

**PRASAR BHARATI
(BROADCASTING CORPORATION OF INDIA)
ALL INDIA RADIO
(TELECOM CELL)**

.....

SPECIFICATIONS COVER SHEET

TITLE	:	Captive Earth Station
SPECIFICATION NO.	:	TC/SPEC/10/04/CES-New II
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TC/SPEC/04/02/CES-New

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

1. INTRODUCTION :

AIR requires Captive Earth Stations (CES) to uplink its Radio programmes for distribution in its network through satellite. The Captive Earth Stations under reference are to be installed at the AIR, CES Dehradun and Silchar. The programmes uplinked by these 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 Rec 580-1 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 for each location will be as per the configuration given in Annexure-II and will include :

1.	Analogue FM IF Modulator (1+1) with auto-changeover unit.	1 Set
2.	Digital Encoder (1+1), Digital IF Modulator (1+1) With Auto-changeover Unit	2 sets for CES,AIR, Silchar 1 set for CES,AIR, Dehradun
3.	PC required for Analog FM IF Modulator/ Digital Encoder and Digital IF Modulator	1 No.
4.	Stereo Limiter /Processor	2 Nos.
5.	IF Combiner (1+1) and C-Band Combiner (1+1)	1 Set each
6.	IF to C-Band Up-converter (1+1) with auto-changeover Unit (1 :1).	1 Set
7.	C-band Solid State Power Amplifier (100 W) in (1+1) HSB configuration with auto-changeover Unit	1 Set
8.	6.1 m Parabolic Dish Motorised Antenna with 2-port feed and accessories.	1 Set
9.	Inter-facility link including Wave guide, coupler, cables and other accessories for Antenna connection to HPA.	1 Set
10.	Wired racks for analogue and digital modulators, encoders, changeover units, Upconverter, HPAs etc.	1 Set (3 Nos)
11.	Cables connectors and other accessories including Audio Distribution Amplifier for integration of the complete system.	1 Set
12.	Dehydrator	1 No.
13.	Monitoring system for Analogue and digital uplink monitoring which includes following items	
	i) 3.66 m S-Band dish antenna .	1 No.
	ii) S-Band LNBC (1+1)	1 Set
	iii) 70 MHz to L-Band Upconverter	1 No.
	iv) C-Band LNBC (1+1)	1 Set
	v) Analogue SCPC Receiver with L-Band input	2 Nos.
	vi) Digital SCPC Receiver with L-Band input	2 Nos.
	vii) Stereo Monitoring Amplifier with analog & digital inputs	1 No.
	viii) Interconnecting cables, connectors & accessories including Active Power Dividers	1 Set

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|-----|--|-------|
| 14. | UPS 2X 5 KVA with change-over switch | 1 No. |
| 15. | Automatic on-line performance measurement and health monitoring system consisting of | 1 Set |
| | i) PC/work station with necessary add-on cards like digital I/O, Data Acquisition etc., software and LaserJet Printer for hardcopy output of measurement results | 1 No. |
| | ii) Digital Test set/Transmission Analyser | 1 No. |
| | iii) Spectrum Analyser | 1 No. |
| | iv) GPS Meter | 1 No. |
| | v) Signal Generator | 1 No. |
| | vi) R.F.Power Meter | 1 No. |
| | vii) Frequency Counter | 1 No. |
| 16. | Installation & Commissioning | |
| 17. | ATP (Optional) | |
| 18. | Training (Optional) | |

3. LOCATION FOR SUPPLY / INSTALLATION : Studio Center, All India Radio, Dehradun & 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 'B' and for quantities 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) Technical requirements
- iii) Standard Mains Power supply

4.3 The tenderer should 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 equipment offered fully incorporate the standard feature for safety and protection.

4.5 After the acceptance of the tender by the intender, the supplier will have to supply the equipment, arrange for its testing as per the Acceptance Test Procedure enclosed in **Section - C**.

4.6 Inspection will be carried out at supplier's works/site in India by engineer(s) of All India Radio. Complete specifications and details will be checked and all parameter

values will be measured. Typical details are enclosed in ATP. The inspection will be carried out on these lines.

The supplier shall put up all the equipment for test on the test bench at his premises before the AIR Representative and shall provide, electric energy, consumable materials, tools, testing instruments, labour and assistance of every kind for carrying out acceptance tests.

- 4.7 The tenderer should clearly indicate in his tender the detailed operation and maintenance manuals that will be supplied as per details given in the tender.
- 4.8 Any requirement to be met by the indenter shall be clearly brought out by the tenderer.
- 4.9 The technical offer of the tender should contain, apart from the technical compliance statement, all original data sheets of the manufacturer in support of the technical compliance statement. The tenders containing only technical compliance statement without the original data sheet/pamphlets of the equipment offered in full are likely to be rejected.
- 4.10 The tenderer, in order to enable the indenter carry out the full technical evaluation of the tender, should give all the details required to ascertain full merits and demerits of the technical offer.
- 4.11 Only those firms having experience in the field of installation & commissioning of Captive Earth Stations are eligible to quote. The tenderer may, therefore, furnish the list of customers where similar job has been carried out by the tenderer.

5 GENERAL REQUIREMENTS

5.1 ENVIRONMENTAL & POWER SUPPLY

- | | | |
|----|-----------------------|--|
| 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 : | 220 V AC±10%,Single phase, 48- 52Hz |

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 each location
- 2 Sets for Directorate
- 2 Sets for each of the five Zonal offices
- 1 Set for STI(T), Delhi
- 1 Set for R&D, Delhi

5.3 Technical/General Details

The tender/offer should also include the following details :

- i) Sufficient information should be furnished with the tender to technically evaluate the offer and to assess full merits/demerits of the same.
- ii) Apart from printed technical data/specs of the equipment, Block schematic upto the sub-system, interconnection and wiring diagram and the photograph etc. should also be attached with the offer.

5.4 Spares (Optional)

Tenderer should 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 must also be quoted.

