good quality professional grade cable with connectors at both ends shall be quoted with following specifications

| | | |
|---|---|---|
| i) | Cable Loss (with F connectors at both ends) | $\leq$ 3.5 dB/100 feet at 1500 MHz |
| ii) | Impedance | 75 $\Omega$ |

## B.2 50W C-BAND SOLID STATE POWER AMPLIFIER (1+1) WITH AUTO CHANGE-OVER UNIT FOR S.S.P.A. ALONG WITH DUMMY LOAD.

SSPA shall be of compact and composite construction, lightweight and rack mounted with front access for operation and control, etc. It shall be offered along with its inbuilt/ associated power supply unit. It shall also have front panel meter to monitor Forward power, VSWR alarm, Reverse power and indications for status, alarm, faults, over temperature, etc. The SSPA should have its own cooling arrangements and should not require any external cooling.

| | | | |
|---|---|---|---|
| a) | Type | : | SSPA |
| b) | Rated continuous o/p power (P1dB ) | : | + 46 dBm |
| c) | Input Freq. | : | 5850 – 6425 MHz |
| d) | Gain Frequency Response | : | ± 0.6 dB over any 40 MHz |
| e) | Saturated output power | : | 50 W |
| f) | Gain | : | ≥ 46 dB |
| g) | R.F. level control | : | 0-20 dB continuous |
| h) | Gain stability over full temp.range | | : ± 1.5 dB |
| i) | Input VSWR | : | ≤ 1.3 : 1 |
| j) | Output VSWR | : | ≤ 1.3 : 1 |
| j) | Phase Noise | : | Should meet IESS 308/309 |
| k) | Harmonic | : | Better than : - 50 dBc (at rated output) |
| l) | Spurious (in band) | : | Better than : - 60 dBc (at rated output) |
| m) | S.S.P.A. standby operation | : | 1 + 1 hot redundancy auto change-over with manual over ride. |
| n) | Mounting | : | 19” Rack |
| o) | Two tone inter-modulation at 3dB total back off from 1 dB compression point | : | -25 dBc or better |
| p) | Monitoring | : | RF Sample output port |
| q) | RF input connector | : | N female |
| r) | RF output | : | CPR137 |
| s) | Operating temp. range | : | 0˚ to +50˚C |

## B.3 SYNTHESIZED IF TO C- BAND UPCONVERTER (1+1) WITH AUTO CHANGEOVER UNIT

It should be possible to operate the upconverter manually. The upconverter should not require a PC or a controller for normal operation and control. Any interface

required for operation in 1+1 hot standby mode with auto changeover shall be included in the offer.

| | | | |
|---|---|---|---|
| a) | Input Frequency | : | 52 MHz to 88 MHz |
| b) | Output Frequency | : | 5850 MHz to 6425 MHz |
| c) | Frequency setting | : | Synthesized, 125 KHz step size |
| d) | Frequency stability | : | Better than ± $1x10^{-8}$ over temp. 0º to 50ºC & ± $1x10^{-9}$ or better per day |
| e) | Input impedance | : | 75 Ω |
| f) | Output Impedance | : | 50 Ω |
| g) | Input level | : | -15 dBm nominal |
| h) | Input connector | : | BNC-F |
| i) | Input Return loss | : | 19 dB or better |
| j) | P1 dB Output level | : | +10 dBm or more |
| k) | Overall Conversion gain | : | 30 dB or more |
| l) | Gain control | : | > 30dB in steps of 0.2 dB or smaller. |
| m) | Gain Slope | : | ± 0.05 dB/MHz |
| n) | Output Return loss (VSWR) | : | 19 dB or better (≤1.25 : 1) |
| o) | Amplitude / Gain stability | : | ± 0.25 dB per day at constant temp. |
| p) | Type of conversion | : | Dual conversion spectrum non-inverted |
| q) | Third order IMD Product | : | -40 dBc with two equal carriers at 10 dB total output Back off from P1 dB. |
| r) | Phase noise | : | -70 dBc/Hz. 100 Hz away from carrier<br>-80 dBc/Hz, 1 KHz away from carrier<br>-100 dBc/Hz, 1 MHz away from carrier |
| s) | Spurious (in band) | : | -60 dBc below carrier (un-modulated) |
| t) | Standby operation | : | 1 + 1 hot redundancy, auto change-over with manual over ride feature. |
| u) | Mounting | : | 19” Rack |
| v) | Test Port | : | IF and RF |
| w) | Remote Interface | : | RS232/ RS485 for parameter setting |
| x) | Front Panel Indications | : | Power, Standby, Fault, Remote/Manual |
| xi) | Operating temp. | : | 0 to +50ºC |

