

**PRASAR BHARATI
DIRECTORATE GENERAL : ALL INDIA RADIO
(TELECOM DIVISION)**

SPECIFICATIONS COVER SHEET

TITLE	:	Captive Earth Station
SPECIFICATION NO.	:	TC/SPEC/69/2009/CES-New
DATE OF LAST UPDATION	:	Sept. 2009
NO. OF PAGES	:	27
SCHEME	:	CES for AIR Silchar and AIR Dehradun

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**Subject : Specification for the Captive Earth Station at
AIR Silchar and AIR Dehradun**

1. INTRODUCTION :

AIR requires Captive Earth Stations (CES) to uplink its Radio programmes for distribution in its network through satellite. The Captive Earth Station under reference is to be installed at the AIR, Silchar and AIR Dehradun. The programmes uplinked by this CES will be received by other AIR stations with their Radio Networking (Receive) Terminals (RNT) and used either for recording or for retransmission through their terrestrial transmitters.

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 uplink signal from the CES will be in C-Band and provision should exist for monitoring the downlink. 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) Equipment as per specifications and requirements given in Section 'A' and Section 'B' as detailed in the tender.
- ii) Acceptance testing of the equipment as per ATP given in Section 'C'.
- iii) Installation, integration, testing and commissioning of the complete system incl. all civil ,electrical earthing, foundations, wave guide tray along with support structure etc.
- iv) Obtaining NOCC clearance for PDA.

- 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 at least five years experience in the field of installation & commissioning of Captive 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.

2.10 The Parabolic Dish Antenna along with its controller and accessories will be inspected during final inspection as per 2.8 above.

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 supply of Captive Earth Station at AIR Silchar and AIR Dehradun 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:

Studio Center, All India Radio Silchar & Dehradun

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:

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

5.3 Spares(Optional)

Tenderer shall 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.14.

5.4 Training

Five working days **O&M** and Equipment Servicing training for engineers at each site i.e. Silchar & Dehradun shall be arranged at AIR Silchar and AIR Dehradun 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 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 **must quote** separately for recommended essential spares 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'**LIST OF EQUIPMENT AT EACH SITE:**

Sl. No.	Item	Quantity	Reference
1.	6.1M(Nominal) Parabolic, Motorised Antenna with controller and 2-port linear motorised feed and accessories.	1 Set.	Section B.1
2.	50W C-band Solid State Power Amplifier (1+1) in Hot standby configuration with auto-changeover unit along with Dummy-load & Dummy load power measuring accessories.	1 Set	B.2
3.	Synthesized IF to C-Band Up-converter 1+1 with auto-changeover Unit.	1 Set	B.3
4.	a)Digital Encoder (1+1)	2 Sets	B.4.1
	b)Digital IF Modulator (1+1) with auto-changeover Unit	2 Sets	B.4.2
5.	Stereo Audio Processor	4 Nos.	B.5
6.	Inter-facility links including Wave guides, couplers, IF Combiner, adapters, cables and other accessories for Antenna connection to SSPA etc.	1 Set	B.6
7.	Wired racks for housing digital base band, IF and RF Equipments including their changeover units etc.	3 Nos.	B.7
8.	Cables connectors and other accessories including Audio Distribution Amplifier(analog+ digital) for integration of the complete system. (1 set per channel)	2 Set.	B.8
9.	Dehydrator with accessories like tubing etc. complete	1 Set	B.9
10.	Monitoring system: i. C-Band LNBC (1+1) ii. Digital Receivers (1+1) iii. Stereo audio Monitoring Amplifier with Analog & Digital inputs. iv. Interconnecting cables connectors & accessories v. L Band Line Amplifier (1+1) vi. L band 1:4 divider	2 Sets 2 Sets 1 No. 1 Set 2 Sets 2 Nos.	B.10 B.10.1 B.10.2 B.10.3 B10.4 B.10.5 B.10.6
11.	UPS 2x5 KVA with autochange-over switch (Rack Mount Type)	1 Set.	B.11
12.	Automatic on-line performance measurement and health monitoring system NMS consisting of: Laptop with NMS software from OEM ,necessary add-on cards for digital I/O, Data Acquisition etc., and LaserJet Printer for hardcopy output of measurement results	1 Set	B.13 B.13.1
13.	Wave guide tray with support system	1 Job	
14.	Earthing system	1 Job	
15.	Inspection	1 Job	2.8
16.	Installation, Testing & Commissioning of the above at Site including NOCC clearance of PDA	1 Job	2.0
17.	Operation & Maintenance Training at Site (one week)	1 Job	5.4