5.5 Training (Optional)

Two weeks training of ten engineers (two engineers from each location and one from STI(T) and one from Directorate) in servicing of the equipment will be required to be arranged at a centralised location in the country. In addition to above, tenderers are also required to arrange three days' training on site to AIR personnel on operation and maintenance of the equipment at each of the above locations.

5.6 Compliance

While complying to our specifications, it may please be noted that just mentioning 'complied' will **NOT** suffice. The compliance should be supported by proper data/documentation from original equipment manufacturer substantiating the compliance in respect of the specs. Deviations, if any, may be brought out clearly in the compliance statement. Full compliance should be given for all the paragraph in each of the sections A, B & C.

5.7 Schedule of Material

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

5.8 Maintenance support

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

5.9 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 of repair of these equipment. Authorization from the principals' is a must.

- (ii) If at any stage during next ten years the manufacturer stops production of these 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.

5.10 Optional items

Tenderer **must quote** for all the optional items marked as option in Section 'A' above.

SECTION - B

TECHNICAL SPECIFICATIONS/REQUIREMENTS MAIN EQUIPMENT SPECIFICATIONS FOR CAPTIVE EARTH STATION

1. ANALOG FM IF MODULATOR (1+1) WITH AUTO CHANGE OVER UNIT

The existing Analog Receiver system being used in the AIR's Radio Networking terminals are of Keltron make and Sat. System Corp. make . So the modulator should be compatible with the same.

a)	No. of audio inputs	:	One mono
b)	Audio input signal bandwidth	:	50 Hz - 15 KHz
c)	Input impedance	:	600 ohms, balanced
d)	Input level	:	+9 dbm (peak)
e)	Pre-emphasis	:	75 micro sec.
f)	Companding	:	2 : 1
g)	Input connector	:	XLR(female)
h)	Type of modulation	:	FM
i)	IF Frequency (Nominal)	:	52 to 88 MHz programmable in 10 KHz steps.
j)	Level of IF carrier at the output:	:	-7 dBm to 0 dbm
k)	Output level stability	:	± 0.4 dB per day
l)	Frequency response	:	50 Hz - 15 KHz, ± 0.5 dB
m)	Signal to Noise Ratio	:	> 70 dB.
n)	T.H.D.	:	Less than 0.25%

o)	Output connector	:	BNC/TNC - Female
p)	Output impedance	:	75 ohms, unbalanced
q)	Frequency stability of the carrier	:	± 10 PPM or less
r)	I.F. Bandwidth	:	200 KHz
s)	IF Filter stop band attenuation	:	30 dB or more at ± 200 KHz of centre frequency
t)	Peak deviation of IF Carrier	:	± 75 KHz with +9 dBm test tone at 1 KHz fed to the base band input of the modulator
u)	Deviation adjustment	:	Continuously variable front panel control preferably with locking arrangement.
v)	Spurious at output	:	Better than 50 dB below carrier at ± 1 MHz from IF carrier
w)	Harmonic at output	:	Better than 50 dB below carrier
x)	Standby operation	:	1+1 hot redundancy auto changeover with manual over ride.

- Note :
- i) The base band signal processing stages like 15 KHz Low Pass Filter pre-emphasis and compressor (2 : 1), amplifier and balanced to unbalanced converter should all be built in the modulator unit.
 - ii) Companding refers to 2 : 1 signal level compression on the uplink side before modulation, 1 : 2 signal level expander already exists on the downlink side in the Radio Networking Receive Terminals in use at AIR stations.
 - iii) Similarly, 75 micro sec de-emphasis circuit exists in the Radio Networking Receive Terminals. 75 micro sec pre-emphasis of the signal before modulation on the uplink side is, therefore, necessary.
 - iv) Frequency response of 50 Hz - 15 KHz ± 0.5 dB takes into account the response of 75 micro sec pre-emphasis circuit and 2 : 1 level compression circuit. While measuring the response of audio circuitry in the base band stages of the Captive Earth Station, necessary correction has to be applied at each frequency of the pre-emphasis network and also for level compression in the compander.

2. **DIGITAL ENCODER AND DIGITAL IF MODULATOR WITH AUTO-CHANGEVER 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. The existing digital receivers are Comstream Radyne make. So modulator and encoder should be compatible with the same.

A. DIGITAL AUDIO ENCODER

The Digital Encoder should have the following specifications.

- a) No. of audio inputs : Two mono/one stereo
- b) Digital Audio input : AES/EBU Standard (Professional)
MPEG Stream(Optional)
- c) Audio Signal Bandwidth : 20 Hz to 20 KHz
- d) Input Impedance : > 100 K ohm
- e) Input level : + 9 dBm (peak)
- f) Dynamic range : More than 80 dB.
- g) Source coding : ISO/MPEG-1 layer 2 MUSICAM
encoding
- h) Channel data rates : 64, 128, 192, 256,
kbps selectable
- i) Modes : Mono, Dual Mono, Joint stereo
- j) Sampling rate : 48 KHz
- k) End to End stability : ± 0.5 dB, 20 Hz-20 KHz, w.r.t.
(from input of encoder input and output levels at
in the uplink to receiver 1 KHz, no gain adjustment
output in the downlink).
- l) End to End gain (from input : ± 0.5 dB at 1 KHz
of encoder in the uplink to
receiver output in the
down-link)
- m) Total Harmonic Distortion : Less than 0.2% at 1 KHz for +8 dBm
(THD) output from the receiver.
- n) Signal to Noise Ratio : More than 80 dB at 1 KHz for +8
dBm output from the receiver
- o) Idle Channel Noise : Less than -67 dBm (unweighted)
- p) Cross talk between the two : More than 75 dB w.r.t. +8 dBm output
Channels from the receiver at 1 KHz
- q) Stereo phase deviation : Less than 1 deg. at all frequencies

- r) Auxiliary data channel : Greater than 4.8 kbps
- s) Interface for aux. : Asynchronous, RS-232
- t) Operation : Encoder independently
- u) Configuration : 1 + 1 in hot standby in conjunction with modulator.