**B.4**

### B.4.1 AUDIO BASE BAND DIGITAL ENCODER

The Digital encoder for base band encoding should conform to the standard and specification of the existing digital radio networking system in AIR Network. It should be possible to control/set encoder through front panel as well as through PC. **One no. Encoder shall have to be submitted to AIR within one month of opening of technical bids for testing compatibility in the existing setup.**

| | | | |
|---|---|---|---|
| a) | No. of Analog audio inputs | : | Two mono/one stereo |
| b) | Digital Audio input | : | AES/EBU Standard (Professional) |
| c) | Audio Signal Bandwidth | : | 20 Hz to 20 KHz |
| d) | Input level (max.) | : | +12 dBu (peak) |
| e) | Dynamic range | : | ≥ 80 dB. |
| f) | Compression | : | ISO/MPEG-1 layer 2 |
| g) | Data rates | : | 64, 128, 192, 256 & 384 kbps (selectable) |
| h) | Modes | : | Mono, Dual Mono, stereo |
| i) | Sampling rate | : | 48 KHz |
| j) | End to End stability (from input of encoder in the uplink to receiver output in the downlink). | : | ±0.5 dB, 20 Hz-20 KHz, w.r.t. input and output levels at 1 KHz, no gain adjustment |
| k) | End to End gain (from input of encoder in the uplink to receiver output in the down-link) | : | ± 0.5 dB at 1 KHz, no adjustment |
| l) | Total Harmonic Distortion (THD) | : | ≤ 0.2% at 1 KHz for +8 dBu output from the receiver. |
| m) | Signal to Noise Ratio | : | ≥ 75 dB at 1 KHz for +12 dBu output from the receiver |
| n) | Cross talk Isolation between the two Channels | : | ≥ 70 dB w.r.t. +12 dBu output from the receiver at 1 KHz |
| o) | Auxiliary data channel | : | ≥ 4.8 kbps |
| p) | Interface for aux. | : | Asynchronous, RS-232 |
| q) | Operation | : | Encoder & Decoder independently |
| r) | Digital I/O | : | Transformer Coupled, balanced |
| s) | Power supply | : | 230VAC ±10%, 50Hz ±4% |
| t) | Operating temp. range | : | 0ºC to +50ºC |

### B.4.2 DIGITAL IF MODULATOR

The Digital modulator should conform to the standard and specification of the existing digital radio networking system in AIR Network. It should be possible to control/set modulator through front panel as well as through PC. **One no. modulator shall have to be submitted to AIR within one month of opening of technical bids for testing compatibility in the existing setup.**

| | | | |
|---|---|---|---|
| a) | Type of Modulation | : | QPSK |
| b) | IF Frequency | : | 52 to 88 MHz continuously adjustable in ≤ 10 Hz step. |