B. Measuring Equipment for CES at each site.

Sl. No.	Item	Quantity	Reference
1	Digital Transmission Analyser	1 No.	Section B.12.1
2	Spectrum Analyser	1 No.	B.12.2
3	GPS Meter	1 No.	B.12.3
4	R.F. Signal Generator	1 No.	B.12.4
5	R.F.Power Meter	1 No.	B.12.5
6	Frequency Counter	1 No.	B.12.6

- C.** 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 FOR CES AT AIR SILCHAR AND AIR DEHRADUN

B.1 6.1M (Nominal) PARABOLIC DISH ANTENNA WITH MOTORISED CONTROL FOR AZIMUTH, ELEVATION AND POLARISATION/ FEED ANGLES AND TWO PORT LINEAR MOTORISED C- BAND FEED WITH TRF.

(A) ELECTRIC SPECIFICATIONS		
a)	Type	King Post, Elevation over Azimuth
b)	Nominal Diameter	6.1 Meter
c)	Frequency Range a) Transmit b) Receive	5.850 to 6.425 GHz 3.700 to 4.200 GHz
d)	Antenna gain (mid band)	i) Transmit : ≥ 49 dBi ii) Receive : ≥ 46 dBi
e)	Antenna G/T	≥ 26 dB/°K
f)	Antenna Beam width i. 3 dB Beam width	≤ 0.6 degree
g)	Side lobes (Transmit and Receive)	As per ITU-R Rec. S.580-V (or latest amendments)
Note : Antenna radiation pattern conformity to ITU-R standard shall be got cleared by the supplier from NOCC/DOT before the completed installation is offered for acceptance for commissioning by AIR).		
h)	Feed and Feed Port	2 Port feed Transmit VLP/HLP Receive HLP/VLP
i)	On axis Cross polarization isolation	≥ 30 dB
j)	Trans-Receive Isolation	≥ 80 dB
k)	Feed insertion loss i) Transmit ii) Receive	≤ 0.2 dB ≤ 0.25 dB
l)	Feed mount type	Cassegrain
m)	VSWR (Return loss) a) Transmit ports b) Receive ports	$\leq 1.30 : 1$ (17 dB) $\leq 1.30 : 1$ (17 dB)
n)	Output wave guide flange interface a) Transmit ports b) Receive ports	CPR – 137 G CPR – 229 G
o)	Power handling capacity	≥ 2 KW CW

(B) Mechanical Specifications		
p)	Antenna orientation	Motorized version for AZ, EL & POL/Feed Alignment along with Manual override.
q)	Antenna steerability a) Elevation b) Azimuth c) Polarization adjustments	15° to 90° (continuous) ± 50° (continuous) ± 90° (continuous) (Scale(s) to be provided for indication)
r)	Wind Speed a) Operational b) Survival	70 kmph 110 kmph
s)	Lightening Protection	Provision for Lightening arrester for antenna.
© MOTORISED CONTROL OF ANTENNA		
a)	Controls required	Azimuth, Elevation and Polarisation/Feed.
b)	Front panel Angle indications	Azimuth, Elevation and Polarisation/Feed.
c)	Safety requirements	i) Limit switches to interlock in each direction of travel. ii) Emergency 'stop' control. iii) Provision for grounding/Earthing.
d)	Position encoding	Absolute, single speed, through brushless resolvers.
e)	Antenna Controller should have	i) The facility for auto-pointing. ii) Capable of storing co-ordinates for at least 5 parking slots. iii) Facility for motor operation in continuous and step mode.
g)	Input power requirement	3 phase 400V±5% /single phase 230±10% VAC, 50±2 Hz.
h)	System interconnect cabling	Shielded cable as per requirement up to a max. length of 1500 ft.

