

**REQUEST FOR PROPOSAL DOCUMENT
PROCUREMENT OF 1350 ARGs**

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SPECIFICATIONS FOR PROCUREMENT OF AUTOMATIC RAINGAUGE STATIONS (1350 Nos.)

(REQUEST FOR PROPOSAL (RFP) DOCUMENT)

1. INTRODUCTION

As part of the augmentation of the surface meteorological network it is proposed to procure 1350 ARGs for installation in various remote locations of India. The ARGs being procured should be compatible with the INSAT series of satellites and Time Division Multiple Access (TDMA) transmission technique.

2. SCOPE OF PRESENT TENDER ENQUIRY

Following is the scope of this tender document to implement the new project for installation and commissioning of 1350 ARGs at selected field stations all over India on a turnkey basis:

- Supply of ARG equipment consisting of sensors, data logger (with built-in display) and transmission system incorporating GPS facility
- Preparation of ARG field sites as per specifications **(Annexure-II)**.
- Transportation of equipment from Pune, installation and commissioning of ARGs at field sites all over India. Exact locations of all 1350 ARGs will be finalized and provided at the time of design review committee meeting to the successful bidder.
- Uplinking ARG data to the satellite compatible with INSAT-3A, KALPANA-1 and INSAT-3D DRTs. Details of satellites are provided in **Annexure-I**
- Procurement of necessary spare ARG systems complete in all respects.

3. OVERALL REQUIREMENTS OF ARG SYSTEMS TO BE SUPPLIED

- 3.1** The ARG equipment should incorporate the state-of-the-art technology (e.g. micro controller, ASIC, FPGA etc) and provide capability for unattended operation for at least one year at remote places using a 12V single sealed maintenance-free battery, rechargeable through a solar panel. All equipment should be qualified for MIL STD – 454K Specifications and suitable for outdoor application. The ARG must be housed in weather-proof enclosure and shall meet all specified environmental specifications.
- 3.2** The height of the mast on which the ARG and sensors are mounted shall be minimum 2.5 m from raised platform.
- 3.3** Transmitter and data logger must have certification from IMD for functional operation through INSAT / Kalpana satellites.

- 3.4 The chassis/enclosure should withstand hostile environment and its moulding should be completely sealed by suitable gasketing to avoid penetration of moisture, salinity etc.
- 3.5 ARG system should have in-built memory of storing data for at least 12 months period.
- 3.6 PCMCIA memory card slot or any other commercially available latest technology memory device for data retrieval and transfer of set up to/from the system. All set up and configuration files should be transferable through the solid state memory device to the data logger and vice versa.
- 3.7 The system should have inbuilt test facility to monitor and display the configuration and functions of various subsystems including present and past data.
- 3.8 Antenna should be portable with LHCP and RHCP modes of polarization (switchable in the field) compatible with INSAT-3A / KALPANA-1 / INSAT-3D DRTs.
- 3.9 Test points to be provided on the system for monitoring the clock and data bit stream and facility to view the above on the front panel display.
- 3.10 Two RS-232, one RS-485 and one USB ports are to be provided. The ports are to be used for programming and data retrieval, thus making the system fully compatible with a Personal Computer (PC) / Laptop, as and when required.
- 3.11 System should have a dedicated port to interface a remote display unit and facilitate values of meteorological parameters to be displayed in real time basis at user-defined intervals.
- 3.12 Facility to give manual commands to transmit data for testing purpose.
- 3.13 Provision of extra five channels for manual data entry of conventional observations like cloud, visibility etc.
- 3.14 Facility for entering manually recorded Synoptic weather observation for manual and/or auto transmission through front panel keypad.
- 3.15 Facility for standard positioning system (SPS) with GPS (location and time) receiver. (L1 frequency).
- 3.16 Source code of the ARG software utilized in the data logger and transmission unit is to be provided along with compilers required for the same. Suitable training in these aspects may also be provided.

4 SPECIFICATIONS OF SENSORS

4.1 General Specifications:

- 4.1.1 The sensors along with the accessories and facilities, shall be fully compatible with the data logger and transmission system specified below (Para 5.0).

- 4.1.2 In the case of sensors with certain optional features which are required to be ordered separately and are not included as a part of the main offer, the same shall be clearly specified in the bid along with the functions of such features. The bidder shall provide all necessary information to enable taking decision regarding ordering for any such features or not.
- 4.1.3 The bidders shall enclose ORIGINAL copies of latest technical literature with their technical bids in respect of all the sensors being offered. The features which are mentioned in the literature enclosed with the bid but are not being quoted as part of the current system shall be clearly brought out in the bid. In the event of failure of the bidder to explicitly mention any such exclusion, it shall be taken as inclusion of all the features mentioned in the bid as a part of the supply and the bidder shall have to provide all such features/ accessories without claim for any extra cost to the purchaser.
- 4.1.4 All the accessories, tools and fixtures required for the installation and dismounting / remounting of the equipment shall be treated as a part of the supply for each type of sensors. Such kits should be supplied with the main ARG systems (10 per cent of total systems orders). Details of each item should be mentioned and quoted in the bid.
- 4.1.5 Bidders shall give general details of all civil works and materials including that for the equipment at the time of bidding. The successful bidder shall furnish the details of all the mounting arrangements including civil works with drawings and design calculations which shall have prior approval of IMD before commencement of work.
- 4.1.6 The safety and security provisions for the system and sensors installed in the open ground, like chain link fencing, locking etc. shall also be provided by the bidder. In general the ARG site should be prepared as per details given in **Annexure-II**.

