

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

SPECIFICATIONS COVER SHEET

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TC/SPEC/04/02/CES-New

**Subject : Specification for the Captive Earth Station at
AIR, Silchar.**

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. 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. It is essential that the Captive Earth Station - RNT link-up which is a part of the satellite based programme distribution system should not impair the quality of the Radio programmes. The Captive Earth Stations should be capable of uplinking signals to the satellite conforming to AIR's specifications and all other 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 (**Annexure-I**) and be compatible with the existing Radio Networking Receive terminal of AIR.

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'

SECTION 'A'**2. CONFIGURATION:**

The supply of Captive Earth Station at Silchar will be as per the configuration given in Annexure-II and will include:

A. Main Equipment:

Sl. No.	Item	Quantity	Reference
1.	6 m Parabolic, Motorised Antenna with controller and 2-port feed and accessories.	1 Set.	Section B.1
2.	100 W C-band Solid State Power Amplifier (1+1) in HSB configuration with auto-changeover unit along with Dummy-load.	1 Set	B.2
3.	Synthesized IF to C-Band Up-converter 1+1 with auto-changeover Unit.	1 Set	B.3
4.	Digital Encoder (1+1) and Digital IF Modulator (1+1) with auto-changeover Unit	2 Set	B.4
5.	PC required for Digital Encoder, Digital IF Modulator, C-Band Upconverter, SSPA and Digital Receiver.	1 No.	B.5
6.	Stereo Limiter /Processor	4 Nos.	B.6
7.	Inter-facility links including Wave guides, couplers, IF Combiner, adopters, cables and other accessories for Antenna connection to SSPA	1 Set	B.7
8.	Wired racks for housing digital base band, IF and RF Equipments including their changeover units etc.	3 Nos.	B.8
9.	Cables connectors and other accessories including Audio Distribution Amplifier for integration of the complete system.	1 Set.	B.9
10.	Dehydrator	1 No.	B.10
11.	Monitoring system: <ul style="list-style-type: none"> i. C-Band LNBC ii. Digital Receivers iii. Stereo audio Monitoring Amplifier with Analog & Digital inputs. iv. Interconnecting cables connectors & accessories along with L Band Splitter. v. L Band Line Amplifier 	2 Nos. 4 Nos. 1 No. 1 Set 2 Nos.	B.11 B.11.1 B.11.2 B.11.3 B11.4 B.11.5
12.	UPS 2x5 KVA with autochange-over switch (Rack Mount Type)	1 Set.	B.12
13.	Automatic on-line performance measurement and health monitoring system consisting of: PC/work station with necessary add-on cards for digital I/O, Data Acquisition etc., software and LaserJet Printer for hardcopy output of measurement results	1 Set	B.14 B.14.1

14.	Inspection	1 Job	A-4.10
15.	Installation, Testing & Commissioning of the above at Site.	1 Job	
16.	Operation & Maintenance Training at Site (one week)	1 Job	A-5.4

B. Measuring Equipment for CES.

Sl. No.	Item	Quantity	Reference
1	Digital Transmission Analyser	1 No.	Section B.13.1
2	Spectrum Analyser	1 No.	B.13.2
3	GPS Meter	1 No.	B.13.3
4	R.F. Signal Generator	1 No.	B.13.4
5	R.F.Power Meter	1 No.	B.13.5
6	Frequency Counter	1 No.	B.13.6

C. Details of other items, if any required for complete integration, operation and testing of equipment (not included in these specifications) may be furnished with the tender.

3. LOCATION FOR SUPPLY & INSTALLATION:

Studio Center, All India Radio, Silchar.

4 SCOPE:

4.1 The Scope of this tender supply includes

- i) Supply of the 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

4.2 The indenter will provide:

- i) Space for installation.
- ii) Prime Power Supply.

4.3 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.

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

- 4.5 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.**
- 4.6 The tenderer shall propose and quote one and only one option for subsystem. Multiple options proposed by the tenderer for any subsystem will not be considered and evaluated by the purchaser.
- 4.7 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.
- 4.8 **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.
- 4.9 Tenderer may be asked to demonstrate the equipment(s) during technical evaluation.
- 4.10 **Inspection:**
- 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.
- 4.11 Supplier shall give intimation to the indenter for carrying out Inspection at supplier's Works at least 6 weeks in advance. Following charges 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.
- 4.12 Any requirement to be met by the indenter shall be clearly brought out by the tenderer.