B.2 50W C-BAND SOLID STATE POWER AMPLIFIER (SSPA)(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 : + 46 dBm
(P1dB)

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 $\pm 1 \times 10^{-8}$ over temp. 0° to 50°C & $\pm 1 \times 10^{-9}$ 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 -80 dBc/Hz, 1 KHz away from carrier -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 +50°C

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, Joint 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)	:	$\leq 0.2\%$ 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 $\pm 10\%$, 50Hz $\pm 4\%$
t)	Operating temp. range	:	0°C to +50°C

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 b) Sequential 1/2, 3/4, selectable
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	:	1×10^{-6} or better

- k) Configuration : 1 + 1 in hot-standby with auto c/o unit
- l) Power supply : 230VAC \pm 10%, 50Hz \pm 4%
- m) Operating temp. range : 0°C to +50°C

B.5 STEREO AUDIO PROCESSOR:

The processor is to optimize modulation with emphasis on clarity, loudness, compression and AGC control etc. and shall conform to the following specifications:

- 1. Frequency response : 20 Hz - 20 KHz : Within \pm 0.5dB
- 2. Configuration : Stereo/dual mono
- 3. Analog input/output : XLR, EMI suppressed, separate for L&R Ch.
- 4. Max. Input level : +24 dBm
- 5. Output level : Front panel Adjustable upto +24dBm
- 6. Digital Input/output : AES/EBU standard professional
- 7. Distortion : \leq 0.05%
- 8. SNR : >80dB
- 9. Indications : LED/ level indicator should be provided for indicating various threshold levels.

The processor is to be supplied in 19" rack chassis.

B.6 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.7 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.8 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.9 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.10 MONITORING SYSTEM FOR DIGITAL UPLINK

The monitoring 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.10.1 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	$\leq 35^\circ\text{K}$
g)	Conversion gain	≥ 55 dB
h)	Phase Noise 1 KHz 100 KHz	-60 dBc/Hz -80 dBc/Hz
i)	Output impedance & Connector	75 Ω ; F (Female)
j)	Power supply	+ 15 V to + 24 V through output connector

B.10.2 DIGITAL SATELLITE RECEIVER WITH L- BAND INPUT

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

B.10.3 STEREO AUDIO MONITORING EQUIPMENT

The Tender shall include a hi-fi 10+10 W professional stereo monitoring amplifier and matching professional stereo speakers system with AES/EBU & Analog inputs.

Stereo Monitoring Amplifier with quality speakers

Power output: 10+10W for L & R channel.
 Input: AES/EBU & Analog
 Frequency response: 20 Hz to 15 kHz \pm 1dB
 Distortion: \leq 0.5%
 AC Power: 230V \pm 10%, 50 Hz \pm 4%

Equipment should be 19" rack mountable.