| | | | |
|---|---|---|---|
| c) | Output level | : | 0 to - 20 dBm adjustable in ≤ 0.1 dB step. |
| d) | Channel coding | : | a) Viterbi 1/2, 3/4 selectable<br>b) Sequential 1/2, 3/4, selectable(optional) |
| e) | Spurious | : | ≦ -50 dBc (in band); ≦ -45 dBc (out of band) |
| f) | Data rate | : | 64, 128, 192, 256, 384 kbps (programmable) |
| g) | Interface | : | V.35 |
| h) | IF impedance | : | 75 ohm |
| i) | Data clock source | : | Internal, external |
| j) | Data clock stability | : | $1x10^{-6}$ or better |
| k) | Configuration | : | 1 + 1 in hot-standby with auto c/o unit |
| l) | Power supply | : | 230VAC ±10%, 50Hz±4% |
| m) | Operating temp. range | : | 0ºC to +50ºC |

## B.5 INTER FACILITY LINKS

The tenderer shall quote for Wave guides, couplers, adaptors, cables and other accessories required for Antenna connection to the output of SSPA. All these accessories shall be of professional standard and compatible with the system. Make, Technical specifications and detailed quantity of each of these shall be mentioned clearly in the offer.

## B.6 WIRED RACKS FOR EQUIPMENT

All the above equipment like Digital encoder, Digital Modulator, Upconverters, SSPA, Dehydrator, Antenna Controller, UPS, Digital Receiver, PC, etc. shall be installed in the industrial Standard Size (46 U) wired racks (3 Nos.) along with requisite jack – strip, tag block & other item. The racks must be properly fitted & earthed.

## B.7 ACCESSORIES FOR SYSTEM INTEGRATION

Interconnecting cables, power supply cables, suitable Audio Distribution Amplifiers, connectors and other accessories required for the integration of the complete Captive Earth Station system shall be included in the tender.

## B.8 DEHYDRATOR

A dehydrator for pressurizing the wave guide with dehydrated air, connecting HPA output to the antenna shall also be quoted along with all accessories, tubings etc.. It shall be compatible with the feed system and SSPA system etc.

| | | |
|---|---|---|
| 1. | Air Capacity/Flow rate | 60 Litres / Hour. |
| 2. | RF-line pressure | Adjustable Upto 0.35 bar |
| 3. | Pressure control | RF line pressure adjustable reduction valve |
| 4. | Over pressure protection | Automatic through safety valve |
| 5. | Pressure indication | Pressure gauge for the complete range of pressure |

## B.9 RECEIVING SYSTEM FOR DIGITAL UPLINK

The receiving system is required for subjective monitoring and for measurements on the downlinked signals from the satellite in C-band (3.7 - 4.2 GHz).

### B.9.1 Professional Grade C-BAND LNBC (Make & Model to be specified)

| | | |
|---|---|---|
| a) | Input frequency | 3700 – 4200 MHz |
| b) | Input impedance | 50 Ω |
| c) | Input connector | WR 229 G Flange |
| d) | Output frequency | 950 - 1450 MHz |
| e) | L.O. Stability | PLL, better than ± 2 PPM |
| f) | Noise temperature | ≤ 35°K |
| g) | Conversion gain | ≥ 55 dB |
| h) | Phase Noise<br>1 KHz<br>100 KHz | <br>-60 dBc/Hz<br>-80 dBc/Hz |
| i) | Output impedance & Connector | 75 Ω ; F (Female) |
| j) | Power supply | + 15 V to + 24 V through output connector |

### B.9.2 DIGITAL SATELLITE RECEIVER WITH L- BAND INPUT

The digital receiver should confirm to the standard & specs of the existing digital radio networking system. It should be possible to control/set receiver through front panel as well as through laptop. **One no. digital receiver shall have to be submitted to AIR within one month of opening of technical bids for testing compatibility in the existing setup.**