- 4.11 Only those firms having vast 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.
- 4.12 The Parabolic Dish Antenna along with its controller and accessories will be inspected during final inspection as per Section A 4.6 –ii above.

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, 1Φ |

- 5.2 **Manual:** Original 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 for AIR Silchar.
 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 in stand alone mode must be offered under "Spares". Essential spares of SSPA shall also be quoted.

5.4 Training

One weeks **O&M** and Equipment Servicing training for engineers working at AIR Silchar and from other AIR offices shall be arranged at AIR Silchar 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

substantiating the compliance in respect of the specs. 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 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 8 to 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 8 to 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) Warranty and guarantee clause will be as per the terms and conditions specified in the commercial section of the tender in this respect.

5.9 Optional items

Tenderer **must quote** separately for recommended essential spares including their quantities and cost.

5.10 Delivery Period

The delivery period for SITC of all the items shall be of five months from the date of order.

SECTION - B

TECHNICAL SPECIFICATIONS/REQUIREMENTS

MAIN EQUIPMENT SPECIFICATIONS FOR CES SILCHAR

B.1 6 M PARABOLIC DISH ANTENNA WITH MOTORISED CONTROL FOR AZIMUTH, ELEVATION AND POLARISATION/FEED ANGLES AND TWO PORT LINEAR C-BAND FEED WITH TRF.

(A) ELECTRIC SPECIFICATIONS		
a)	Type	King Post, Elevation over Azimuth
b)	Nominal Diameter	6 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	≥ 24.3 dB/K
f)	Antenna Beam width i. 3 dB Beam width ii. 15 dB Beam width	As per ITU-R Rec. S.580-V (or latest amendments) Figures shall be indicated
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	≥ 33 dB
j)	Trans-Receive Isolation	≥ 80 dB with TRF
k)	Feed insertion loss i) Transmit ii) Receive	≤ 0.2 dB ≤ 0.4 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	75 kmph 110 kmph
s)	Pointing Stability	± 0.2°
u)	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.
f)	Position encoding resolution	14 bit
g)	Input power requirement	3 φ 415V±5% /1φ 230±10% VAC, 50±2 Hz.
h)	System interconnect cabling	Shielded cable as per requirement up to a max. length of 1500 ft.

B.2 100 W 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 output power at the output of wave-guide flange | : | 80 W continuous |

c)	Input Impedance & Freq.	:	50 Ω ; 5850 – 6425 MHz
d)	Gain Frequency Response	:	± 1 dB over any 40 MHz ± 3 dB over full band
e)	Saturated output power	:	Nominal 100W (50 dBm)
f)	R.F. level control	:	0-20 dB continuous
g)	Gain stability for constant temp. & drive	:	± 2 dB over 0° to 50° Celsius ± 0.5 dB (24 hour)
h)	Input VSWR	:	$\leq 1.3 : 1$
i)	Output VSWR	:	$\leq 1.25 : 1$
j)	Phase Noise	:	Should meet IESS 308/309 at 100 Hz offset : -60 dBc at 1 KHz offset : -80 dBc at 10 KHz offset : -90 dBc
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	:	Better than -25 dBc
p)	Monitor	:	RF (O/P) – 30 dB or better w.r.t output

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	:	-20 dBm to 0 dBm
h)	Input connector	:	BNC-F
i)	Input Return loss	:	19 dB or better
j)	Output level	:	+10 dBm or more at 1 dB compression

k)	Overall Conversion gain	:	30 dB or more
l)	Gain control Step Size	:	0.2 dB or smaller.
m)	Gain Slope	:	± 0.05 dB/MHz
n)	Output Return loss (VSWR)	:	19 dB or better ($\leq 1.25 : 1$)
o)	Amplitude / Gain stability	:	± 0.25 dB per day at constant temp.
p)	Type of conversion	:	Dual conversion spectrum non-inverted
q)	Amplitude response	:	± 0.5 dB over the input frequency range of 52 MHz to 88 MHz.
r)	Third order IMD Product	:	-40 dBc with two equal carriers at 10 dB total output Back off.
s)	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
t)	Spurious (in band)	:	-60 dBc below carrier (un-modulated)
u)	Standby operation	:	1 + 1 hot redundancy, auto change-over with manual over ride feature.
v)	Mounting	:	19" Rack
w)	Test Port	:	IF and RF
x)	Remote Interface	:	RS232/ RS485 for parameter setting: Freq., Gain, Fault Status, Attenuation, RF On/Off etc.
y)	Front Panel Indications	:	Power, Standby, Fault, Remote/Manual

B.4 DIGITAL ENCODER (1+1) AND DIGITAL IF MODULATOR (1+1) WITH AUTO-CHANGEOVER UNIT.

