Appendix-'A'

Scope of work

The responsibility of the shortlisted applicant shall include but not limited to: -

(i) Design, development, realization and testing (functional and environmental), of 'Portable Rugged Automated Meteorological Observation System (PRAMOS)'.

(ii) Transportation, site preparation/foundation work, installation and commissioning of mast and Portable Rugged Automated Meteorological Observation System (PRAMOS) at 20 field locations in Indian Himalayas.

(iii) Warranty period: min 02 years from the date of acceptance after installation and commissioning

Followings are the broader environment & terrain condition at remote field locations for deployment/testing of PRAMOS:

a). The locations are avalanche prone and the terrain is mountainous (mixed rock & soil).
b). Wind velocity upto 60 m/s is witnessed in the regions.
c). Temperatures as low as -40°C may be encountered during winters.
d). Region witness's heavy rains in rainy season.
e). Standing snow of up to 5m may exist during winter months.
f). Field locations for deployment of PRAMOS are in range or 3000 to 5500 m altitude.

1). Broad specifications:

PRAMOS will be used for automatic collection and transmission of snow & meteorological data of different climatic zones of Indian Himalayas. The PRAMOS foundation related civil work will be made ready before hand. PRAMOS should be portable, rugged, modular and easy to install within 1-2 hours excluding the foundation work.

PRAMOS will consists of following

- Single Multi-Parameter Weather Sensor with cable, mounting hardware and accessories
- Snow Specific Sensors (as described in subsequent section)
- DGRE specific Datalogger
- Satcom Terminal (NATSAT-M) with mounting hardware
- Solar panel with battery charge regulator & SMF lead acid battery
- Collapsible/modular/telescopic mast with fencing
- NEMA-IV enclosure with D38999 Series-III connectors

Tentative proposed tower/mast design of PRAMOS may be telescopic mast type or collapsible/modular with mechanized/motorized winch system for lowering and raising. The max raised height of mast should be 6 meters and collapsed height should be 0.5 (approx.) meters. The PRAMOS should have collapsible type arms of length 1 meters. There should be mechanical (automatic) mechanism for opening of collapsible type arms. Collapsible arm should have conduit with miniature junction boxes for the sensors/communication signal power wiring/cabling.

PRAMOS should have mounting hardware for placement of 20-watt solar panel (standard size) or better. The PRAMOS should have provision for lighting arrester on the top of mast with collapsible conduit.

PRAMOS should have mounting hardware for placement of Satcom Terminal (NATSAT-M) (mounting drawing will be shared later) and wiring/cabling of NATSAT and DGRE specific datalogger (mounting drawing will be shared later).

PRAMOS should have mounting hardware for placement of standard NEMA-IV enclosure with D38999 Series-III connectors. The NEMA-IV enclosure shall house the Datalogger and battery with charge regulator.

The PRAMOS should have a multi-parameter (single body) weather sensor with measurement capability of temperature, relative humidity, atmospheric pressure, wind speed/direction, precipitation intensity and quantity. PRAMOS should have separate sensors for measurement of snow surface temperature, radiation and snow depth. The snow specific and multi-parameter weather sensors output should have RS 485 interface for data exchange.

The broader specification of sensors is given in Table 1.

Table 1: Broader specifications of broader specification of sensors

Table-1	
Combined All in one weather sensor specifications for PRAMOS	**Requirement of DGRE**
General	
Weight	≤ 2 kg
Interface	RS 485
Power Supply	9 to 12 VDC
Operating Temperature	-40°C to +60°C or better (with heater)
Operating RH	0 to 100 %
Protection	IP 66 or better
Heater	Required
Temperature	
Principle	NTC or equivalent
Measuring Range	-40°C to +60°C or better
Accuracy	± 0.5°C or better of full scale
Relative humidity sensor	
Principle	Capacitive
Measuring Range	0 to 100 % RH
Accuracy	±2% or better of full scale
Atmospheric Pressure Sensor	
Principle	MEMS capacitive
Range	400 to 1000 mBar (hPa) or better
Accuracy	± 1 mB (hPa) or better over operating temp. range (-40°C to +60°C)
Wind Direction Sensor with Heating	
Principle	Ultrasonic