| | | |
|---|---|---|
| i) | **Input**<br>a) Freq. Range<br>b) Freq. Step Size<br><br>c) Impedance<br>d) Signal Level | <br>950 – 1450 MHz<br>Resolution ≤ 25 KHz Local (remote control optional)<br>75 Ω<br>-25 dBm to -70 dBm |
| ii) | Demodulation | QPSK |
| iii) | Channel change time | < 1 sec |
| iv) | FEC decoding | a) Rate 1/2, 3/4 Viterbi<br>b) Rate ½ Sequential<br>(Selectable Rate preferred) |
| v) | Audio coding | ISO/MPEG-I/Layer-2 |
| vi) | Data rates (Selectable) | 64, 128, 192, 256 & 384 kbps (QPSK) |
| vii) | Modes | Mono, Dual mono & Joint stereo |
| viii) | **Audio output**<br>a) Impedance<br>b) Level (Maximum)<br>c) T.H.D. (@256kbps; 1 KHz)<br>d) Audio signal bandwidth<br>e) Frequency response<br>f) Signal to Noise ratio<br>g) Dynamic range<br>h) Cross-talk ratio<br>i) Audio output channels<br>j) Digital Audio output | <br>≤ 600 Ω<br>+ 12 dBu (adjustable)<br>≤ 0.2% (at +8 dBu output)<br>20 Hz to 20 KHz<br>1.0 dB(p-p) (20 Hz to 20 KHz) @ 0 dBu O/P.<br>≥ 75 dB (at 256kbps,Eb/No ≥9 dB, +12 dBu)<br>≥ 80 dB<br>≥ 75 dB w.r.t. +12 dBu input in Encoder<br>Two mono/one stereo<br>AES/EBU standard professional |
| ix) | Threshold Eb/No | ≤ 5.5 dB (QPSK) |
| x) | B.E.R. Immunity at 128 kbps, QPSK, Vit ½ at Eb/No 5.5 dB. | 1x $10^{-5}$ for no subjective loss in quality |
| xi) | Audio Sampling Rate | 48 KHz (24, 32, 44.1 KHz Optional) |
| xii) | Auxiliary data channel<br>a) Data rate<br>b) Interface | <br>≥ 4.8 Kbps<br>RS – 232 |
| xiii) | Supply for LNBC | Provision for + 15 V to + 24 V through output connector to compatible LNBCs |

### B.9.3 INTER-CONNECTING CABLES, CONNECTORS AND ACCESSORIES

Interconnecting RF & Audio cables, power supply cables, connectors, L Band Splitter, audio patch cords (20 nos., assorted length) and other accessories required for the monitoring system shall be included in the tender.

### B.9.4 L -BAND LINE AMPLIFIER

| | | |
|---|---|---|
| 1. | Frequency of operation | 950 - 1450 MHz |
| 2. | Input level | - 80 dBm to -50 dBm |
| 3. | Input and Output Impedances | 75 Ω |
| 4. | Input/ Output return loss | ≥ 8dB |
| 5. | Noise figure (Typical) | ≤ 10 dB |
| 6. | Gain | ≥ 20dB |
| 7. | Gain flatness (Over entire band) | ± 2 dB |
| 8. | Operating voltage (Through centre conductor of the RF cable) | +14V to 24 VDC |
| Features :<br>a) Capable of handling voltage required for LNBC.<br>b) Provision for wall mount installation | | |

## B.10 UPS 2 x 5 KVA (RACK MOUNT TYPE)

Two nos.(1+1) of 5 kVA rack mountable On-Line, single phase UPS with 30 minutes full load backup and two separate individual battery bank of Sealed Maintenance Free batteries are required to be supplied.