The Digital encoder for base band encoding and digital modulator should conform to the standard and specification of the existing digital radio networking system in AIR Network. The existing digital receivers are Radyne make. So modulator and encoder should be compatible with the same. It should be possible to control/set encoder & modulator through front panel as well as through PC.

B.4.1 AUDIO BASE BAND DIGITAL ENCODER

a)	No. of Analog audio inputs	:	Two mono/one stereo
b)	Digital Audio input	:	AES/EBU Standard (Professional) Connector DB-15/XLR
c)	Audio Signal Bandwidth	:	20 Hz to 20 KHz
d)	Input Impedance	:	≥ 10 k Ω (Analog) 110 Ohm (digital)
e)	Input level (max.)	:	+12 dBu (peak)
f)	Dynamic range	:	≥ 80 dB.
g)	Compression	:	ISO/MPEG-1 layer 2
h)	Data rates	:	64, 128, 192, 256 & 384 kbps (selectable)

i)	Modes	:	Mono, Dual Mono, Joint stereo
j)	Sampling rate	:	48 KHz (24, 32, 44.1 KHz Optional)
k)	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
l)	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
m)	Total Harmonic Distortion (THD)	:	$\leq 0.2\%$ at 1 KHz for +8 dBu output from the receiver.
n)	Signal to Noise Ratio	:	≥ 75 dB at 1 KHz for +12 dBu output from the receiver
o)	Idle Channel Noise	:	≤ -60 dBu (unweighted)
p)	Cross talk Isolation between the two Channels	:	≥ 75 dB w.r.t. +12 dBu output from the receiver at 1 KHz
q)	Stereo phase deviation	:	$\leq 1^\circ$ at all frequencies
r)	Auxiliary data channel	:	≥ 4.8 kbps
s)	Interface for aux.	:	Asynchronous, RS-232
t)	Operation	:	Encoder & Decoder independently
u)	Interface Type	:	Transformer Coupled, balanced

B.4.2 DIGITAL IF MODULATOR

a)	Type of Modulation	:	QPSK/BPSK user programmable
b)	IF Frequency	:	52 to 88 MHz continuously adjustable in ≤ 10 Hz step.
c)	Frequency Accuracy & Stability	:	Accuracy : ± 10 Hz Stability : ± 1 ppm over the temp. range 0 to 50°C over a period of one year
d)	Output level	:	0 to - 20 dBm adjustable in ≤ 0.1 dB step.
e)	Channel coding	:	a) Viterbi 1/2, 3/4, 7/8 and 1 b) Sequential 1/2, 3/4, 7/8 and 1
f)	Spurious	:	-50 dBc (in band); -45 dBc (out of band)
g)	Data rate	:	64, 96, 112, 128, 192, 256, 384 kbps (programmable)
h)	Interface	:	V.35
h)	Configuration	:	1 + 1 in hot-standby with auto c/o unit in connection with digital encoder and with manual override.

B.5 PERSONAL COMPUTERS

A computer (with genuine windows X-P Professional or upgraded version) similar to IBM/DELL/Compaq/HP shall be offered. This computer shall be compatible with Digital Encoder and Digital IF Modulator for control and setting of the operational parameters. The computer shall be of sleek and rack mount type.

a)	Display	LCD/TFT type, ≥ 43.18 cm (17"), Resolution $\geq 1024 \times 768$ pixels.
b)	CPU	Intel® Core™ 2 Duo Processor, (≥ 2.33 GHz, 4 MB L2 Cache, ≥ 1333 MHz FSB) or Latest
c)	RAM	1 GB (DDR2, ≥ 533 MHz, SDRAM).
d)	Hard Disk Drive	≥ 80 GB HDD.
e)	Net Work Interface Card	10/100 Mbps Network Card.
f)	Sound Card	Integrated Sound Card along with quality speakers.
g)	Pointing Device	Optical scroll mouse.
h)	Keyboard	Standard Key Board.
i)	Optical Drive	CD-RW / DVD Combo (52x32x52x; 16x or better)
j)	Modem	56 kbps.
k)	Ports	i Serial Comm.: 1 no. or more (RS232) ii Parallel: 1 no. iii USB 2.0 : 2 nos. (Front) & 2 Nos. (Back).
l)	OS and Software.	Pre loaded Genuine Microsoft® Windows® XP professional or Latest, Recovery CD Media (Licensed copy of media) including all drivers etc, Norton Anti-virus, Fully loaded configuration.
m)	Warranty	At least 1 year on site (both hardware and software).