B.10.4 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.10.5 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	\geq 8dB
5.	Noise figure (Typical)	\leq 10 dB
6.	Gain	\geq 20dB
7.	Gain flatness (Over entire band)	\pm 2 dB
8.	Operating voltage (Through centre conductor of the RF cable)	+14V to 24 VDC
Features :		
a) Capable of handling voltage required for LNBC.		
b) Provision for wall mount installation		

B.10.6 L Band 1:4 divider

(a)	Type of splitter	passive type
(b)	No.of outputs	Four
(c)	Division loss	\leq 7.5 dB Typical
(d)	Input impedance	75 ohm
(e)	Output impedenc	75 ohm
f)	One in/out port to be DC pass	

B.11 UPS 2 x 5 KVA (RACK MOUNT TYPE)

Two nos.(1+1) of 5 kVA rack mount UPS with individual battery bank has to be supplied along with auto changeover switch

a)	Type	On-Line , Pure Sine wave
b)	Power rating	5 KVA, Single phase
c)	Battery back up	30 minutes (full rated load of UPS)
d)	Type of battery	Sealed Maintenance Free.
e)	Input Voltage	180 – 270 Vac, 230 Vac (Nominal); 50 Hz, single phase
f)	Output voltage	230V \pm 2%, 50 Hz, single phase
g)	Type approval	ISO certified, standard, reputed make
h)	Metering & Indicators	It should be possible to monitor battery low, over Load etc. through Meters/Indicators/Network Management Software (NMS). It should also be possible to monitor all types of alarms.

B.12 MEASURING EQUIPMENT FOR CES AT EACH SITE :**B.12.1 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 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.12.2 SPECTRUM ANALYZER

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

4.	AMPLITUDE a) measurement range b) Input Attenuator c) Max. input d) DANL e) Overall Accuracy f) Disp. per Division g) Measurement Units i) Log ii) Linear	: Displayed Average Noise Level to + 30 dBm. : 0 dB to 60 dB in 5/10 dB Step Size. : +30 dBm : Better than -150dBm : ± 1.5 dB (or better) : 1 dB to 15 dB dBm, dBmV, dB _μ V mV, μV, μW, nW
5.	SPECTRAL PURITY a) 10 KHz offset from carrier b) 100KHz offset from carrier	<i>SSB Phase Noise</i> : -98 dBc/Hz : -100dBc/Hz
6.	DISPLAY	High resolution LCD color display
6.	DEMODULATED O/P	AM and FM on internal speaker/connector
7.	DIRECT MEASUREMENT FUNCTIONS Marker Functions	: Adjacent Channel Power Ratio, Occupied Bandwidth, Channel power : 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 a) USB 2.0 or equivalent b) RF Input	: For Data transfer to & from PC. : N female, 50Ω
11.	a) Operating TEMP. RANGE b) Power requirement	: 0° to + 40° C : 230V ± 10%, 50 ± 2 Hz, single phase

B.12.3 GPS RECEIVER

This system is required for finding out the exact six figures geographical co-ordinates (Longitude and Latitude), Height Above Mean Sea Level of sites and to accomplish mapping during field strength survey. The equipment shall be user friendly and based upon latest state of art design using microprocessors.

SPECIFICATIONS:

- a) **TRACKING CAPABILITY** -continuous and updates position every sec.
- b) **ACCURACY** :Position : 20m
- b) GPS Receiver should be able to down load & upload the required data & maps from the computer to GPS memory.
- c) **ACQUISITION TIME** : Less than 60 seconds initially, Less than 1 second in warm condition

Electronic compass feature: Accuracy \pm 2 degree

Standard accessories: memory card, interconnecting cable etc. to be provided.

B.12.4 R.F. SIGNAL GENERATOR

1.	Frequency 1.1 Range 1.2 Resolution 1.3 Stability	250 KHz to 2.0 GHz \leq 1.0 Hz $\leq 1 \times 10^{-9}$
2.	Spectral purity (at f=1GHz) 2.1 Non-harmonics (offset \geq +10 KHz) 2.2 Phase noise (20kHz carrier offset, 1Hz measurement BW)	< -70 dBc -130dBc/Hz _____
3.	Output level 3.1 Range	-120 to + 13 dBm

4.	4.1 Digital Modulation a) Modulation Modes b) Symbol rate	QPSK QAM (16, 32 64, 256) :upto 1.5 Mbps or better (Adjustable)
6.	General 6.1 Temperature range a) Operating 6.2 Relative humidity 6.3 Power supply	0 to +40°C 95% at 40°C 230V ± 10%, 50 ± 2 Hz, single phase