**The (1+1) UPS system should work in load sharing mode.**

## B.11 MEASURING EQUIPMENT FOR CES AT BORIVALLI, MUMBAI :

### B.11.1 DIGITAL TEST SET/ TRANSMISSION ANALYSER

This equipment is essentially required to measure the Bit Error Rate (BER) & other communication parameters of digital channel of the overall Captive Earth Station from the input of the uplink chain to the downlink monitoring SCPC Receiver output. The equipment shall therefore, generate the necessary transmit signals for BER & Modulation measurement, which are compatible with the Digital Encoder/Digital modulator on the uplink side. Similarly, the equipment shall have the capability to receive and analyse the digital signals received from the Digital SCPC Receiver on the downlink monitoring side. The data rates and data interfaces provided in the equipment shall be compatible with the Digital Encoder/Modulators and Digital SCPC Receiver. Following features are required for measurements:

| | | |
|---|---|---|
| 1. | Multi interface capability | V.35, V.36/ RS-449, V.11/ X 21, RS -232 |
| 2. | Test Patterns | n X 64 kbps channels of framed signal, unframed signal |
| 3. | PRBS | $2^n$ -1 where n= 6,9,11,15<br>Alternating 1 and 0s, All 1s, All 0s, 8 bit and 16 bit programmable words. |
| 4. | Error injection | Bit, Code, CRC errors, Single, ratio (Single , Continuous or burst) or frequency |
| 5. | Clocking | Internal ( 2048 kbps), External, From RX |
| 6. | Front panel Display | LCD |
| 7. | Stores/ Memory | 8 test result memories and 8 configuration store memory. |

### B.11.2 SPECTRUM ANALYZER

| | | |
|---|---|---|
| 1. | ***FREQUENCY*** | |
| | a) Range | : 100 KHz to ≥ 6.7GHz |
| | b) Tuning Resolution | : 1 Hz |
| | c) Span | :10 Hz to full range; 0 Hz (for Zero Span) |
| | d) Accuracy | : 1 x $10^{-6}$ or better |
| 2. | ***BAND WIDTH*** | |
| | a) Resolution BW | : 10 Hz to 3.0 MHz in 1-3 Steps |
| | b) Video BW | : 1 Hz to 3.0 MHz in 1-3 Steps |
| 3. | ***SWEEP TIME*** | |
| | a) Zero Span | : upto 600 s. |
| | b) Non Zero Span | : 200 ms to 600 s |
| | **c)** Sweep Trigger | : Free Run, External ,Video |

| | | |
|---|---|---|
| 4. | ***AMPLITUDE***<br>a) measurement range<br><br>b) Input Attenuator<br>c) Max. input<br>d) DANL<br><br>e) Overall Accuracy<br><br>f) Disp. per Division<br><br>g) Measurement Units<br>i) Log<br><br>ii) Linear | : **D**isplayed **A**verage **N**oise **L**evel to + 30 dBm.<br><br>: 0 dB to 60 dB in 5/10 dB Step Size.<br>: +30 dBm<br>:Better than -150dBm<br><br>: ± 1.5 dB (or better)<br><br>: 1 dB to 15 dB<br><br>dBm, dBmV, $dB_{\mu V}$<br><br>mV, µV, µW, nW |
| 5. | ***SPECTRAL PURITY***<br><br>a) 10 KHz offset from carrier<br>b) 100KHz offset from carrier | *SSB Phase Noise*<br><br>: -98 dBc/Hz<br><br>: -100dBc/Hz |
| 6. | **DISPLAY** | High resolution LCD color display |
| 6. | **DEMODULATED O/P** | AM and FM on internal speaker/connector |
| 7. | ***DIRECT MEASUREMENT FUNCTIONS***<br><br>**Marker Functions** | : Adjacent Channel Power Ratio, Occupied Bandwidth, Channel power<br><br>:Standard, Delta, Marker to Peak etc for measurement of level etc. |
| 8. | ***Memory*** | : Should have provision for storing ≥ 200 Setups/Traces in Internal / External memory (Flash card). |
| 9. | ***Calibration and Self Test*** | : In-built diagnostics system for self-tests and calibration routines for the instrument to remain within defined tolerances and maintain its accuracy of measurement |
| 10. | ***GENERAL***<br>a) USB 2.0 or equivalent<br>b) RF Input | :  For Data transfer to & from PC.<br>:  N female, 50Ω |
| 11. | a) Operating TEMP. RANGE<br>b) Power requirement | :  0º to + 40º C<br>:  230V ± 10%, 50 ± 2 Hz, single phase |

## B.12 AUTOMATIC ON-LINE PERFORMANCE MEASUREMENT / HEALTH MONITORING SYSTEM

Spectrum Analyzer offered shall preferably integrate with PC/work station so that Spectrum traces and other measured parameter can be stored for further observations/records.