B.6 STEREO LIMITER/ PROCESSOR:

The limiter /processor is to be supplied in 19" rack chassis. It shall conform to the following specifications:

A INPUT :

- (a) Should be electronically balanced and floating, EMI-suppressed, separate for Left and Right in XLR.
- (b) Analog Input Impedance : ≥ 10 K Ω Active balanced, EMI Suppressed in XLR.
- (c) Nominal Level : -10 dBu to +8 dBu
- (d) Maximum Input Level : +20 dBu
- (e) Digital input : AES/EBU Standard (Professional) in XLR

B OUTPUT :

- (a) The limiter/ processor must have the electronically-balanced and floating outputs, separate for L&R Channels in XLR.
- (b) Analog Output Impedance : $\leq 600\Omega$, Active balanced, EMI Suppressed
- (c) Maximum output Level : +9 dBu
- (d) Digital output : AES/EBU Standard (Professional) XLR
- C** Frequency Response : 20 Hz - 20 KHz : Within ± 0.5 dB
- D** Adaptive Pre-emphasis : Switchable and selectable to 50/75 μ s.
- E** Cross talk : ≤ -70 dB at 1KHz +9 dBu.
- F** Harmonic Distortion : $\leq 0.2\%$ @ 1 KHz; +9 dBu.
- G** Dynamic Range : ≥ 80 dB
- H** Metering : Preferably LED bar graph for showing Gain Reduction and modulation level

I Protection against RF Interference:

The equipment shall be protected with adequate shielding against RF interference so as to perform satisfactorily as per specifications in the high power Uplink transmitter halls.

J Indications: LED/ level indicator should be provided for indicating various threshold levels.

K The Out put level shall be front panel controllable.

L Accessories: The equipment shall be supplied complete with all mating connectors, input/output cords and power supply cord. Other optional accessories may be quoted separately.

B.7 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.8 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.9 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.10 DEHYDRATOR

A dehydrator for removal of accumulated moisture from the wave guide, couplers etc. connecting HPA output to the antenna shall also be quoted. It shall be compatible with the feed system and SSPA system etc.

1.	Air Capacity	60 Litres / Hour.
2.	RF-line pressure	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.11 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). The monitoring system shall have C-Band reception facility as detailed below.

B.11.1 C-BAND LNBC

a)	Input frequency	3700 – 4200 MHz
b)	Input impedance	50 Ω
c)	Input connector	WR 229 G Flange
d)	Input/output return loss (Typical)	≥ 10 dB
e)	Output frequency	950 - 1450 MHz
f)	L.O. Stability	PLL, better than ± 10 PPM over the temperature range 0° to 50°C and over 24 hrs.
g)	Noise temperature	$\leq 35^\circ\text{K}$
h)	Conversion gain	≥ 55 dB
i)	Gain flatness	± 2 dB over full band
j)	Min. Image rejection	Better than - 50 dB (typical)
k)	Spurious/harmonics	50 dB below carrier
l)	Phase Noise 1 KHz 100 KHz	-60 dBc/Hz -80 dBc/Hz
m)	Output impedance & Connector	75 Ω ; F (Female)
n)	Power supply	+ 15 V to + 24 V through output connector

B.11.2 DIGITAL SATELLITE RECEIVER WITH L- BAND INPUT

The digital receiver should conform to the standard & specs of the existing digital radio networking system. The existing digital encoder & modulator are of Radyne make. So receiver should be compatible with the same. It should be possible to control/set receiver through front panel as well as through PC.

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 & BPSK (user selectable)
iii)	Carrier lock range	$\geq \pm$ 500 KHz (Selectable)
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 (MUSICAM)
vi)	Data rates (Selectable)	64, 128, 192, 256 & 384 kbps (QPSK) 64, 128, 192 & 256 kbps (BPSK)
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	\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
ix)	Threshold Eb/No	\leq 5 dB (BPSK), \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)	Stereo Phase deviation	\leq 1.5° for 20 Hz to 10 KHz; \leq 3° for 10 KHz to 20 KHz.
xiii)	Auxiliary data channel a) Data rate b) Interface	\geq 4.8 Kbps RS – 232
xiv)	Supply for LNBC	Provision for power supply to compatible LNBCs

B.11.3 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.