4.2 Individual Sensor Specifications

All sensors should be NIST (National Institute for Standards and Technology, (USA) traceable.

4.2.1 Air (Dry Bulb) Temperature:

- | | | |
|------------------|---|---|
| a) Range | : | -40°C to +60°C |
| b) Accuracy | : | ± 0.2 °C or better, with radiation shield |
| c) Resolution | : | ± 0.1°C |
| d) Sensor Type | : | Resistance type |
| e) Response Time | : | 10 sec or better |

4.2.2 Relative Humidity Sensor:

- | | | |
|------------------|---|--------------------------|
| a) Range | : | 0 to 100% RH |
| b) Accuracy | : | ±3% or better |
| c) Resolution | : | 1% |
| d) Sensor Type | : | Capacitive / Solid-state |
| e) Response Time | : | 10 sec. or better |

4.2.3 Rainfall Sensor:

- a) Range : 0 to 1023 mm/hr
- b) Accuracy : $\pm 5\%$ or better
- c) Resolution : 0.5 mm
- d) Sensor Type : Tipping bucket rain gauge or any other suitable sensor.
- e) Option for Snow bound ARG : Rainfall/snowfall measurement may be added

5. SPECIFICATIONS OF DATA LOGGER AND TRANSMISSION SYSTEM

5.1 Datalogger specifications

- 5.1.1 The system shall automatically collect the observations from attached sensors, process the same and store them into its memory as per the pre-programmed procedure at every full hour UTC and data shall be transmitted to the INSAT-DRT in TDMA mode. Details of TDMA mode are provided in para 6.0. In-depth details of TDMA technique will be provided during the Design Review Committee Meeting which will be held with the successful bidder.
- 5.1.2 The system shall also send the values of meteorological parameters (user selectable) to a remote display unit located at a distance between 50 metres to 2 km depending on the location of each of the ARG site.
- 5.1.3 The number of analog/digital/ SDI channels in the data logger must be compatible to the sensors being supplied. The type and the number of extra channels provided in the data logger must be specified as an option.
- 5.1.4 The sensor's signal conditioning unit should be an integral part of the system.
- 5.1.5 The system shall have provision to easily include and change the following information as mandatory requirements:
 - Unique station identification code
 - Time of observation
 - Sensor identification.
- 5.1.6 The system shall have an integrated microprocessor based data acquisition and storage system having adequate hardware configuration and software support to serve as an interface between sensors and the communication link to perform tasks as stated below:
 - 5.1.6.1 Providing necessary electrical power to the sensors and conversion of electrical output signals from the sensors into engineering values based on calibration equations stored in the memory. Full compatibility with all types of sensors provided in the packages shall be mandatory.
 - 5.1.6.2 Storage of observed data along with time for all the parameters in the memory. Memory capacity to retain at least one year's data is required. Data shall be

available even if the power supply to the system has failed (RAM Backup battery) for one year.

- 5.1.6.3 The stored data shall be retrievable via serial port to a PC/laptop and a PCMCIA card or any other compact and commercially available solid state memory device.
- 5.1.6.4 The system should be stand-alone and all programming functions/set-ups to be carried out through system keypad and display independent of a PC/Laptop.
- 5.1.6.5 The system should be capable of continuous updating of the values of sensed weather parameters and post processing the instantaneous values into average values over a specified period of time for transmission to the ARG earth station.
- 5.1.6.6 Management of data transmission to ARG earth station through satellite, which shall include formatting of transmitted data with necessary preambles, station ID codes, parity checks etc. as per transmission methodology for transmission through satellite channel, scheduling and operating the ARG transmitter automatically.
- 5.1.6.7 Management of ARG transmitter to optimize the battery consumption.
- 5.1.6.8 The system shall provide a complete health status of the battery, transmitter and other components.
- 5.1.6.9 The health data shall be stored as a log record and shall be capable of being retrieved and displayed when required.
- 5.1.6.10 The system shall have in-built sensor simulation system options to conduct tests on the system for field installation, two-point calibration/re-calibration and maintenance of the sensors.
- 5.1.6.11 The system shall have a weather-proof housing.
- 5.1.6.12 The system shall support the following functions:
 - Easy programming set up.
 - Multi tasking capability
 - User friendly software programming.
- 5.1.6.13 Transmission via satellite and / or telephone modem, selectable by the user.
- 5.1.6.14 The system shall have self-diagnostic facility and be capable of displaying Station ID/Sensor ID codes and messages on the display panel for general identification of the fault. Facility to monitor these codes and other health status through an external lap top/PC.
- 5.1.6.15 The system shall be provided with a keypad option and at least 16 character display in the front panel. Setup shall be organised in a tree of menus and sub-menus. Protection of setup parameters and data through password should be supported by the system. In addition, the ARG shall support the manual entry of data through keypad and its display.
- 5.1.6.16 Data including the setup and program files shall be transferable from the system via a serial port to PC and PCMCIA card or other suitable memory device and vice versa.