### B.12.1 LAPTOP WITH NETWORK MANAGEMENT SYSTEM (NMS)

A high-end Laptop of reputed make with data acquisition capability and software capability to analyse and present the acquired data in proper format shall be provided. This laptop shall be compatible with the system for control and setting of the operational parameters. Single laptop shall be able to control all the multiple circuits. The concerned Health Monitoring Software shall be installed in it and shall also be supplied **additionally in a CD**.

The Monitoring & Control Software shall have all the necessary features and parameters. The measurement package shall also include various sensors/interfaces etc., for acquiring data from Digital encoder & modulators, upconverters and SSPA on the uplink side and Digital SCPC Receivers on the downlink monitoring side. The system shall also be able to communicate with UPS etc. The data thus acquired from these equipment shall be analysed by the system for storage and continuous display of the following parameters for all the channels uplinked from the Earth Station.

a) Uplink frequency
b) Carrier power
c) Down link frequency
d) Down link C/N
e) Eb /No

Laser-jet Printer of reputed manufactures like HP/Canon/Samsung etc. shall be provided.

**B.12.2** Specifications: Laptop along with compatible NMS hardware & software duly configured (Software for NMS shall also be provided in CD for future reloading).

Laptop shall be rack mountable.(sliding) and shall be of reputed make. It shall be used for control and setting of the operational parameters for Digital encoder, modulators, Upconverters and SSPA on the uplink side and Digital SCPC Receivers on the downlink monitoring side. The operating system should be Pre loaded Genuine licensed Windows Vista(TM) along with Recovery CD media including all drivers etc. Fully loaded configuration. The License shall be in the name of consignee.

## B.13 SPARES (Optional):

Following optional spares should be quoted along with other recommended essential spares suitable for operation in stand alone mode:

i) SSPA (complete unit)
ii) Upconverter (complete unit)
i) Digital Receiver (complete unit)
ii) Digital Encoder (complete unit)
iii) Digital Modulator (complete unit)
iv) C band LNBC (complete unit)
v) L band power divider
vi) Analog Audio distribution amplifier
vii) Digital Audio distribution amplifier
viii) L-band line amplifier
ix) SSPA spares

# SECTION - 'C'

## ATP FOR AUGMENTATION OF UPLINK/DOWNLINK SYSTEM :

### 1 INTRODUCTION

This document describes the Acceptance Test Procedure (ATP) for testing the various units of CES Equipment under procurement. It covers the details of the item to be tested, list of equipment required for testing and the tests required to be carried out.

### 2 ITEMS TO BE TESTED

i) Solid State Power Amplifier (SSPA) for Borivali only.
ii) Up-converter.
iii) Digital Encoder and Modulator.
iv) Receiving System comprising of LNBC, L-Band Line Amplifier and Digital Receiver etc.
v) Spectrum Analyzer.
vi) Transmission Analyzer
vii) UPS
viii) Laptop
ix) Dehydrator
x) Any other item considered necessary

### 3 TEST EQUIPMENT

a) All requisite test equipment conforming to the required standard for testing and commissioning shall be provided by the supplier.

b) List of the test & measuring equipments :

(This is a ***tentative list***. Additional equipment shall be specified by the indenter if needed).

i) Audio Analyzer and Spectrum Analyzer (>8 GHz range)
ii) Power Meter with sensor & Attenuator etc. (Capable to measure 125 W)
iii) Frequency counter ( ≥ 7 GHz)
iv) Signal Generator (≥ 7 GHz)
v) Noise figure meter with noise source.
vi) Digital Modulation Analyzer
vii) PC with Printer
viii) Any other equipment and standard reference source/setup necessary for measurements.
ix) Calibrated Directional coupler, inter-connecting cables, Attenuators, combiner, Dividers, adopters etc. as may be necessary for the tests.