FEATURES: The amplifier shall essentially have the following features:

- a. Protection against current overloads: The amplifier should mute in case of overload and revert to normal functioning once overload ceases to exist.
- b. Protection against thermal overload: Temperature of power pack and heat sinks of both channels should be monitored continuously and the amplifier should get muted with a visual indication whenever temperature exceeds permissible limits. In case of excessive temperature of heat sinks, the amplifier should be protected, by fuse blow up or by any other suitable measures.
- c. Monitoring amplifier output should be continuously monitored for DC components or very low frequency components which might endanger speaker if present for longer durations. Amplifier output should get blocked in such an eventuality.
- d. The amplifier should have protection against open circuit, full short circuit, ultrasonic frequencies and RF.
- e. Necessary function switches such as volume/gain control, Digital & Analog Selector Swirch, low and high frequency filters should be available on front panel. These controls shall be rugged and reliable.

INPUTS & OUTPUTS

1. No. of inputs (stereo) : 1 set (2 mono) (XLR female connectors)
2. Input level
 - a) Nominal level : 0 dBu
 - b) Range : -10 dBu to +10 dBu for rated output
3. Input impedance (Analog/Digital) : $\geq 10 \text{ k}\Omega / 110 \Omega$.
4. CMRR (20 Hz – 20 kHz) : $\geq 60 \text{ dB}$
5. Output impedance : 8 ohms.
6. Power Output : 10W rms continuous per channel at 8 Ω
7. Frequency Response (@1 kHz) : Better than $\pm 1 \text{ dB}$ (20 Hz to 20 KHz)
8. Total Harmonic Distortion : $\leq 0.5\%$ at rated output at 1 kHz
9. SNR (with I/P shorted & rated O/P (unweighted rms) at 0dBu input (20 Hz- 22 kHz) : Equal to or better than 85 dB
10. Damping factor : ≥ 75 into 8 ohm at <1 kHz
11. Level difference between Channels : $\leq 0.5 \text{ dB}$
12. Phase difference between Channels : $\leq \pm 10^0$ (20 Hz to 20 kHz)
13. Inter-channel X-Talk isolation : $\geq 75 \text{ dB}$ at 15 KHz & nominal level

ACCESSORIES

- i) All necessary accessories like power cord and mating connectors shall be supplied along with the units. The standard accessories should be clearly mentioned in the quotation.
- ii) Optional accessories if considered useful/ recommended by the supplier should be quoted separately.

MECHANICAL

The amplifier should be 19" rack mounting type.

B.11.4 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.11.5 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	\leq 5 dB
6.	Gain (User adjustable on front panel)	20 to 30 dB
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.12 UPS 2 x 5 KVA (RACK MOUNT TYPE)

Two nos. of 5 kVA rack mount UPS with individual battery bank has to be supplied along with auto changeover switch. Preferably that the two UPS should work on load sharing basis.

a)	Type	On-Line , Pure Sine wave
b)	Power rating	5 KVA, Single phase
c)	Battery back up	\geq 30 minutes (full rated load of UPS)
d)	Type of battery	Sealed Maintenance Free.
e)	Input Voltage	160 – 270 Vac, 230 Vac (Nominal); 50 \pm 2 Hz, 1 Φ
f)	Output voltage	230V \pm 4%, 50 \pm 0.5 Hz, 1 Φ
g)	Efficiency	\geq 85 %
h)	Type approval	ISO certified, standard, reputed make
i)	Rack Height	\leq 5 RU
j)	Bypass feature	Automatic and Manual both
k)	Metering & Indicators	LED status display with load and battery bar-graphs, On Line, On Battery, Replace Battery Overload Indicators along with audio alarm when the UPS is on battery & low battery.
Note:		
1. DC Voltage & Current Rating of the battery bank shall be indicated by the tenderer.		
2. Availability of load sharing feature is optional but shall be indicated.		