B. DIGITAL MODULATOR

- a) Type of Modulation : QPSK/BPSK user programmable
- b) IF Frequency : 52 to 88 MHz continuously adjustable in <100 Hz steps
- c) Frequency stability : ± 1 ppm over the temp. range 0 to 50°C over a period of a year
- d) Output level : -5 to -25 dBm adjustable in steps of 0.1 dB.
- e) Channel coding : Viterbi 1/2, 3/4, 7/8 and 1
Sequential 1/2, 3/4 and 1 (optional)
- f) Spurious : < -50 dBc in band
< -45 dBc out of band
- g) Data rate : 64, 128, 192, 256 kbps (programmable)
- h) Interface : V.35
- i) Configuration : 1 + 1 in hot-standby with auto c/o unit with preferably manual override.

3. PC

A PC (with Windows X-P Professional or upgraded version) similar to HP/IBM/Compaq/DELL is required for setting operational parameters of Analog FM IF Modulator (if necessary) and for Digital encoder, Digital IF modulator operation. This PC should be compatible with the Analog FM IF modulator, Digital Encoder and Digital IF Modulator. It should also be as per the recommendation of the Analog FM IF Modulator, Digital Encoder and Digital IF Modulator manufacturers. The PC should preferably be a common one for the operation of both the Analog FM IF Modulator, Digital Encoder and Digital IF Modulator on the uplink side and the Analog Digital SCPC Receivers on the down-link side. It should be pre loaded with some communication software so as to enable it communicate with aforementioned equipment.

Specifications :

Pentium-4 processor or latest version, with minimum speed of 1.5 GHz, 40GB HDD, 256 MB DDR SD RAM, 1.44 MB FDD, 52X CD ROM Drive, 32 MB Video RAM, 10/100 Base T NIC Card, Windows X-P Professional. Back up copy of licensed operating system software should also be supplied. The monitor should be LCD Flat panel display of 15" or more. Computer should be complete with necessary interfaces, connectors etc.

4. STEREO LIMITER/ PROCESSOR :

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

A INPUT :

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

B OUTPUT :

- (a) The limiter/ processor must have the electronically-balanced and floating outputs, separate for L&R Channels
- (b) Output Impedance : 600 ohms
- (c) Nominal Level : Front panel adjustable
- (d) Maximum output Level : +9 dBm
- (e) Digital output : AES/EBU Standard (Professional)

C Frequency Response : 20 Hz - 20 KHz : Within ± 0.25 dB

D Adaptive Pre-emphasis : Switchable and selectable to 50/75 micro sec.

E Cross talk :: ≤ -70 dB at 15 KHz

F Harmonic Distortion : < 0.1%

G. Dynamic Range : >80 dB

H Metering : Preferably LED bar graph for showing Gain Reduction and modulation level

I Operating Temperature Range : 0-40°C

J 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.

K Indications:

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

L Accessories :

The equipment shall be supplied complete with all mating connectors, input/output chords and power supply chord. Other optional accessories may be quoted separately.

5. IF COMBINER (5 MHz – 200 MHz) & C- BAND COMBINER (5850 - 6425 MHz)

(a) Type of combiner	Preferably passive type
(b) No.of inputs	Four (2-way and 6 way combiners may also be quoted as option)
(c) Insertion loss	2 dB or less for two way combiner (For 4-way and 6-way combiners the loss should be specified).
(d) Port to port isolation	30 dB
(e) Input impedance	75 ohm for IF 50 ohm for RF
(f) Output impedance	75 ohm IF 50 ohm for RF
(g) Input/output return loss	12 dB or more

6. IF TO C-BAND UPCONVERTER (1+1) WITH AUTO CHANGEOVER UNIT

It should be possible to operate the Upconverter manually(with front panel control). The Upconverter should not require a PC or a controller for normal operation and control. Upconverter 1+1 must have an auto change over (hot standby) mechanism. The change over switch may be either an in-built one or an independent.

a) Input Frequency	:	52 MHz to 88 MHz
b) Input impedance	:	75 Ω
c) Input Return loss	:	20 dB or better
d) Input level	:	-20 dBm to +1 dBm
e) Input connector	:	BNC-F
f) Output Frequency	:	5845 MHz to 6425 MHz
g) Output Impedance	:	50 Ω
h) Output Return loss	:	19 dB or better

i)	Output level	:	>=+10 dBm or more
j)	Overall conversion gain	:	:30 dB or more
k)	Gain control Step size	:	0.2 dB steps or smaller
l)	Gain Slope	:	± 0.05 dB/MHz
l)	Type of conversion	:	Dual conversion spectrum not inverted
m)	Amplitude response	:	± 0.5 dB over the input frequency range of 52 MHz to 88 MHz.
n)	Third order IMD Products	:	-40 dBc with equal carriers at 10 dB total output Backoff .
o)	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
p)	Frequency stability	:	Better than $\pm 1 \times 10^{-8}$ over temp 0 to 50 degrees Celsius $\pm 1 \times 10^{-9}$ or better per day
q)	Gain stability	:	± 0.25 dB per day at constant temp.
r)	Spurious	:	-60 dBc or better
s)	Frequency setting	:	Synthesised with minimum 125 KHz step size
t)	Standby operation	:	1+ 1 hot redundancy auto change-over preferably with manual over ride.
u)	Mounting	:	19" Rack
v)	Test port	:	RF and IF
w)	Remote Interface	:	RS-232 RS-484 Parameter settings:Frequency,gain,fault Status,priority,etc.
x)	LED Indications	:	Power, standby,LO fault, Remote/Manual etc.

7. 100 W C-BAND SOLID STATE POWER AMPLIFIER (1+1) WITH AUTO CHANGE-OVER UNIT ALONG WITH DUMMY LOAD.