## 4. TESTS REQUIRED TO BE CARRIED

(NOTE: This is only a ***tentative list***; Additional items of tests may be specified and carried out by the indenter, if needed.

### 4.1 S.S.P.A.

i) Functionality test for individual SSPA and in (1+1) configuration.
ii) Power output check
iii) Gain check
iv) Gain flatness check
v) Frequency response
vi) IMD Product
vii) Spurious
viii) Any other tests to check the conformity to the specs.

### 4.2 UP-CONVERTER :

i) Functionality test for individual up-converter and in (1+1) configuration
ii) Output frequency check
iii) Output level and stability check
iv) Frequency stability
v) IMD Product
vi) Spurious check
vii) Phase Noise check
viii) Any other test to check the conformity to the specs.

### 4.3 DIGITAL MODULATOR AND DIGITAL ENCODER

i) Functionality test for individual modulator and in (1+1) configuration
ii) I.F. Range
iii) O/P Frequency stability and accuracy
iv) O/P level stability
v) Coding standard, data rates check
vi) Digital modulation selectability check
vii) All Base-band measurements alongwith receivers
viii) Spurious Check
ix) Any other test to check the conformity to the specs.
x)

### 4.4 RECEIVING SYSTEM

i) Functionality check for individual monitoring setups for Digital demodulator.
ii) Test for LNBC - output frequency level, L.O. stability, Noise Temp., phase and spurious noise, gain etc.
iii) Test for Digital Demodulator/Receiver including carrier lock range, Eb/No, Analogue and digital (AES/EBU) outputs, level, THD, Noise level, Freq. Response and Cross Talk for both stereo channels, BER immunity test etc.

### 4.5 ANTENNA SYSTEM : The tests for antenna will include:

i) Antenna functionality test as per details given in the specifications.
ii) Antenna transmit Gain.

iii) Antenna Radiation Pattern : The radiation pattern conforming to ITU standard specified shall be got cleared by the Supplier and original certificate from NOCC in respect of radiation pattern &X-pole measurements to be submitted to indenter for records.
iv) Receive Gain
v) Cross Pole Discrimination
vi) VSWR/ Return loss
vii) Port to port isolation.
viii) Any other test to check the conformity to the specs

### 4.6 INTEGRATED SETUP (AT SITE)

a) After the individual tests the equipment will be installed and integrated to work as CES as per specs. The integrated setup will then be tested for complete system performance and functions.

b) The tests for commissioning would include the integration check and conformity to system specs including:

i. EIRP Stability
ii. Radiation conformity to ITU Standard specified
iii. Emissions conforming to International Standard for Satellite transmission.
iv. Overall uplink/down-link check and performance measurements to meet the specs.
v. Any other tests necessary to check the conformity to specs.

### 4.7 PERIPHERAL EQUIPMENT

All peripheral equipment like UPS (battery details like nos. & rating), laptop (System configuration and installed software etc.), Test & Measuring equipment (functionality operation etc.) etc. shall be tested for the various functionalities specified and conformity with the specification.