B.13 MEASURING EQUIPMENT FOR CES.**B.13.1 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.13.2 SPECTRUM ANALYZER

1.	FREQUENCY a) Range b) Counter Resolution c) Span d) Accuracy e) Response	: 100 KHz to ≥ 6.7 GHz : 1 Hz : 100 Hz to 6.7 GHz; 0 Hz (for Zero Span) : Better than ± 100 Hz (Stable Temp.) : $\leq \pm 0.5$ dB (100 KHz to 3.0 GHz) : $\leq \pm 2.0$ dB (3.0 GHz to 6.7 GHz)
2.	BAND WIDTH a) Resolution BW b) Video BW	: 10 Hz to 3.0 MHz in 1-3 Steps : 10 Hz to 3.0 MHz in 1-3 Steps
3.	SWEEP TIME a) Zero Span b) Non Zero Span c) Sweep Trigger	: 50 μ s to 600 s. : 100 ms to 600 s. : Free Run, Single, Video

4.	AMPLITUDE a) Range b) Input Attenuator c) Max. input d) Ref. Level Range e) Dynamic Range f) Overall Accuracy g) Average Noise i) CF 1 GHz ii) CF 6 GHz h) Log Scale i) Disp. per Division j) Linear Scale k) Grids l) Measurement Units i) Log ii) Linear	: Displayed Average Noise Level + 30 dBm. : 0 dB to 60 dB in 10 dB Step Size. : +30 dBm (RF Attenuation 10dB) : -130 dBm to +30 dBm : ≥ 85 dB : ± 1.0 dB (or better) (at 0 dB attenuator, 10 Hz VBW & RBW) : -135 dBm : -130 dBm : 0 dB to -120 dB from Ref. Level : 2 dB to 15 dB (adjustable in 1 dB step) : 10 % of ref. Level per division : 10 x 10 Divisions : dB _W , dB _m , dB _{μW} , dB _V , dB _{mV} , dB _{μV} : V, mV, μV, nV, W, mW, μW, nW,
5.	SPECTRAL PURITY a) 10 KHz offset from CF b) 100KHz offset from CF c) Residual Spurious	SSB Phase Noise (@ 1KHz RBW) : -90 dBc/Hz : -100dBc/Hz : -84 dBm (Preamp Off), 100KHz– 6.7 GHz
6.	a) Third order inter-mod. for two -30dBm tones b) Residual FM	: - 80dBc (@ ≥ 50 KHz separation) : 2 Hz (F = 500 MHz, RBW = 1 KHz)
7.	DISPLAY a) Screen Size b) Traces i) Function ii) Detection	: ≥ 16 cm, high resolution, coloured : Min. of two Traces per diagram/sweep : Clear/write, Max. Hold, Min. Hold, Average : Max. Peak, Min. Peak, Auto Peak, Sample RMS, average, Quasi Peak
8.	DEMODULATION	: AM and FM
9.	DIRECT MEASUREMENT FUNCTIONS a) No. of Markers b) Marker Functions	: Adjacent Channel Power Ratio, Occupied Bandwidth, C/No, C/N : Three or More. : Standard, Delta, Marker to Peak, Marker to Center, Marker to Reference Level, Next Peak Level, Next Peak Right, Next Peak Left, All Markers Off, Noise Marker, Frequency Marker.
10.	Memory	: Should have provision for storing ≥ 200 Setups/Traces in Internal / External memory (Flash card).
11.	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

12.	INTERFACES a) USB 2.0 or equivalent b) RF Input c) Coupling d) IF Input e) AF output f) PC interface	: For Data transfer to & from PC. : N female, 50Ω & 75Ω Both (Selectable) : AC & DC (Selectable) : BNC Female connectors for external frequency reference and external trigger : Jack / inbuilt speaker. : RS232/RS485
13.	ENVIRONMENTAL a) Operating b) Storage c) Relative Humidity d) Power requirement	: 5° to + 45° C : - 40° to +70° C : 95% at + 40° C : 200 to 240 V, 48-52 Hz (AC), 1Φ

B.13.3 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** - Minimum 10 channels simultaneously.
- b) **ACCURACY** :
 - i) Position : ± 20 m over 5 minutes
Elevation : ± 20 m over 5 minutes
 - ii) The Receiver should have option to enhance accuracy upto ± 5 m by means of Post Processing Differential Mode by comparison with a stationary Reference.
- c) **Memory**:
 - i) Internal ROM : ≥ 4 MB
 - ii) External : Slot for Flash Card compatible to ≥ 16 MB.
- d) **PC Interface**: GPS Receiver should be able to down load & upload the required data & maps from the computer by means of RS 232 Serial Port / USB 2.0 Port.
- e) **Antenna**: Both Internal and External.
- f) **DISPLAY** :
 - (i) Latitude : 6 figures: degree, minutes, seconds
 - (ii) Longitude : 6 figures: degree, minutes, seconds
 - (iii) Height Above Mean Sea Level - Meters.
 - (iv) Vehicle movement with direction - user definable.
- g) **ACQUISITION TIME** : Less than 60 seconds with current Almanac in memory (in clear weather).