SSPA shall be of compact and composite construction light weight and rack mountable with front access for operation and control etc. It should be available alongwith its inbuilt/ associated power supply unit. It should also have front panel meter to monitors output

power, VSWR alarm, reverse power and indications for status, alarm, faults etc. The SSPA should have its own cooling arrangements. It should not require any external cooling.

a)	Type	:	SSPA
b)	Rated output power at the output of wave-guide flange	:	80 W continuous
c)	Frequency range	:	5850 - 6425 MHz (Selectable)
d)	Gain Frequency Response	:	± 1 dB over any 40 MHz ± 3 dB over full band
e)	Saturated output power	:	Nominal +50 dBm
f)	R.F. level control	:	0-20 dB continuous
g)	Gain stability for constant temp. & drive	:	± 2 dB over 0°C to 50°C ± 0.5 dB (24 hour)
h)	Input VSWR	:	1.3 : 1
i)	Output VSWR	:	1.3 : 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 O/P	:	60 dBc (below rated O/P)
l)	Spurious	:	50 dBc (below rated O/P)
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)–40 dB or better w.r.t output

8. 6.1 M PARABOLIC DISH ANTENNA WITH MOTORISED AZIMUTH AND ELEVATION ANGLES AND TWO PORT LINEAR C- BAND FEED WITH 60 dB TRF.

a)	Type	King Post
b)	Antenna Diameter	6 M

c)	Frequency Range Transmit Receive	5.850 to 6.425 Ghz 3.700 to 4.200 GHz
d)	Antenna gain (Transmit)	>49.0 + 20 log F/6)dBi (F in GHz)
e)	Antenna Noise Temperature	30°K To 50°K for 40° to 5° elevation angles
f)	Pattern Beam width	3.7 - 6.425 GHz, 3 dB beam width less than 1°; 15 dB beam width less than 2°.
g)	Side lobes (Transmit and Receive)	As per FCC/ITU-R Rec.580-1.

Note : Antenna radiation pattern conformity to ITU-R standard to be cleared by NOCC/DOT before acceptance and commissioning).

h)	Feed and Feed Port	i) Transmit VLP/HLP ii) Receive HLP/VLP
j)	Cross polarisation isolation for transmit receive ports On axis Within 1 deg. Beam width	33 dB 30 dB
k)	Port to port isolation of the feed Transmit to Receive	30 dB
l)	Feed mounting	Cassegrain
m)	Feed insertion loss 3.7 - 4.2 GHz 5.85 - 6.425 GHz	0.1 dB 0.15 dB
n)	VSWR (Return loss) Transmit ports Receive ports	1.3 : 1 (17 dB) 1.3 : 1 (17 dB)
o)	Output wave guide flange interface Transmit Receive	CPR - 137 G CPR - 229 G
p)	Power handling capacity	5 KW CW
q)	Antenna orientation	Manual & motorised for azimuth and elevation adjustments with antenna controller for automatic tracking of a satellite
r)	Polarisation adjustments	Manual and through antenna controller for adjustments from indoor.
s)	Antenna steerability Elevation Azimuth	15° to 90° ± 45°

t)	Wind Speed	
	Operational	75 kmph
	Survival	110 kmph

9. MOTORISED CONTROL OF ANTENNA

a)	Controls required	Azimuth, Elevation and polarisation.
b)	Front panel indications	Azimuth, Elevation and polarisation
c)	Safety requirements	i) Limit switches to interlock in each direction of travel ii) Emergency 'stop' control iii) Provision for grounding
d)	Position encoding	Absolute, single speed, through brushless resolvers.
e)	Position encoding resolution	14 bit
f)	Input power requirement	3 phase 415V/240V AC, 50 Hz.
g)	System interconnect cabling	Shielded cable as per requirement up to a max. length of 1500 ft.

10. DEHYDRATOR

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

1.	Air Capacity	60 Litres / Hour max.
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

11, INTER FACILITY LINK

The tenderer should quote for Wave guide, couplers, adaptors, cables and other accessories required for Antenna connection to the output of HPA.

12. WIRED RACKS

The tenderer should also quote for wired racks (3 each per site) for analog and digital modulators, encoders, changeover units, upconverters, HPAs etc.

13. POWER SUPPLY UNITS

Power supply units for analog and digital modulators, encoders, changeover units, upconverters, HPAs should also be included in the tender.

14. 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 should be included in the tender.

15. INTERFACE UNITS, SOFTWARE ETC.

The required interface units, software etc. for the operating Data Channel and VLBR voice channel should be quoted as an optional item.

16. MONITORING SYSTEM FOR ANALOG AND DIGITAL UPLINK MONITORING

The monitoring system is required for subjective monitoring and for measurements on the down-linked signals from the satellite in S(2.5 - 2.7 GHz) and C(3.7 - 4.2 GHz) bands. The up-linked signals from the Captive Earth Station in C-Band may be received either in C-Band or in S-Band depending upon the satellite transponder used. Therefore, the monitoring system would have S-Band and C-Band reception facility as detailed below.

i) S – BAND ANTENNA

1.	Type & size	Parabolic dish antenna 3.66 M. dia
2.	Material of dish	Perforated aluminium alloy
3.	Receive Band	S-Band
4.	Feed	Prime focus
5.	Polarization	LHCP
6.	Frequency band	2.5 to 2.7 GHz
7.	Gain	> 36.9 dB (Nominal) at 2.6 GHz
8.	Type of mount	Elevation over Azimuth
9.	Pointing Accuracy	Better than $\pm 0.5^\circ$
10.	Steerability	Elevation : 30° to 80° , Azimuth $\pm 30^\circ$
11.	Feed Return Loss	15 dB
12.	Wind Speed	
	Operational	70 KMPH
	Survival	150 KMPH
13.	Axial Ratio	3.5 dB
14.	Focal Length / Diameter	0.4
15.	Feed Impedance	50 Ω