Range	0 to 359 degree
Accuracy	≤ 3 degrees or better
Threshold	1.0 m/s or better
Wind Speed Sensor	
Principle	Ultrasonic
Range	0-60 m/s or better
Accuracy	± 3 % of FSR or better
Threshold	1.0 m/s or better
Snow and Rain Precipitation (Solid & Liquid)	
Droplet Size	0,3.....5 mm
Detection sensitivity	0,01 mm/h
Particle Velocity	0.9.....15.5 m/s
Resolution	0.1 mm
Snow Depth Sensor	
Range	0.5 m to 5 m or better
Resolution	1 mm or better
Accuracy	0.5% of distance to target or better
Temperature Range	-40°C to +50°C
Power	9 to 12 VDC
Output	SDI-12/Digital
Net Radiation Sensor	4- Component Net Radiometer
Pyranometer Spectrally Flat Class C according t ISO 9060:2018	Albedo sensor will consist of two pyranometers one facing the sky and the other to the ground. Albedo sensor will provide readings of incoming and outgoing shortwave radiations.
Spectral range	300 to 2800 nm
Sensitivity	10-15 μV/W/m^2 or better

Field of view	180 degree
Operating Temperature Range	- 40°C to 60°C
Pyrgeometer	
Spectral Range	5.5 µm to 42 µm
Sensitivity	5-10 µV/W/m^2
Field of view	≥ 150 degree
Operating Temperature	-40 to + 60^0 C
Infra-red Snow Surface Temperature Sensor	The sensor will be Infra-red type and will have protective housing for long term outdoor use.
Sensing Temperature Range	-50° C to + 55° C or better
Accuracy	±0.5° C or better
Beam Angle	≤ 45^0
Spectral Range	8 to 14 µm
Sensitivity	60 µV/ Deg C (Approx.) or better
Output	Analog within 0 to 5 or ± 3.5 mV DC
Input Voltage	0 to 5 V DC

2). The Datalogger is a recorder device for unattended acquisition of meteorological and snow data. DGRE had designed and developed a DGRE specific Datalogger in past and same is being used in remote areas of Indian Himalayas where regular maintenance and supervision is difficult. Datalogger is having provision for quick and easy mounting in NEMA-IV rated enclosure.

3). The DGRE specific Datalogger was designed around ARM cortex-M7, RISC Architecture, 32Bits, Upto 216MHz Clock, 2MB Flash Memory, Make: ST Microelectronics, Model: STM32F765ZGT6.

4). The application programming was developed in bare-metal type style/format/environment.

5). The DGRE specific Datalogger automatically can power-up sensors, take readings from sensors, covert readings into the engineering values (for analog sensors) based on calibration parameters, and store them into its memory along with time stamp as per the scheduled time interval and same data is transmitted through GSM modem or/and Satcom (NATSAT-M) modem by providing data on RS232 port using AT command protocol.

General Features:

- Extreme temperature range -40 to 60 °C for components

- Support for MODBUS RS485, SDI12 and RS232 protocols for acquisition of sensors data
- Precision 8 Single Ended and 4 Differential Analog inputs
- On-board GSM/GPRS modem
- Regulated 5V and 12V sensors excitation
- Support M2M Modem and SatCom (externally)
- Easy configuration with USB port

The dataloggers various parameter and their specifications are given in the table below:

Datalogger various parameter and their specifications

Datalogger Parameters	Specifications
Microcontroller	ARM cortex-M7, RISC Architecture, 32Bits, Upto 216MHz Clock, 2MB Flash Memory Make: ST Microelectronics, Model: STM32F765ZGT6
ADC	24-bit ADC with 30 KHz sample rate (no missing codes), Sig Delta with PGA architecture, ± 0.0010% nonlinearity, SPI Interface Make: Texas Instruments, Model: ADS1256IDBTG4
Real –Time Clock	
(i) Resolution	Counts Seconds, Minutes, Hours, Day, Date, Month, and Year with Leap Year Compensation Valid Up to 2100
(ii) Accuracy	±3.5 ppm over industrial temperature range
(iii) Backup battery	Internal lithium battery
Memory	16GB SD Card (Extended Temperature Range) 2Mbit EEPROM (from internal Storage)
Display and Keypad	Make: Newhaven Model: NHD-0420CW-AY3
(i) Display Type	4x20 OLED Display (Sunlight readable)
(ii) Sunlight-readable	Yes
(iii) Time out feature	Yes (to conserve power)
(iv) Keypad	4x Keys (Up, Down Enter, Back)
(v) LED Indications	5 x LEDs (Status, GPRS, Cloud, Log, Reverse Power)
Ports/Channels	• 2 x EIA RS485, 1 x RS232, 1 x SDI12 • 2 x 4-20mA (Single Ended ±0.1% of FS) • 6 x 0-5V (Single Ended, Accuracy: 100µV) • 4 x ±2.5V (Differential, Accuracy: 100µV)) • 4 x Digital Inputs (0-5V) • 2 x Pulse Inputs (0-5V, 100KHz, 16 bits) • 4 x Digital Outputs (Open Collector, 125mA/ch)
Switched Power	• 3 x 5V (1A/ch, Cumulative: 1A, Regulated) • 3 x 12V (1A/ch, Cumulative: 1A, Regulated)
Telemetry support	• GSM/GPRS (4G) Quad Band (FDD LTE, TDD LTE, TDSCDMA, WCDMA CDMA2000 1x/EVDO, GSM (900/1800MHz)) • MODEM (DTE) Port for Satellite Communication • Ethernet for M2M Modem/VSAT Communication

Datalogger Parameters	Specifications
Programming, Data Collection, Logging, Transmission, and configuration	
a). Programming	Programmable though STM programmer using Micro USB port or using STM programming device.
b). Data Collection, Logging, and Transmission	• Collection: As per scheduled interval • Logging: 1 min - 24 hours / reading • Transmission: User configurable
c). Configuration	HMI, Debug (DCE) RS232 port
Power	
a). Input supply	9-18 VDC ± 10% (Nominal 12VDC)
b). Current	Sleep: 5mA @12VDC, Operating: 300mA (depend on no. of sensors connected to datalogger.
c). Power	5W (peak)
d). Protection	• Surge protection on sensor inputs • Over voltage and reverse polarity protection on Power i/p
e). Isolation	1.5KV Galvanic Isolation
Mechanical	
a). Dimensions	328 (L) x 194(W) x 50.2(D) mm
b). Mounting	Panel / Wall mount
c). Weight	1.6Kgs approx.
d). Color (RAL)	Black (9005)
e). Material	AL-5052
Environmental	
a). Operating Temperature	-40 to 60 °C excluding display
b). Humidity	0 to 100% RH (non-condensing)

6). DGRE is looking for Industry Partner who can ruggedize the existing system hardware with development of PRAMOS so that system can pass environment tests. The industry partner shall subject all the ruggedized Dataloggers for Environmental Stress Screening (ESS) as part of the Acceptance Test Plan (ATP) and one of the randomly selected ESS qualified item for qualification test (QT). These test are to be conducted at developmental partner premises or any other testing facilities approved by DGRE. The Acceptance Test Plan (ATP) and Qualification Tests (QT) plan documents will be issued later along with RFP. The list of tests to be done are given below as per applicability.

7). The firm will be allocating minimum two mechanical/CAD-CAM engineer for modelling of PRAMOS tower based on the inputs from DGRE. The CFD/ANSYS analysis should be carried by the firm on finalized tower design in their premises.

8). Training

The prospective developmental partner shall provide 5 days training at DGRE Chandigarh or at actual field location as decided by DGRE for integration, operation, configuration, diagnosis and maintenance of PRAMOS without any additional cost.

9). List of deliverables

The details of the list of deliverables are given in the table below.

Sl. No.	List of Deliverable Items	Qty.(No./set)
1.	PRAMOS System (Prototype units)	01 No.
2.	PRAMOS Systems(Qualified units)	20 No.
3.	Field installation *(of* PRAMOS systems at sites with altitude are in range or 3000 to 5500 m*)*	20 No.