5.1.7	Analog to digital converter	
	Resolution	: 16 bit or better
	Conversion Accuracy	: ± 1 LSB
5.1.8	System clock:	
	Stability Long-term	: 1 ppm/year or better
	Stability (Temperature)	: 3 ppm or better from -40°C to 55°C
5.1.9	Operating Temperature range	: -40°C to + 55°C
5.1.10	Internal Memory	: 1 MB RAM minimum
5.1.11	Battery Backup (internal)	: Lithium Battery, storage: 2 years
5.1.12	Real-Time Clock	: GPS synchronised
5.1.13	Watchdog Timer	: System Reset upon microprocessor failure
5.1.14	Sample Intervals	: 1 sec. to 24 hr. in 1 second increments (user selectable)
5.1.15	Visual display	: 16 Character or more, alphanumeric LED/LCD to operate in temp. range -10°C to +55°C
5.1.16	Power consumption	: Average over an hour shall be less than 0.2A at 12V D.C. including that of sensors, GPS and transmitter.
5.1.17	<u>Power Supply:</u>	
	a) Battery	: Single 12V chargeable maintenance-free battery 65 AH capacity
	b) Charge controller	: Internal or External
	c) Solar panel	: Rated capacity 30W, Open circuit voltage: 21V, Short circuit current 2.4 A.

5.2 ARG transmitter & antenna

The system transmitter should be an internal component of ARG. It should have necessary hardware and software to receive data from the ARG and transmit in TDMA mode as in para 6.0. The transmitter should have the capability to handle data transmission to the DRTs located on any of the INSAT series of satellites as given under **Annexure I**. The selection of frequency and mode of transmission shall be through software settings only. No hardware changes for switching from one satellite DRT to another are desirable.

5.2.1 Transmitter features

5.2.1.1	Carrier Frequency Band	:	402.0 MHz to 403.0 MHz Carrier frequency 402.658 MHz
5.2.1.2	Carrier Settability	:	In steps of 100 Hz from 402.0 MHz to 403.0 MHz
5.2.1.3	Modulator	:	PCM/BPSK
5.2.1.4	Data bit rate	:	4.8 KBPS (User selectable)
5.2.1.5	Data coding	:	NRZ(L)
5.2.1.6	<u>Frequency stability:</u>		
	a) Long term	:	Transmit frequency inaccuracy including aging of oscillator should not exceed ± 400 Hz per year. Oscillator/synthesizer should have provision to adjust for the long term drift
	b) for temperature	:	± 1 ppm or better (-40 to +55°C)
5.2.1.7	Signal Bandwidth	:	6.0 KHz maximum or better
5.2.1.8	Output Power	:	3-10 W (settable)
5.2.1.9	Power Stability	:	± 1 dB
5.2.1.10	Spurious	:	-60 dB or better
5.2.1.11	Harmonics	:	-40 dB or better
5.2.1.12	Environmental Operating Temperature	:	-40°C to +55°C
5.2.1.13	Environmental Relative Humidity	:	0 to 100% RH for out door equipments
5.2.1.14	Operating power	:	Switched 12V D.C controlled by data logger.

5.2.2 Antenna features

- The bidder shall ensure compatibility of the antenna in the entire system and also ensure achievement of objectives given in the telemetry link calculations to be provided by the bidder.
- The antenna shall have a proper mounting and pointing arrangement suitable for transmission to any one of INSAT satellites based DRTs (located anywhere in the geostationary arc from 45°E to 115°E longitude). The bidder shall also provide suitable templates, fixtures and tools for reorienting of the antenna towards any satellite by the field personnel as and when required.

- Proper lightning and surge protection shall be provided to protect all the equipment connected to the antenna from atmospheric hazards.
- Antenna to be designed with an optimum size so that it could be easily transported to remote and inaccessible places. Mounting of antenna should take care of Azimuth and Elevation changes. Systems have to operate in harsh and saline conditions and adaptable to tropical conditions.
- The following technical features shall be supplied by the bidder in addition to the technical information being provided by him as part of the bid:

5.2.2.1	Polarization	:	LHCP and RHCP (Switchable in field)
5.2.2.2	Gain	:	Minimum 11 dBi or better
5.2.2.3	Center frequency	:	402.0 MHz to 403.0 MHz
5.2.2.4	3dB Beam width	:	40°
5.2.2.5	VSWR	:	1.2 : 1
5.2.2.6	Impedance	:	50 ohms
5.2.2.7	Axial Ratio	:	To be specified by bidder
5.2.2.8	Operating wind speed	:	250 kmph
5.2.2.9	Wind Survival	:	300 kmph
5.2.2.10	Material	:	Rust-proof and oxidation-proof for use in coastal and saline areas
5.2.2.11	Connector type	:	To be specified by bidder
5.2.2.12	Mounting	:	Should have engraved elevation angle marking
5.2.2.13	Operating temperature	:	-40°C to +55°C
5.2.2.14	Operating Relative Humidity	:	0 to 100% RH
5.2.2.15	Weight	:	Light weight
5.2.2.16	Size	:	Small, portable
5.2.2.17	Operating rain rate	:	100 mm/hr and water proof

5.3 Certification

Transmitter and data logger must have certification from IMD for functional operation through INSAT / Kalpana-1 satellites for either TDMA or PRBS (Pseudo Random Burst Sequence) type of transmission technique.

6. TIME DIVISION MULTIPLE ACCESS (TDMA) SCHEME

Each TDMA type of transmitting system shall have a unique GPS synchronized time of transmission which must be stamped on the body of the system by the manufacturer. The burst data format is shown in Fig (1). However, CRC is added to the data frame and half rate convolution coded. It is then appended with CR & BTR preamble and UW and transmitted in TDMA mode. Burst duration is 186 msec.