ii) S - BAND LNBC

a)	Input frequency	2500 – 2700 MHz
b)	Input impedance	50 Ω

c)	Input connector	N type
d)	Input/output return loss	> 12 dB
e)	Output frequency	950 - 1150 MHz
f)	L.O.Stability	PLL, better than ± 5 KHz over the temp. range 0° to 50°C and over 24 hrs.
g)	Noise temperature	Less than 45°K
h)	Conversion gain	55 dB or more
i)	Gain flatness	± 2 dB over full band
j)	Min. Image rejection	-50 dB
k)	Spurious/harmonics	50 dB below carrier
l)	Phase Noise	
	1 KHz	-60 dBc/Hz
	100 KHz	-80 dBc/Hz
m)	Output impedance	75 Ω
n)	Power supply	+ 15 V to + 24 V through output connector

iii) 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	> 12 dB
e)	Output frequency	950 - 1450 MHz
f)	L.O.Stability	PLL, better than ± 2 PPM over the temp. range 0° to 50°C and over 24 hrs.
g)	Noise temperature	Less than 35°K
h)	Conversion gain	55 dB or more
i)	Gain flatness	± 2 dB over full band
j)	Min. Image rejection	-60 dB
k)	Spurious/harmonics	50 dB below carrier
l)	Phase Noise	
	1 KHz	-60 dBc/Hz
	100 KHz	-80 dBc/Hz
m)	Output impedance	75 Ω
n)	Power supply	+ 15 V to + 24 V through output connector

iv) ANALOG SCPC RECEIVER WITH L-BAND INPUT

i)	Frequency	950 - 1450 MHz
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ii)	I.F. Frequency Tune	52 to 88 MHz in 10 KHz step .
iii)	Transponder Tune	Selectable 1 to 24
iv)	No. of channels	Two independent channels
v)	Audio Frequency Response	± 1 dB
vi)	De-emphasis	75 μ
vii)	Line output	+9 dBm max. front panel adjustable.
viii)	Stability factor (Receiver)	PLL System ± 15 KHz.
ix)	Tuning steps	10 KHz, all frequencies
x)	S/N ratio	≥ 65 dB
xi)	Input Impedance	75 Ω
xii)	Audio output Impedance	600 Ω
xiii)	Audio expanding	1 : 2
xiv)	Demodulation	FM
xv)	C/No Threshold	64 dB-Hz.
xvi)	Audio distortion	Less than 1%

v) DIGITAL SCPC RECEIVER WITH L-BAND INPUT

i)	Input	
	a) Freq. Range	950 - 1450 MHz
	b) Freq. Tuning	Resolution ≤ 25 KHz Local (remote control optional)
	c) Impedance	75 Ω
	d) Level	≤ -50 to -10 dBm
ii)	Demodulation	QPSK (Optional BPSK user selectable)
iii)	Carrier lock range	$\geq \pm 500$ KHz
iv)	FEC decoding	Rate 1/2 Viterbi-decoding, sequential-decoding (optional) (Selectable Rate preferred)
v)	Audio coding	ISO/MPEG-I/Layer-2 (MUSICAM)
vi)	Data rates (Selectable)	64, 128, 192 & 256,kbps (QPSK) 64, 128, 192 & 256 kbps (BPSK)
vii)	Modes	Mono, Dual mono & Joint stereo
viii)	L-Band output	Buffered L-Band output should be available for additional receivers
ix)	Audio output	
	a) Impedance	Balanced, 600 Ω
	b) Level (Maximum)	+ 9 dBu (adjustable)
	c) T.H.D. (at 1 KHz)	$\leq 0.2\%$ (at +9 dbu output)
	d) Audio signal bandwidth	20 Hz to 20 KHz ± 1.0 dB (20 Hz to 20 KHz)
	e) Frequency response	≥ 75 dB (referred to +9 dbu)
	f) Signal to Noise ratio	≥ 80 dB
	g) Dynamic range	≥ 75 dB.
	h) Cross-talk ratio	Two mono/one stereo

- i) Audio output channels AES / EBU STANDARD (Professional)
- j) Digital Audio output

- x) Required Eb/No (B.E.R. $\leq 10E^{-5}$) ≤ 5.5 dB(QPSK) , 5 dB (BPSK)
- xi) B.E.R. Immunity At 128 kbps, QPSK, Seq. rate $\frac{1}{2}$ at 4.5 Eb/No $1 \times 10E^{-4}$ for no subjective loss in quality
- xii) Audio Sampling Rate 48 KHz
- xiii) Stereo Phase deviation Less than 1° for 20 Hz to 10 KHz;
Less than 3° for 10 KHz to 20 KHz.
- xiv) Auxiliary data channel
 - a) Data rate > 4.8 Kbps
 - b) Interface RS – 232

vi) INTER-CONNECTING CABLES, CONNECTORS, SPEAKERS AND ACCESSORIES

Interconnecting cables, power supply cables, connectors and other accessories required for the monitoring system should be included in the tender. The Tender should also include a hi-fi monitoring amplifier and good quality speakers.

17. UPS (1+1) CONFIGURATION :

This is an important part of the uplinking system. The UPS will be required to keep the uplink system running in the event of mains failure. The rating and quality of the UPS should be such so as to take care of the interrupted operation of the complete uplinking chain and serve as back up for thirty minutes on full load. UPS of standard make like APC, Liebert etc. should be tendered.

1.	Type	On line, pure sine wave
2.	Power rating	5 KVA , Single phase
3.	Battery back up	For 30 minutes operation on full load.
4.	Type of battery	Maintenance free , sealed Lead Acid , Valve regulated having a life time of more than 3 years
5.	Input Voltage Range	160 – 280 V AC (at full load)
6.	Input Frequency Range	45 – 55 Hz
7.	Output voltage	220V, 50 Hz, Single phase
8.	Output voltage regulation	± 1 % static , 5 % dynamic
9.	Output Frequency	50 Hz ± 0.1 Hz
10.	Bypass feature	Automatic and Manual both

11.	Type approval	ISO certified, standard, reputed make
12.	Ripple	Less than 0.5 % for DC output (battery charging voltage)
13.	Efficiency at full load(Nominal input)	Better than 88 %
14.	Metering & Indicators	Meters/ Indicators : should be there to monitor input & output voltage and current etc. and must have all types of alarm indicators.