B.12.5 R.F. POWER METER

1.	Frequency Range	100 KHz to 7 GHz with suitable sensors
2.	Power Range	-70dBm to +33dbm with suitable sensors and attenuators
3.	Accuracy (Instrumentation)	± 1% of full scale on all ranges
4.	Reference calibrator	Should be available
5.	Measurement Accessories	All sensors, couplers, attenuators etc. required for power measurement over the entire frequency band shall be supplied with the power meter.
6.	Power supply	230V±10%, 50Hz ± 2Hz (with battery option)
7.	Operating Temperature range	0°C to +40°C

B.12.6 FREQUENCY COUNTER

1.	Frequency Range	10 Hz - 7 GHz
2.	Input impedance	≥ 1M / 30pF, 50 Ω
3.	Sensitivity	-15dBm or better
4.	Max. safe input level	≥ +10dBm
5.	FM tolerance	20 MHz p-p or better
6.	Reference oscillator stability	± 5 x 10 ⁻¹⁰ per day
7.	Temp. stability of reference oscillator	± 5 x 10 ⁻⁹ over temp. range 0°C to +40°C (reference to 25°C)

8.	Resolution	1 Hz to 100 KHz
9.	Display	10 digits or more
10	Power supply	230V±10%, 50Hz± 2Hz (with battery option)
11	Operating Temperature range	0°C to +40°C

B.13 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.13.1 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.

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.

- a) **CPU:** Intel(R) Core 2 Duo Processor, 1.8 GHZ or latest version.
- b) **RAM:** minimum 2 GB
- c) **HDD:** 160 GB Hard Drive,
- d) **Optical Drive:** Internal 8X DVD+/-RW Combination Drive
- e) **Net work interface card:** 10/100 Base T NIC card
- f) **Operating System:** Pre loaded Genuine licensed Windows Vista(TM). Recovery CD media including all drivers etc. Fully loaded configuration. License in the name of consignee.
- g) **Display:** 15" Widescreen .
- h) **Modem:** Min. 56Kbps
- i) **Ports:** i) Serial Comm: 1 Nos or more (RS 232)
ii)USB 2.0: 3 No's or more
- j) **Battery Pack:** Lithium-ion.
- k) **Media reader:** Integrated media reader, touch pad.
- l) **External mouse:** Optical
- m) **Standard Features:** At least 3 Hrs battery backup, A/C power adopter/charger.
- n) **Laser jet printer** of reputed make.

B.14 SPARES (Optional):

Following optional spares shall be quoted along with other recommended essential spares:

- 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 (complete unit)
- vi) Analog Audio distribution amplifier
- vii) Digital Audio distribution amplifier
- viii) L-band line amplifier
- ix) SSPA spares

SECTION - 'C'

ATP FOR CES AIR SILCHAR & AIR DEHRADUN

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).
- ii) Up-converter.
- iii) Digital Encoder and Modulator.
- iv) Monitoring System comprising of LNBC, L-Band Line Amplifier and Digital Receiver, monitoring Amplifier etc.
- v) Spectrum Analyzer.
- vi) GPS receiver.
- vii) RF Signal Generator
- viii) Transmission Analyzer
- ix) Power Meter
- x) Frequency Counter
- xi) UPS
- xii) Audio Limiter
- xiii) Laptop
- xiv) Dehydrator
- xv) 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, adapters 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.

4.4 MONITORING 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 (at Each Site): 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 from NOCC by the Supplier and original certificate from them 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), PC (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.