The TDMA frame format is shown in Fig (2). TDMA technique is an open loop system with timing derived from GPS receiver which is part of ARG. TDMA frame duration is one hour. The one hour frame is divided into 6 time windows, each of 10 minute duration. Each ARG is assigned 1-second time slot in any of the 10-minute slot and the repeat transmission is after 10 minutes, which falls in the next time slot.

The one second frame is worked out taking into account the following details:

- 20 millisecond differential propagation delay over coverage area.
- RTC clock accuracy around 1 millisecond per day - GPS receiver updates RTC once every twenty four hours to conserve battery power of ARG.
- GPS receiver accuracy of less than 1 microsecond
- Guard time required in the present burst receiver at Hub station.

Features of ISRO TDMA transmission

Features of ISRO TDMA transmission scheme are provided for general guidance. However, international norms applicable for TDMA may be followed.

- Total number of ARG that could be accommodated in a single carrier is 1800.
- By including CRC in the data frame, data validity could be ensured.
- With preserving BCH coding of SID, data quality could be checked and valid data retrieved even for the bad CRC.
- By preserving present SID (Station Identification Code) structure of IMD, SID for all users of DRT could be standardized. The SID consists of 21bits (9 bits for user type, 2 bits for priority, and 10 bits for Platform ID)
- With Forward error correction convolution coding, better data quality is ensured.
- With one repeat transmission, reliability of data reception is improved.

1	CRC CODE GENERATION	Polynomial; CRC-CCITT-16 $X^{16}+X^{12}+X^5+1$
2	DATA SCRAMBLING	Polynomial: $1+X^{-1}+X^{-15}$ Initial State: 6959 (Hex)
3	CONVOLUTION ENCODING	Convolution Coding ½ Rate, Constraint Length K=7 Polynomial: G1=133(Octal), G2=171(Octal)
4	HEADER DETAILS	CR: 192 Symbols (all '0's) BTR: 64 Symbols (all '1's) UW: 64 Symbols (07EA CDDA 4E2F 28C2 (Hex)) Note: UW transmitted with LSB first of

		every byte, starting from 07EA. (See Fig.1)
5	RF DATA ENCODING	Differential coding (NRZ-L) is done for the entire burst (Preamble and the convolution coded bits) before RF modulation.

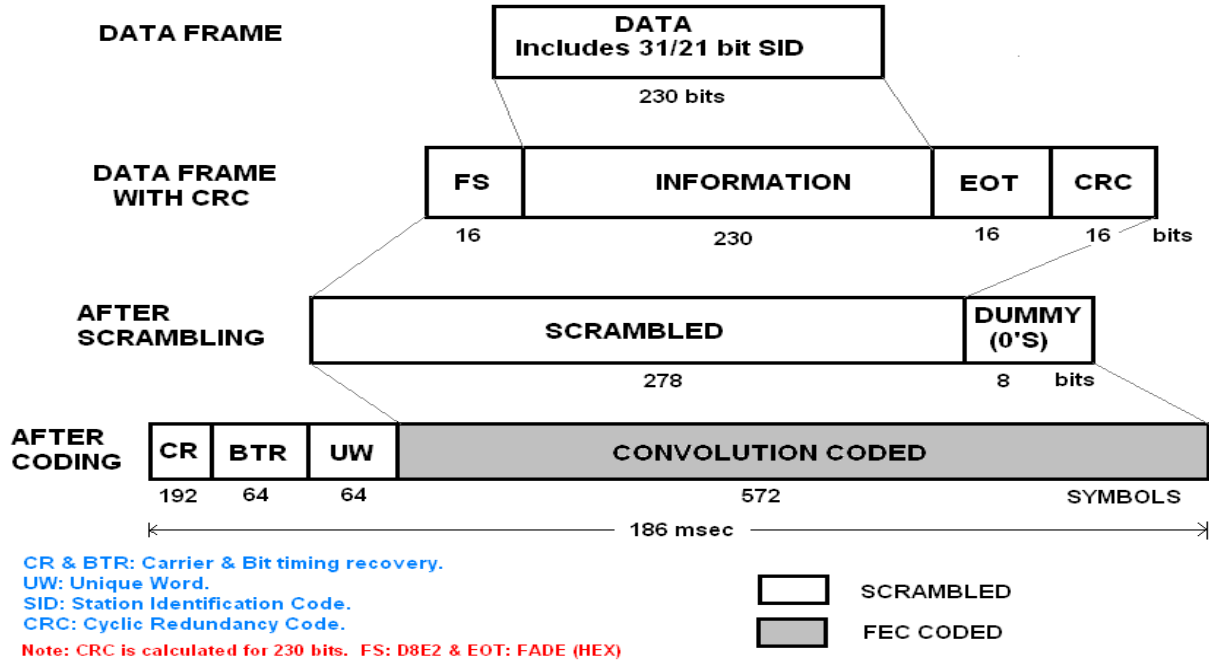


Fig (1) Burst Transmission Format for TDMA Technique (4800 Symbols/sec.)