- h) **WEIGHT** : ≤ 1 kg (Without batteries)
- i) **OPERATING VOLTAGE** : 3V to 9V dc – Rechargeable/ Dry batteries (AA/AAA cells or 9V_{DC} battery), easily field replaceable. [Optional: 9V to 16V dc External DC supply (like car battery supply) along with adopter if any may be offered]

The equipment shall be supplied with all necessary cables, carrying case, 2 set of suitable rechargeable batteries, battery charger and other accessories (Details to be given in tender). The system shall retain the stored values / maps while replacing batteries. The system shall be able to record time and date of measurements.

B.13.4 R.F. SIGNAL GENERATOR

1.	Frequency 1.1 Range 1.2 Resolution 1.3 Stability a) Aging rate b) Temp. effect (0 to 50°C)	250 KHz to 2.0 GHz ≤ 1.0 Hz $\leq 1 \times 10^{-7}$ /day $\leq \pm 6 \times 10^{-8}$						
2.	Spectral purity 2.1 Harmonics (CW mode, $\geq +6$ dBm) 2.2 Non-harmonics (offset $\geq +10$ KHz) 2.3 Phase noise (CW mode, $\geq +6$ dBm) (Values in dBc/Hz) a) $10 \text{ MHz} \leq f \leq 150 \text{ MHz}$ b) $\geq 150 \text{ MHz}$ 2.4 Residual FM (demod, band = 30 Hz to 20 KHz) 2.5 Residual AM (demod. Band = 30 Hz to 3 KHz)	≤ -30 dBc < -70 dBc Offset freq. <hr/> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: center;">1 KHz</th> <th style="width: 50%; text-align: center;">20 KHz</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">-90</td> <td style="text-align: center;">-110</td> </tr> <tr> <td style="text-align: center;">-80</td> <td style="text-align: center;">-100</td> </tr> </tbody> </table> ≤ 20 Hz rms $\leq 0.1\%$ rms	1 KHz	20 KHz	-90	-110	-80	-100
1 KHz	20 KHz							
-90	-110							
-80	-100							
3.	Output level 3.1 Range 3.2 Resolution 3.3 Accuracy 3.4 Impedance (N-type connector) 3.5 VSWR (at 0 dBm) 3.6 Units	-120 to $+13$ dBm ≤ 0.5 dB $\leq \pm 1.0$ dB 50Ω (75Ω optional) ≤ 1.5 dB _m , dB _{μV} , mV, μ V						

4.	<p>Modulation</p> <p>4.1 Frequency modulation</p> <p>a) Modes</p> <p>b) Peak deviation</p> <p>c) Resolution</p> <p>d) Frequency response</p> <p>e) Carrier frequency offset at full deviation</p>	<p>Internal/External (AC, DC)</p> <p>0 to 400 KHz (adjustable)</p> <p>≤ 1 KHz</p> <p>≤ 3 dB</p> <p>$\leq \pm 1$ KHz</p>
	<p>4.2 Amplitude modulation</p> <p>a) Range</p> <p>b) Incidental FM</p> <p>c) Modulation input</p> <p>4.3 Pulse modulation</p> <p>4.4 Digital Modulation</p> <p>a) Modulation Modes</p> <p>b) Symbol rate</p> <p>c) Internal data generator</p> <p>d) Input level</p>	<p>0 to 100 %</p> <p>≤ 1 KHz peak</p> <p>Internal/External</p> <p>Optional (not essential)</p> <p>PSK(BPSK, QPSK, OPQSK, DQPSK)</p> <p>QAM (4, 16, 32 [64, 256 optional])</p> <p>FSK (symmetric 2, 4, [8, 16 optional])</p> <p>Adjustable upto 1.5 Mbps.</p> <p>Programming of date, level switching and burst output.</p> <p>TTL(HCL)</p>
5.	Sweep function	Optional (not essential)
6.	<p>General</p> <p>6.1 Temperature range</p> <p>a) Operating</p> <p>b) Storage</p> <p>6.2 Relative humidity</p> <p>6.3 Power supply</p> <p>6.4 EMI/Susceptibility</p> <p>6.5 Standard/Optional accessories</p>	<p>0 to +50°C</p> <p>-10 to +55°C</p> <p>95% at 40°C</p> <p>230 V AC, $\pm 10\%$, 48-52 Hz, 1Φ</p> <p>As per CISPR</p> <p>All Std. accessories shall be included in the offer. Optional accessories shall be quoted separately.</p>