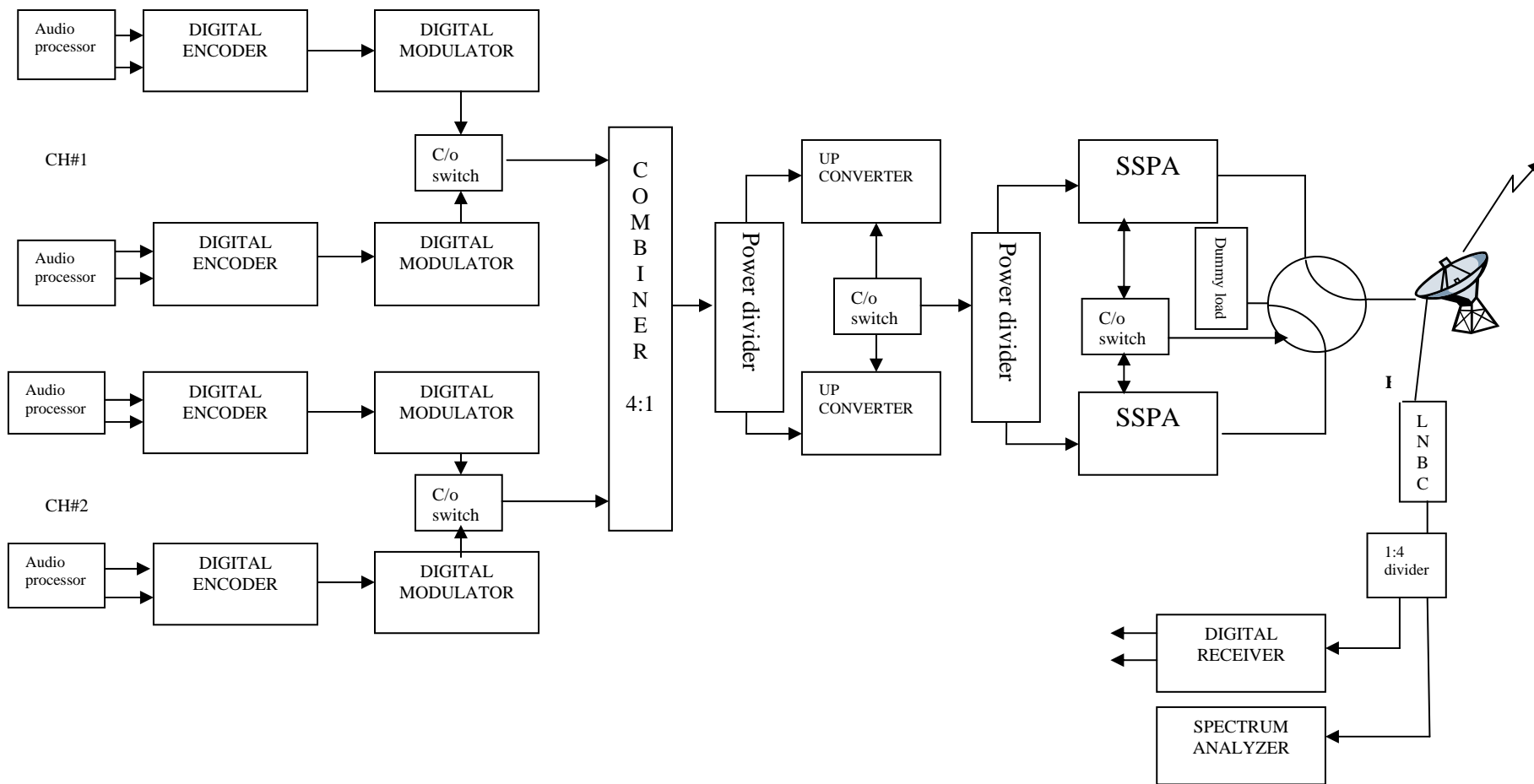
- 4.8 In addition, all the manuals/ drawings will be inspected for completeness.

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 CES FOR AIR SILCHAR AND AIR DEHRADUN

INSAT 3C



Note: UPS & NMS etc. not shown