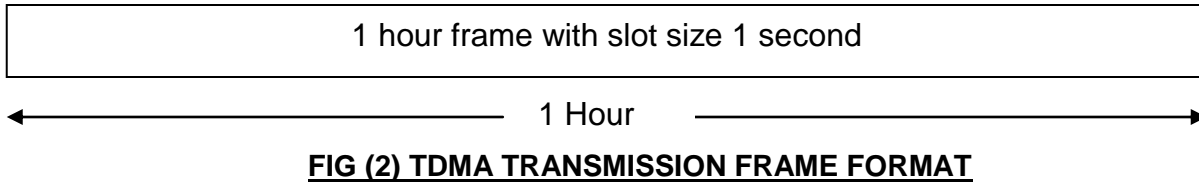


Fig.1 may be referred. CRC is calculated for 262 bits which include FS and EOT. It is then scrambled. 1byte, all '0's is added with the scrambled bits, after which the entire bits are convolution coded. Preamble (CR, BTR and UW) is appended with the convolution coded bits. The resulting bits are then differential coded and transmitted.

The system should have flexibility to accommodate more number of carrier channels by suitable changes in the TDMA transmission scheme.

More details will be provided at the time of the design review meeting which will be held with the successful bidder.

Table below gives the present AWS parameters and their identification code used in the TDMA transmission format. In case of ARG, Channel identification codes with data value as zero to be transmitted for channels without sensors:

Sl.No.	Channel No.	Identification Code	Parameter
1.	1	0000 (:0)	Instantaneous sampled value of air temperature in deg C at the end of every full hour UTC
2.	2	0001(:1)	Max. air temperature of the hour(samples taken every minute)
3.	3	0010(:2)	Minimum air temperature of the hour(samples taken every minute)
4.	4	0100(:4)	Wind speed in knots(3 minute vector averaging prior to full hour UTC)
5.	5	0101(:5)	Wind direction in degrees(3 minute vector averaging prior to full hour UTC)
6.	6	0110(:6)	Station level pressure (sampled at the end of every full hour UTC)
7.	7	0111(:7)	Instantaneous value of RH at the end of every full hour UTC
8.	8	1100(:12)	Cumulative rainfall since last reset (reset at every 03 UTC everyday), rounded off to the next higher integer
9.	9	1101(:13)	Hourly soil temperature
10.	10	1110(:14)	Duration of bright sunshine since last 20 UTC. Reset to zero at 20 UTC
11.	Cal1	:C1	Battery voltage (volts)
12.	Cal2	:C2	Hourly rainfall (rounded off to next higher integer)
13.	Cal3	:C3	Hourly soil moisture

CAL voltages and ARG health bits have the configuration of 10 bits + 1 parity bit.

Data of sensors has the configuration of 10 bits + 1 parity + 4 sensor ID bits.

The slots for calibration voltages are utilized to transmit other meteorological parameters and values of calibration voltages are no longer transmitted.

7. ARG SITE PREPARATION

The bidder shall prepare the ARG site according to the details and layout given in **Annexure-II** in different parts of India. It is to be ensured that IMD's representative is present at the site at the time of site preparation / installation and official commissioning of the ARG site. All cabling in the ARG site should be concealed/underground using suitable GI/steel piping /conduits. Each site should have a good quality metal sign board (Size: Height 2 ft x width 3 ft) painted in English or Hindi, as per the State where ARG is located with the following information:

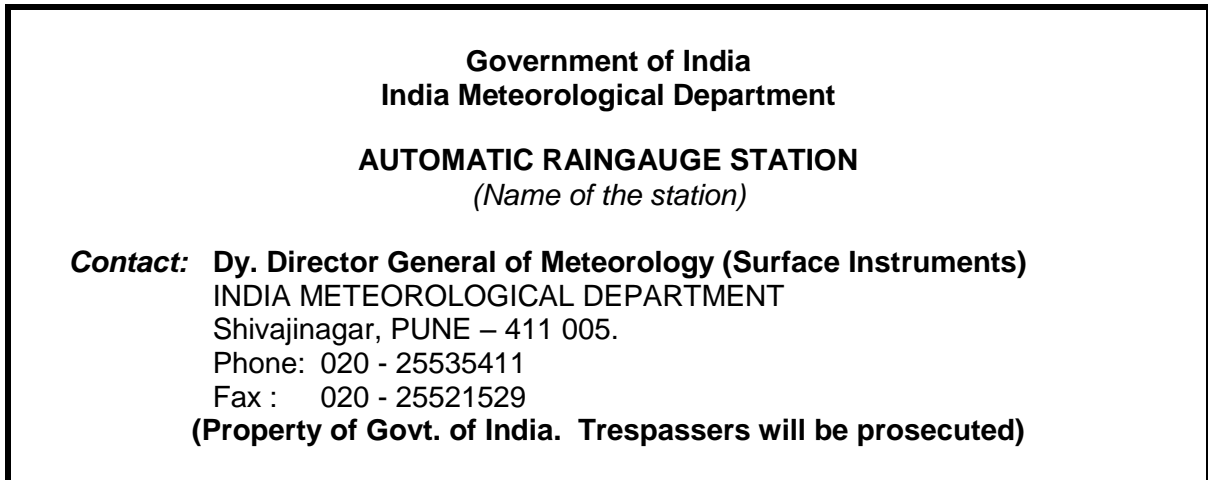


Fig. 3: Details for metal sign board

8. TRAINING TO IMD OFFICIALS

The manufacturer / supplier should provide in-depth training in hardware and software to at least **TEN** IMD officers in the installation, operation and maintenance of the system and about all software aspects including source code, at the manufacturer's place for a minimum period of four weeks. The firm will bear the cost of IMD officers towards travel expenses and per diem at Govt. of India rates.