18. AUTOMATIC ON-LINE PERFORMANCE MEASUREMENT / HEALTH MONITORING SYSTEM

The Captive Earth Station is to be equipped with modern test and measuring equipment for reliable monitoring and performance measurement Accordingly, the tenderer should offer test and measuring equipment from established and reputed manufacturer only. However, recommended list of such equipment with broad specifications are given below to enable the tenderer to make suitable offer in this regard. All the measuring equipment mentioned below should be able to integrate with PC work station so that entire system works as integrated setup to function as automatic on-line performance measurement/Health Monitoring System.

i) PC/WORKSTATION WITH NMS

A PC/ Work Station similar to HP/IBM/Compaq/DELL is required. A high-end PC/Workstation of Industrial grade with data acquisition capability and software capability to analyse and present the acquired data in proper format should be provided. This PC/Workstation should be compatible with the system for control and setting of the operational parameters. Single PC/Work Station should be able to control all the multiple circuits. The concerned Health Monitoring Software should be installed in it and should also be supplied additionally in a CD. The Monitoring & Control Software should have all the necessary features and parameters .

The measurement package should also include various sensors/interfaces etc., for acquiring data from Analog and Digital modulators, upconverters and HPA on the uplink side and Analog and Digital SCPC Receivers on the downlink monitoring side. The data thus acquired from these equipments should be analysed by the system for continuous display and storage 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
- f) Frequency deviation

Laser-jet Printer like HP 6L or Canon LBP 810 should also be provided to obtain hardcopy of performance figures of the Earth Station.

Specifications :

Pentium-4 processor or latest version, with minimum speed of 1.5 GHz, 40GB HDD, 256 MB DDR SD RAM, 1.44 MB FDD, 52X CD ROM Drive, 32 MB Video RAM, 10/100 Base T NIC Card, Windows X-P Professional or later version. Back up copy of licensed operating system software should also be supplied. The monitor should be LCD Flat panel display of 15" or more. PC/ Work Station should be complete with necessary interfaces, connectors etc. PC/ Work Station should be rack mounted.

ii) SPECTRUM ANALYSER

1.	Frequency range	9 KHz to 6.7 GHz
2.	Frequency stability	1×10^{-6} / year
3.	Frequency Resolution	0.1 Hz to 10 KHz
4.	Sweep time	
	0 Hz	160 μ s to 2500 s
	≥ 10 Hz	5 ms to 16000 s
5.	Resolution BW (3dB)	10 Hz to 5 MHz
6.	Max. dynamic range	10 Hz Bandwidth
7.	Displayed Noise Floor at 1 dB compression	152 dB
8.	Max. inter modulation free range for $f > 100$ MHz	105 dB
9.	Total measurement uncertainty (0 to 50 dB below reference level, RBW < 100)	< 1 dB
	For $f < 1$ GHz	< 1.5 dB
	For 1 GHz to 7 GHz	
10.	Level	
	Display range	Noise floor displayed to 30 dBm
11.	Max. input level	
	RF attenuation 0 dB	
	DC voltage	0 V
	CW RF power	20 dBm
12.	Setting range of reference level	
	Log level display	- 130 to + 30 dBm in 0.1 dB steps
	Linear level display	7 nV to 7.07V in 1% steps
13.	Units of level axis	
	Log level display	dBm, dB μ V, dB μ A, dBpW
	Linear level display	mV, μ V, mA, μ A, pW, nW
14.	Pulse spectral density	97 dB μ V/MHz
15.	Max pulse voltage (RF attenuation ≥ 10 dB)	150 V
16.	Max harmonic suppression	90 dB
17.	Trigger function	
	Trigger	Free run , line, video, RF, external
18.	Delayed sweep	
	Trigger source	Free run , line, video, RF, external
	Delay time	100 ns to 10 s, 1 μ s
	Delayed sweep time	161 μ s to 1000 s
19.	Demodulation	
	Modulation modes	AM and FM
	Audio output	Loudspeaker and headphone output

	Marker stop time	100 ms to 60s
20.	Inputs and Outputs (front panel)	
	RF input	N female, 50 Ω
	Attenuator	0 to 70 dB, selectable in 10 dB steps
	AF output	Jack, adjustable up to 1.5 V
21.	Inputs and Outputs (rear panel)	
	IF	BNC female 50 Ω ,
	Level	0 dBm at reference level
	Serial interface	RS-232 interface(COM1 and COM2)
22.	Display	24 cm colour LCD
23.	Mass memory	1.44 MB FDD , Hard Disk
24.	Power Supply	240 V AC, 50 Hz

iii) 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 should 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 should 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 should 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 stores

iv) SIGNAL GENERATOR

1.	Frequency	
	1.1 Range	250 KHz to 2.0 GHz
	1.2 Resolution	≤ 1.0 Hz
	1.3 Stability	
	a) Aging rate	$< 2 \times 10^{-9}$ /day
	b) Temp.effect (0 to 50°C)	$< \pm 5 \times 10^{-8}$