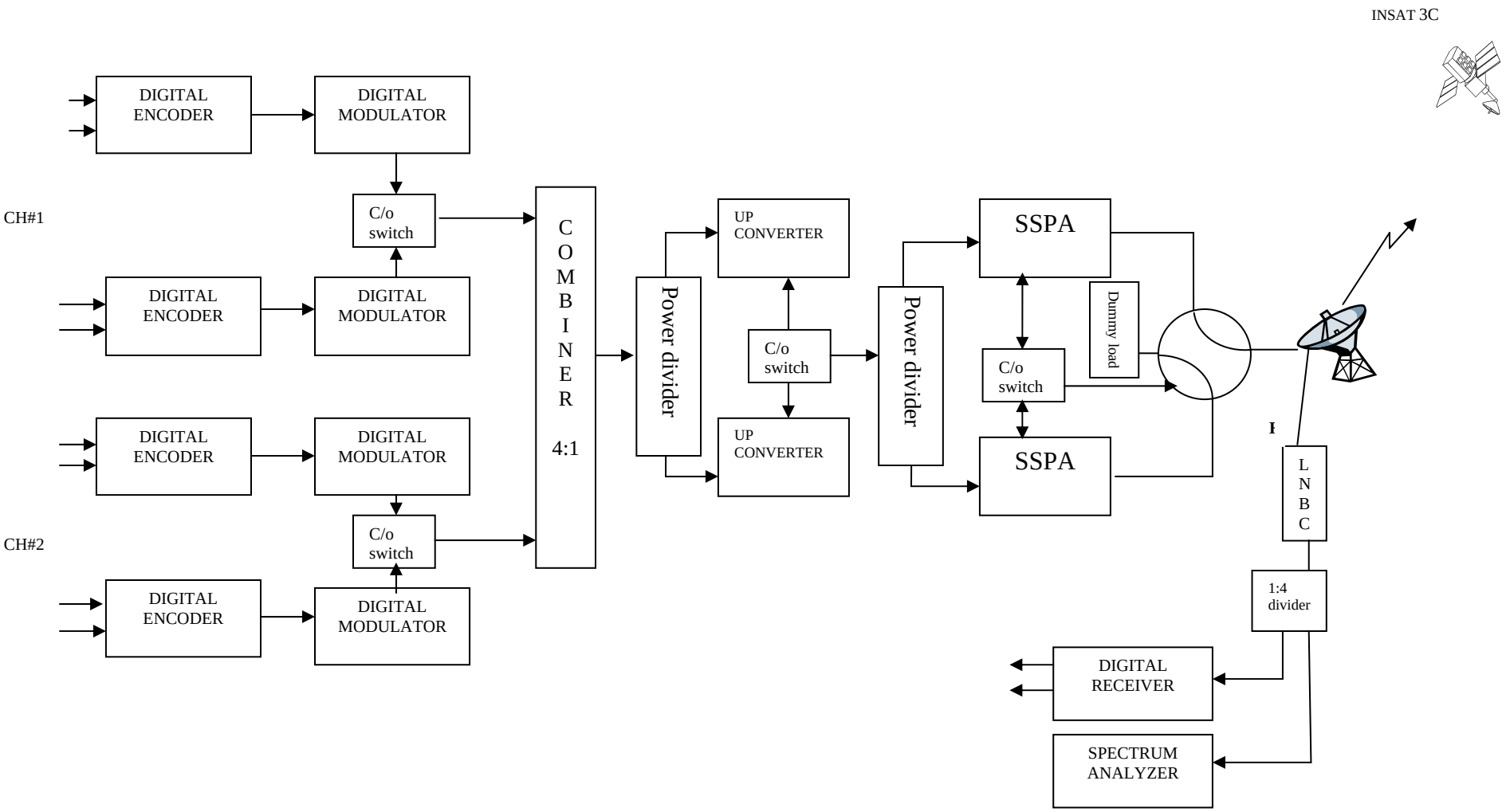
**4.8** In addition, all the manuals/ drawings will be inspected for completeness.

## 5. DETAILED ATP

i) Based on above, supplier shall give a detailed ATP document giving procedure for tests of individual item as well integrated setup. This should include test setup, equipment details, inter-connection diagram and the Format for test reports

ii) The indenter will examine the same and then it will be finalized after mutual discussion.

**REPRESENTATIVE BLOCK DIAGRAM OF CAPTIVE EARTH STATION** **ANNEXURE I**




Note: UPS & NMS etc. not shown