9. WARRANTY AND MAINTENANCE

The manufacturer should provide a free comprehensive warranty of at least two years after commissioning of the system in the field. The manufacturer should take on the work of servicing and routine maintenance of field equipment once in three months. Response time for rectifications of faults in the field ARG equipment should not be more than two days. If the down time is more than two days, the warranty period will be presumed to be extended by a period twice the down time.

Reports of maintenance visits should be submitted on a quarterly basis to the respective regional maintenance centres alongwith a copy to DDGM(SI), Pune. Analysis of the data quality with a co-located meteorological observatory, if available, should be submitted. Hand-held digital standards for air temperature, relative humidity should be compulsorily available with the firm and taken to the ARG sites by the maintenance party to compare and evaluate the data quality. Hand-held GPS needs to be carried to each of the sites by the installation party to ascertain the exact elevation and latitude / longitude of the sites and report it to the Central Receiving Station, Pune for validation purposes.

In the case of indigenous firms, 80% of the total cost of equipment will be paid on receipt and acceptance of the material at Pune. 20% of the balance amount will be paid after final commissioning and acceptance of the ARG.

In the case of import of equipments, 90% of the total cost of equipment will be paid upon opening of Letter of Credit and the balance 10% will be paid after final commissioning and acceptance of ARG.

No advance payment will be made towards installation charges. Payment will be made in instalments for every 100 ARG sites commissioned and accepted.

10. TESTING, INSTALLATION & CALIBRATION KIT

The supplier shall provide 20 sets of kits of all equipment, meters, tools and test kits required for the purpose, including telecommunication equipment. The kit shall have all the necessary jigs, tools and fixtures required for installation and dismounting of telecommunication equipment, including antennae and associated cables of all types. All the tools and fixtures required for mounting and dismounting all the equipment from their respective installation sites shall be included.

11. DOCUMENTATION

The authorisation of representation from the manufacturer of the equipment should be submitted by the bidder along with the technical bids.

The manufacturer should provide detailed manuals for operation, servicing and maintenance of each sub system including all block diagrams and detailed circuit diagrams. The catalogues of all the vital components used in the system should also be provided. The copies of software listings may be provided in the form of CDROMs or other suitable media. All manuals should be given in printed form also.

12. COMPLIANCE / NON-COMPLIANCE STATEMENT

The tenderer shall submit a detailed item-wise compliance / non-compliance statement referring para-wise to the requirements given in this document, for quick evaluation of tender and for any future reference. The compliance statement shall be supported by original brochure(s) of the equipment or sub component from the manufacturer. In case the original brochure is silent on any part of tender specification, it shall be supported by an undertaking by the manufacturer, if claimed complied. The technical specifications and other requirements contained in this document are essentially required by the indenter. However, reasons for non-compliance, if any, for certain limited paras, or even sub-paras of the document may also be given by the tenderer. Silence on any part of the technical specification or failure / omission to provide any such details will be treated as non-compliance. All non-compliance of specifications, even of small nature, should be clearly brought out.

13. RELIABILITY

In general, it is desired that sensors should be capable of operating for 2-3 years without physical technical intervention. Sensors and ARG system should have built-in performance checks and indicators which should be utilized whenever possible.

14. SPARES AND CONSUMABLES

- The manufacturer should also quote for critical spares including sensors and components for operating these systems for a period of 2 years after the expiry of warranty period. The cost of these spares to be restricted within 15 per cent of the total cost of equipment.

- A list of accessories and test equipment along with their cost should also be submitted by the manufacturer along with the offer.
- The manufacturer should also quote for all the required supporting structures, housings masts, shelters etc along with the main equipment.

15. INSTALLATION, SYSTEM INTEGRATION AND COMMISSIONING

Land based ARG will be located in a fenced plot of land ideally measuring 7m X5m having adequate exposure for sensors. The bidding firm should undertake the installation work in the presence of IMD personnel who will officially commission the ARG after verification of the data quality. A report on the data quality of the ARG is also required to be submitted by the firm after ensuring data reception at the Earth Station, Pune.

16. DELIVERY SCHEDULE

Complete set of data loggers and transmission systems (1350 Nos.):

Delivery : In six approx. equal parts

First consignment: Six months from the date of award of contract.

All consignment: 18 months from the date of award of contract.

Commissioning : Two year for all 1350 stations

In case of delay of supply of the consignment, liquidated damage charge will be imposed @ 2% in delay of every month or its part to a maximum of 10%.

Delivery of the equipment should be done at the O/o DDGM(SI), Pune free of cost. The equipment must be under insurance during transportation.

If the bidder is unable to execute the project to the satisfaction of consignee, IMD has the right to re-tender after giving adequate notice to the supplier. The cost of re-tendering demurrage and the difference in the cost, if any, of the new order would be payable by the supplier.

17. PRICE PROPOSAL

The bidder shall submit the detailed price proposal containing separately, item-wise, the prices for each and every deliverable item and support services like fencing and other civil works separately. Since the plot size may vary, different items of the work for site preparation may be quoted as 'rate per square metre' or 'per metre' as the case may be. The price proposal should be given in a separate sealed cover. Technical document should contain an exact copy of the price bid without revealing the price details.

List of deliverables is given in **Annexure-IV**.