2.	Spectral purity	
2.1	Harmonics (CW mode, > +6 dBm)	< -30 dBc
2.2	Non-harmonics (offset > +10 KHz)	< -70 dBc
2.3	Phase noise (CW mode, > +6 dBm) (Values in dBc/Hz)	Offset freq.
		<hr/>
		1 KHz 20 KHz
		<hr/>
	a) 10 MHz < f < 150 MHz	-90 -110
	b) > 150 MHz	-80 -100
2.4	Residual FM (demod, band = 30 Hz to 20 KHz)	< 20 Hz rms
2.5	Residual AM (demod. Band = 30 Hz to 3 KHz)	< 0.1% rms
3.	Output level	
3.1	Range	-120 to + 13 dBm
3.2	Resolution	< 0.5 dB
3.3	Accuracy	$\leq \pm 1.0$ dB
3.4	Impedance (N-type connector)	50 Ω
3.5	VSWR (at 0 dBm)	≤ 1.5
3.6	Units	dBm, dB μ V, mV, μ V
4.	Modulation	
4.1	Frequency modulation	
	a) Modes	Internal/External (AC, DC)
	b) Peak deviation	0 to 400 KHz (adjustable)
	c) Resolution	< 1 KHz
	d) Frequency response	≤ 3 dB
	e) Sensitivity for external input (600 Ω , balanced)	> 40 KHz (peak) for 1 V peak
	f) FM rate	30 Hz to 100 KHz
	g) Carrier frequency offset at full deviation	$< \pm 1$ KHz
	h) Incidental AM	< 1%
4.2	Amplitude modulation	
	a) Range	0 to 100 %
	b) Incidental FM	< 1 KHz peak
	c) Modulation input	Internal/External (600 Ω)
4.3	Pulse modulation	Optional (not essential)
4.4	Digital Modulation	
	a) Modulation Modes	PSK(BPSK, QPSK, OPQSK) QAM (4, 16, 32 [64, 256 (optional)]) FSK (symmetric 2, 4, [8, 16 optional])
	b) Symbol rate	Adjustable upto 12 Mbps.
	c) Internal data generator	Programming of date, level switching and burst output.
	d) Input level	TTL(HCL)

5.	Sweep function	Optional (not essential)
6.	General	
6.1	Temperature range	
a)	Operating	0 to +50°C
b)	Storage	-10 to +55°C
6.2	Relative humidity	95% at 40°C
6.3	Power supply	220 V AC, $\pm 10\%$, 48-53 Hz
6.4	EMI/Susceptibility	As per CISPR
6.5	Standard/Optional accessories	To be specified by supplier

vi) R.F. POWER METER

1.	Frequency Range	100 KHz to 7 GHz (depending upon sensor used)
2.	Power Range	To suit the 400 W HPA output measurement
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 $< 1.5 \mu\text{W}$.
7.	Response Time	(0 to 99% of reading 5 time constants) should be less than 10 seconds
8.	Calibration Range	85% to 100% in 1% steps.
9.	Cal Adjustment	Front panel adjustment sets gain of meter to match power sensor in use.
10.	Measurement Accessories	All sensors, couplers, attenuators etc. required for power measurement over the entire frequency band should be supplied with the power meter.
11.	Power requirement	220 $\pm 10\%$, 48- 52 Hz, AC mains
12.	Environmental Operating Temperature	0°C to +50°
13.	Relative Humidity	95% at 40°C

vii) FREQUENCY COUNTER

1.	Frequency Range	10 Hz - 7 GHz
2.	Input impedance	1 M/25 pf, 50 Ω
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 - +20 dBm
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 segment LED digits
12.	Measurement Rate	Automatic
13.	Power requirement	220 \pm 10%, 48 - 52 Hz, AC mains
14.	Environmental Operating Temperature	0°C to +50°
15.	Relative Humidity	95% at 40°C

vii) **GPS RECEIVER-CUM-MAPPING SYSTEM**

1. The system is required by AIR for finding out the exact six figure geographical coordinates, Height Above Mean Sea Level of AIR sites and to accomplish mapping during field strength survey. The equipment should be user friendly and based upon latest state of art design using micro processors.
2. GPS Receiver System will obtain their signals from NAVSTAR group of 24 Satellites which have been launched by US Department of Defense. Each of these Satellites is operating at a height of about 20,000 Km with Orbit Period of 12 hours. All these satellites are transmitting Ranging and Navigational data signals continuously. A minimum of five satellites are visible at any given location at all the times and a minimum of 4 satellites are required for precise calculations of latitude, longitude and altitude. The GPS System should be able to receive, process and store the Almanac transmitted from these satellites for processing the Data obtained at different locations. After processing of data the result should be indicated on processor screen to be supplied along with.
3. The GPS receiver system should be able to receive and process the signals received from the visible set of satellites. The system should have an inbuilt processor and suitable software for data collection and management. It should have a minimum of 2 MB ROM and 4 MB flash memory card. The system should have capability to down load the same into any general purpose computer. The system should be able to operate in Averaging mode also for enhancing accuracy when Selective Availability is ON in the Satellites System.
4. The system should be able to receive and process a minimum of six channels simultaneously. The system should be able to indicate the best time period for data collection (availability of various satellites) at least for next one month.
5. The GPS System should have the following additional facilities :-

- a) It should be possible to down load the acquire data as well as the processed data from the system to any other computer by means of RS 232 Serial Port.
- b) It should be capable of being used for mapping purposes along with recording of vehicle movement path.
- c) The output data format should be compatible so that it can be imported by popular GIS packages for interpretation.
- d) The receiver should consist of 2 nos. of antennae - 1 No inbuilt and the other external type which should be able to be mounted on a vehicle, along with cables.
- e) The GPS system should be able to operate on dry batteries and set of two chargeable batteries along with one charger to be supplied.
- f) The system should be able to record time and date of measurements.

6. SPECIFICATIONS

- a) **TRACKING CAPABILITY** - Minimum 6 channels simultaneously.
- b) **ACCURACY :**
 - (i) Autonomous Mode with SA ON :
Position : ± 50 m
 - (ii) Averaging Mode with SA ON :
Position : ± 20 m over 5 minutes
Elevation : ± 20 m over 5 minutes
 - (iii) The Receiver should have option to enhance accuracy upto ± 5 m by means of Post Processing Differential Mode by comparison with a stationery Reference.
- c) **DISPLAY :**
 - (i) Latitude - 6 figures, degree, minutes, seconds
 - (ii) Longitude : 6 figures, degree, minutes, seconds
 - (iii) Height Above Mean Sea Level - Metres.
 - (iv) Vehicle movement with direction - user definable.
- d) **ACQUISITION TIME** : Less than 30 seconds with current Almanac in memory.
- e) **WEIGHT** : Maximum 5 Kg.
- f) **OPERATING VOLTAGE** : 4 to 10 V, DC - dry batteries, 2A or 3A cells, easily field replaceable.
- g) **OPERATING TEMPERATURE** - 0 TO + 50°C.
- h) **RELATIVE HUMIDITY** : 95% non-condensing.