B.13.5 R.F. POWER METER

1.	Frequency Range	100 KHz to 7 GHz (depending upon sensor used)
2.	Power Range	400 W (with suitable attenuator)
3.	Dynamic Range	≥ 50 dB full scale in 10 dB steps for a total range of 50 dB.
4.	Accuracy (Instrumentation)	$\pm 1\%$ of full scale on all ranges
5.	Internal Frequency for calibration	Should be available
6.	Drift	(1 hour typical, at constant temp. after 24 hrs. warm up) with sensor $\leq 1.5 \mu\text{W}$.
7.	Settling Time (for 0 to 99%)	≤ 5 seconds (no. of averages of 64)

8.	Calibration Range	85% to 100% in 1% steps.
9.	Cal Adjustment	Either Front panel adjustment sets gain of meter to match power sensor in use or auto calibration as per sensor in use.
10.	Measurement Accessories	All sensors, couplers, attenuators etc. required for power measurement over the entire frequency band shall be supplied with the power meter.

B.13.6 FREQUENCY COUNTER

1.	Frequency Range	10 Hz - 7 GHz
2.	Input impedance	$\geq 1M / 30pF, 50 \Omega$
3.	Sensitivity	- 20 dBm or better
4.	Max. input level	+ 10 dBm
5.	Line discrimination in automatic mode	20 dB (typical)
6.	FM tolerance	20 MHz p-p
7.	Break down input level	10 Hz to 550 MHz : 6V RMS or better 550 MHz to 7 GHz : +10 dBm or better
8.	Reference oscillator stability	$\pm 5 \times 10^{-8}$ per day $\pm 5 \times 10^{-7}$ per month
9.	Temp. stability of reference oscillator	$\pm 9 \times 10^{-7}$ over temp. range 0°C to +40°C
10.	Resolution	1 Hz to 100 KHz
11.	Display	7 digits or more
12.	Measurement Rate	Automatic

B.14 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.14.1 PC/WORKSTATION WITH NMS

A high-end PC/Workstation of Industrial grade similar to HP/ IBM/ Compaq/ DELL with data acquisition capability and software capability to analyse and present the acquired data in proper format shall be provided. This PC/Workstation shall be compatible with the system for control and setting of the operational parameters. Single PC/Work Station 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: Similar as per Section B.5 along with compatible NMS hardware & software duly configured (Software for NMS shall also be provided in CD for future reloading).

SPARES (Optional):

Following optional spares **must** be quoted along with other recommended essential spares:

- i) Upconverter (complete unit)
- ii) Digital Receiver (complete unit)
- ii) Digital Encoder (complete unit)
- iii) Digital Modulator (complete unit)
- iv) C band LNBC (complete unit)
- v) Active power divider (complete unit)
- vi) SSPA spares

SECTION - 'C'

DRAFT ATP FOR CES SILCHAR

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) Personal Computer/Workstation.

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 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.**
- 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. GENERAL

- 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.

ANNEXURE - I**EXISTING AIR - RN SYSTEM PARAMETERS**

Type of Receive Terminals	
C-Band Size G/T Polarisation	6.1 M 26 dB/°K Linear Horizontal
System Characteristics : Mode RN Channel Data Rate	SCPC 256 Kbps
Digital System : Modulation FEC Base-Band Compression Base-Band Modes	QPSK 1/2, Convolution coding and sequential/Viterbi decoding ISO MPEG - I layer-II MUSICAM - Selectable Rates 20 Hz - 20 KHz Stereo, Joint Stereo, Mono, Relay & Data Channel
INSAT SYSTEM DETAILS	
Satellite Locations : Different locations from 55°E to 105°E (Presently 55°, 74° , 83°, 93.5°; Insat 3C at 74° is being used at present)	
CXC-Band Transponder Uplink Freq. Band Downlink Freq, Band Sat. EIRP S.f.d. Polarisation Uplink Downlink	5930 – 6410 MHz 3705 – 4185 MHz 38 dBw -85 dBw/ m ² Linear Vertical Linear Horizontal