18. TESTING AND ACCEPTANCE

The bidder shall submit testing and acceptance plan for comments by IMD. The systems will be tested and evaluated in the laboratory at Pune according to the document.

19. SITE PREPARATION

The preparation of the ARG field sites will be taken up by the bidder after placing the firm order as per the agreed site preparation document (**Annexure- II**).

(Note: The value and number based specifications specified above can be marginally modified by the individual supplier in order to meet the specific system design offered by him. Wherever such modifications are suggested, the supplier shall clearly bring out the benefits that may accrue by way of these modifications of the specific parameters. If any parameter value is changed without giving full justification in the bid, the same shall be treated as a material deviation from technical specifications.)

20. SYSTEM DESIGN REVIEW

After award of contract the vendor shall conduct a detailed design review of the overall system where full technical details of the system will be mutually discussed between IMD and vendor's engineers. A detailed design review document needs to be provided by the supplier. The full technical details of the ARG system, hardware aspects of the ARG will be discussed and finalized in the Design Review Meeting. Test plan and general test procedures will also be discussed during this review. Detailed procedures for conducting Acceptance Tests will be finalized subsequently based on the outcome of discussions in the design review.

INSAT DRT SPECIFICATIONS

For the purpose of data transfer from field ARG unit to ARG Data Receiving Earth Station at Pune, the Data Relay Transponder (DRT) on the different INSAT / KALPANA-1 series of satellites shall be used and the specifications given below shall be treated as standard to be adhered by the offered telemetry system.

SATELLITE	KALPANA-1 74° E	INSAT-3A 83°E	INSAT-3D 82°E
RECEIVE FREQ. BAND	402.65 - 402.85Mhz	402.65 - 402.85Mhz	402.10 - 402.50Mhz
TRANSMIT FREQ. BAND	4500-4510Mhz band 4506.05Mhz	4500-4510Mhz band 4506.05Mhz	4500-4510Mhz band 4506.05Mhz
RECEIVE G/T	-19db/deg.K	-19db/deg.K	-19db/deg.K
MAX.EIRP	24dBW peak	24 dbW peak	24 dbW peak
C-BAND EIRP for RECEIVE FLUX DENSITY	2.0dBW for -146 dBW/m ²	2.0 dbW for -146 dbW/m ²	2.0 dbW for -146 dbW/m ²
REC.POLARI SATION	RHCP	LHCP	LHCP
TRANSMIT POL	LINEAR	LINEAR	LINEAR
FREQ.TRAN SLATION ERROR	± 40Khz over life ± 6Khz over 1 month	± 40Khz over life ± 6Khz over 1 month	± 40Khz over life ± 6Khz over 1 month

Data Relay Transponder (DRT) onboard INSAT 3D to be launched by 2007 will have a receiving frequency band of 402.3 MHz ± 200 KHz.



SPECIFICATIONS OF ARG SITE PREPARATION

1. ARG Enclosure

Area of the ARG enclosure should be ideally 7 m x 5 m. If a rare condition demands then even lesser area (5 m x 4 m) can be demarcated in consultation with IMD officials at respective Regional Met. Centre / Met Observatory. The approach to the site should be made free of obstacles like bushes, trees etc and a suitable cement path must be laid to approach the platform.

2. Fencing for the ARG site

2.1 The height of the fencing for the ARG site enclosure must be 2 metres from the ground level.

2.2 The fencing must be made over a cement enclosure which is nine inches above ground level.

2.3 Fencing angle should be of size 50mm x 50mm x 6mm and pre coated with red-oxide. The total length of the fencing angle should be 2.8 meters i.e. (2.0m above ground level + 0.8 m below ground level)

2.4 Two MS angles must be used diagonally at each of the four corner angles of the site. The angles can be attached (with welding or the other appropriate means) from the middle of the existing corner angle to the ground. The depth of the support will remain the same as of main angle.

2.5 The dimensions of the fencing angle foundation should be 1.0 ft x 1.0 ft (length X width) and at a depth of 3 feet. The foundation should be square shaped.

2.6 Distance between each fencing angle should be 1 metre.

3. Chainlink

3.1 Dimensions of GI Chainlink : 3 inches x 3 inches and of Gauge :10 (3 mm diameter).

3.2 GI chainlink mesh must be stretched and welded/fixed properly on the fencing angles.

3.3 A pipe or angle must be fixed on the upper part of the fencing to have a neat finishing and at the same time to avoid loosening of the fencing over a period of time.

3.4 The chainlink fencing should be fastened with the help of screws fitted on the fencing angles. Alternately it may be welded neatly at four equidistant positions of 0.5 mt each.

4. Gate

4.1 Dimensions: 2 m X 1 m x 6 mm (Length x Width) with locking facility

4.2 The gate must be fabricated by MS Angle whose dimensions should be minimum 40mm x 40mm x 6mm

4.3 Suitable locking facility with 3 keys for safety purposes is mandatory. Standard locks like NAVTAL should be used.

- 4.4 Make sure that tower foundation and the gate are in a straight line.
- 4.5 Gate and MS Angle must be well painted with white / silver colour.
- 4.6 Gate should have proper support of MS angles with additional support of crossed MS angles. Alternately gate should be fixed with the support of RCC pillars.

5. Tower Foundation

Dimensions: 3 ft x 3 ft (length x width) and 5 ft deep. The raised platform of the foundation must be 2.0 ft. above the ground level.