The equipment should be supplied with all necessary cables, carrying case, 2 set of rechargeable batteries, battery charger and other accessories. Details to be given in tender.

19. SPARES :

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

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

SECTION - 'C'

DRAFT ATP FOR CAPTIVE EARTH STATION

1 INTRODUCTION

This document describes the Acceptance Test Procedure (ATP) for testing the various units of the Captive Earth Station 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

The items to be tested first individually and then integrated are as follows :-

a) Individual Items

- i) Antenna along with feed system
- ii) High Power Amplifier (HPA)
- iii) Up-converter
- iv) Analog Modulator
- v) Limiter/Processor
- vi) Digital Encoder and Modulator
- vii) Monitoring System comprising of LNBC, Analog Receiver and Digital Receiver
- viii) UPS

b) Integrated Setup

- i) Complete integrated setup from Audio input point to modulator, up-converter, HPA and transmit Antenna for transmission to Satellite.
- ii) Receiving setup from Antenna in Receiving mode to LNBC, Demodulators and Analog O/P.

3 TEST EQUIPMENT

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

b) List of the test & measuring equipment :

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

- i) Spectrum Analyser (>8 GHz range)
- ii) Power Meter with sensor & Attenuator etc.
- iii) Frequency counter
- iv) Signal Generator
- v) Noise figure meter with noise source.
- vi) Digital Modulation Analyser
- vii) Plotter
- viii) PC with Printer

Any other equipment and standard reference source/setup necessary for measurements. Directional coupler, inter-connecting cables, Attenuators, combiner, Dividers etc. as may be necessary for the tests.

4. TESTS REQUIRED TO BE CARRIED

(NOTE : This is a tentative list, Additional items of tests may be specified by the indenter if needed.)

4.1 ANTENNA SYSTEM : The tests for antenna will include:

- i) Antenna functionality test as per details given in the specifications.
- ii) Antenna transmit Gain.
- iii) Antenna Radiation Pattern : The radiation pattern conforming to the standard specified will have to be got cleared from NOCC by the Supplier).
- iv) Receive Gain
- v) Cross Pole discrimination
- vi) VSWR
- vii) Return loss
- viii) Port to port isolation
- ix) Deicing system for AIR, Leh
- x) Any other test to check the conformity to the specs.

4.2 H.P.A.

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

4.3 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) Spurious check
- vi) Phase Noise check
- vii) Any other test to check the conformity to the specs.

4.4 DIGITAL MODULATOR

- i) Functionality test for individual modulator and in (1+1) configuration
- ii) I.F. Range
- iii) O/P Frequency stability
- iv) O/P level stability

- v) Coding standard, data rates check
- vi) Digital modulator check
- vii) Reference frequency stability check
- viii) Return loss.
- ix) Spurious Check
- x) Any other test to check the conformity to the specs.

4.5 UPS:

The UPS will be tested for power rating, back up time, output sine-wave characteristics and other parameters etc.

4.6 MONITORING SYSTEM

- i) Functionality check for individual monitoring setups for Analog Demodulator and Digital demodulator.
- ii) Test for LNBC - output frequency level, L.O. stability, Noise Temp., phase and spurious noise, gain etc.
- iii) Tests for Analog Demodulator/Receiver including carrier lock range, audio output level : THD, Noise level, frequency response, cross talk etc.
- iv) Test for Digital Demodulator/Receiver including, carrier lock range, Eb/No, Audio output, level, THD, Noise level, Freq. Response and Cross Talk. for both stereo channels, BER immunity test etc.

4.6 INTEGRATED SETUP

- i) 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.
- ii) The tests for commissioning would include the integration check and conformity to system specs including :
 - i) EIRP Capability
 - ii) EIRP Stability
 - iii) Radiation conformity to Standard specified
 - iv) Emissions conforming to International Standard for Satellite transmission.
 - v) Overall uplink/down-link check and performance measurements to meet the specs.
 - vi) Any other tests necessary to check the conformity to specs.

5 GENERAL

- i) Based on above supplier is required to 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 finalised after mutual discussion.

AIR - RN SYSTEM PARAMETERS

Type of Receive Terminals

S-Band	Size	3.66 M
	G/T	11 dB/°K
	Polarisation	LHCP
C-Band	Size	6.1 M
	G/T	24 dB/°K
	Polarisation	Linear H/V

System Characteristics :

Mode	SCPC
RN Channel Band-Width	200 KHz(Analog) 350 KHz (Digital 256 kbps)

Analog System :

Modulation/Demodulation	Companded FM
Base-Band	15 KHz
Compression	2 : 1
Pre/De-emphasis	75 μ Sec.
Peak deviation	\pm 75 KHz at +9 dBm

Digital System :

Modulation	QPSK
FEC	1/2, Convolutional coding and sequential/Viterbi decoding
Base-Band Compression	ISO MPEG - I layer-II Selectable Rates
Base-Band Modes	20 Hz - 20 KHz Stereo, Joint Stereo, Mono, Voice/Data Channel

INSAT SYSTEM DETAILS

Satellite Locations : Different locations from 55°E to 105°E
(Presently 55°, 74°, 83°, 93.5°)

CXS - Band Transponder

	S1	S2
Uplink freq.	5070	5910
Downlink freq.	2570	2610
Polarization	Uplink : Linear H/V or circular	
Downlink	L.H.C.P. or circular	
Sat. EIRP	42 dBw	
S.f.d.	-90 dBw/ m ²	

CXC-Band Transponder

Uplink Freq. Band	5950 – 6400
Downlink Freq, Band	3700 – 4200
Sat. EIRP	32 dBw
S.f.d.	-90 dBw/ m ²
Polarisation	
Uplink	Linear H/V or circular
Downlink	Linear H/V or circular