6. Tower Height

The height of the tower should be 2.5 metres above raised platform.

7. Rain Gauge foundation

- 7.1 Rain gauge foundation must be of dimensions 1ft x 1 ft (length x width) and 3 ft deep.
- 7.2 The rain gauge may be located so that it is at a minimum distance of 2 metres away from obstructions on all four sides.
- 7.3 The raised platform should be six inches above the ground level.
- 7.4 The base plate of rain gauge should be 1 ft. above ground level.
- 7.5 In the case of flood prone areas the base plate on which the rain gauge is mounted should be placed 1.0 metre above ground level.
- 7.6 Such locations are to be decided based on the suggestion of respective Regional Met. Centre /Met Observatory.

8. Proportions for concrete foundations

- 8.1. Concrete pillar foundations for the ARG tower, fencing angle should be made in the volumetric mixing proportions as follows:
- 8.2. Concrete foundation : 1 (Cement) : 2 (Sand) : 4 (Metal)
- 8.3. Fine plastering : 4(Cement) : 1 (Sand)
- 8.4. Concrete Pillar must be cemented to achieve smooth finish above the ground level.
- 8.5. After 8 hours, these foundations should be cured with water at least 3 times a day for four days.

9. Local Earthing

- 9.1 Material required:
 - 9.1.1 Salt: 20 Kg
 - 9.1.2 Charcoal: 20 Kg
 - 9.1.3 Sand 100 Kg

9.1.4 The lightning arrestor rod is made of copper which is mounted on the top most part of the ARG tower. It should be of thickness 12 mm and of one metre length with a connected copper wire of dimensions 3.5 Meter length and 6mm thickness (gauge). At the other end of copper wire is the Earthing rod of dimensions 15mm thickness and 1.8 meter length, which is buried into the ground. On the bottom of Earthing rod, one copper plate of dimensions 1' x 1' should be connected. ARG datalogger enclosure should also be grounded with local earthing.

9.1.5 Procedure:

9.2.1 A pit of 4-5 feet depth, 2' X 2' wide at bottom (like a cone shaped pit) has to be dug.

9.2.2 After leveling the bottom of the pit, uniform layer in the sequence of 6 inches of Salt + 6 inches Charcoal + 6 inches Sand is filled. Such sequence is repeated 3 times till the earth pit is filled to the top. The copper earthing rod is placed in the center of the pit. The pit is closed and leveled.

10. Painting

The tower, fencing angles, chain-link fencing and gate should be properly painted to avoid rusting. The ARG tower is painted in equal sections of alternate colours of red and white indicative of wireless transmissions from the tower.

All concrete foundations shall be painted using white cement.



List of 1350 ARGs

Station	P.F. Index	Ht in metres a.m.s.l	Latitude	Longitude	Azimuth	Elevation	Datum Pressure	User I.D.	Priority	Platform I.D.	BCH CODE

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1.	LIST OF DELIVERABLE ITEMS	QTY	UNIT COST	TOTAL COST
1.1	ARG EQUIPMENT CONSISTING OF			
1.2	Datalogger and transmission system(with built-in display), suitable signal conditioning for analog/digital sensors, serial (RS-232 interface) SDI-12 interface, PCMCIA / solid state memory drive (16 MB) solar charge controller, clock sync through GPS	1350		
1.3	Antenna with cable, connectors and mounting accessories	1350		
1.4	System enclosure as per NEMA-4 standards with gasketing etc.	1350		
1.5	Maintenance free rechargeable batteries 12 V (65 AH)	1350		
1.6	Solar panels for charging the above battery (12V/30W)	1350		
1.7	System operation, maintenance and service manuals (Hard copies) and CDs containing soft copies	400		
2.0	SENSORS			
2.1	Air temperature/relative humidity sensor with suitable connector and 10 mts cable alongwith radiation shield	500		
2.2	Raingauge sensor with 10 mts cable	1350		
2.3	Sensor mast assembly with suitable enclosures for housing the different sensors free from solar radiation etc.	1350		
2.4	Field Calibration Unit for tipping bucket rain gauges (portable and handy to be retained in site enclosure)	1350		
3.0	SPARES FOR ARG			
3.1	Complete data logger and transmission system with all accessories as given in 1.2 (with NEMA enclosure/housing)	150		
3.2	Antenna assembly with all accessories as given in 1.3 and antenna(RF) cables	150		
3.3	GPS antenna	150		
3.4	PCMCIA cards/ solid state memory devices (16 MB)	100		
3.5	LAPTOPS for field programming	10		
4.0	SPARES FOR SENSORS			
4.1	Air temperature and relative humidity sensor	50		
4.2	Rain gauge with 10 m cable	50		
5.0	TEST AND CALIBRATION EQUIPMENT			
5.1	PCMCIA card / solid state memory card reader	100		
5.2	Hand-held high precision Standard digital thermometer (0.1 °C accuracy)	30		
5.3	Hand-held high precision Standard digital relative humidity indicator	30		
5.4	High precision Hand-held GPS (to find the geo-coordinates of sites with accuracy less than 10 m)	10		
6.0	Installation and Civil Work			
6.1	Leveling of site	As reqd		
6.2	Fencing the ARG	As reqd		
6.3	Foundation for ARG mast and installation	1350		
6.4	Metal Sign board for all ARGs	1350		
7.0	Training of IMD personnel	10 IMD officials		