

ANNEX 1

TECHNICAL SPECIFICATIONS FOR HYDROMETEOROLOGICAL EQUIPMENT

TECHNICAL SPECIFICATIONS

Supply of Meteorological Equipment

1. GENERAL

Contractor will provide the following equipment:

- 1 recording raingauge (self-emptying) with dedicated data logger, rechargeable battery, solar panel and GSM/UHF/Iridium transmission facilities, complete with all housing and mounting accessories;
- 1 GSM modem for connection to computer base station for receipt of transmitted signals from remote sensors
- Measuring equipment for Automatic water level recording stations with Data Logger comprising;
 1. 1 radar water level sensors plus data logger, solar panel & rechargeable battery power supply
 2. 1 GSM modem data transmission facilities
- 10 sets standard water level staff gauges 0-3.0m;

In the following paragraphs technical characteristics of equipment are specified. The Contractor may offer better or different instrumentation, that can guarantee fulfilment of objectives.

2. LIST OF EQUIPMENT

2.1. Recording Raingauge with GSM/UHF/Iridium Transmission Facilities

The Contractor will provide 1 recording raingauge for remote locations fully equipped with GSM/UHF/Iridium transmission facilities, rechargeable batteries and appropriate solar panels. All sensitive electronic equipment will be suitably housed either integral with or external to the rain recording unit. Mounting equipment for the solar panel shall also be supplied.

2.1.1. Automatic equipment

- Dedicated data logger and GSM/UHF/Iridium modem
- Power supply, including solar panel, rechargeable battery, regulator and necessary cabling
- Rainfall sensor/recorder

- Snow Depth Sensor
- Air Temperature Sensor
- Atmospheric Pressure Sensor
- Pole and mounting arm(s) for sensors and solar panel

2.2. GSM modem for data reception

The Contractor will supply 1 external GSM modem for connection to computer base station. The modem shall be compatible with the transmission/reception modem incorporated in the remote recording raingauges and water level sensor. (specification in annex)

2.3. UHF/Iridium modem for data reception (as required)

The Contractor will supply 1 external GSM modem for connection to computer base station. The modem shall be compatible with the transmission/reception modem incorporated in the remote recording raingauges and water level sensor. (specification in Section 6)

2.4. Automatic Water Level Recording Stations

Contractor will provide equipment for the establishment of 1 Automatic water level recorder station. The equipment to be installed is as follows:

2.4.1. Automatic equipment

- Data Logger
- Housing to IP66 (NEMA 4 or equivalent) to contain Data logger and other electronic peripherals.
- Power supply system including solar panel, rechargeable battery and all necessary cabling.
- All mounting hardware, grounding, and lightning protection.
- 1 Radar water level sensors (including mounting accessory and 20 m cable)

Technical specifications of the equipment are detailed in 6.

2.5. Staff Gauges

Contractor will provide 10 complete sets of staff gauges to indicate water level at a site from 0 to 3.0 metres. The staff gauges will be supplied in 1.0 metre lengths, marked accordingly.

Technical Specifications are detailed in the Annex

equipped with 40 metres of cable, data logger and rechargeable battery.

Technical Specifications are detailed in Section 6

2.6. Software

Software shall be supplied that will permit remote communication with all data loggers and facilitate data transfer and subsequent storage at a central receiving station. All software associated with transmission of hydrometeorologic data shall be software that will link seamlessly to the Delft-FEWS platform.

3. ASSOCIATED ACTIVITIES

3.1. Civil Engineering Work

Contractor will be required to provide details of civil works required for the installation of all equipment and supervise all minor civil works required for the final installation of the equipment which will be undertaken by beneficiary. The Contractor is not required to undertake any additional construction works in association with his offer.

3.2. Fabrication, Integration, and Factory Testing

Contractor will fabricate and assemble each unit at the factory. He will conduct preliminary system testing on each field unit, and will then verify operating functions as designed. Finally, he will prepare the necessary documentation, for both software and hardware associated with this system.

4. SPARES

Contractor will recommend a detailed list with costs of the necessary set of spares, for 1-2 year system sustainability.

Moreover, he will guarantee availability of spare parts for a minimum of 10 years, with prices updating through price actualization formulas.

5. SHIPPING AND HANDLING

5.1. Packing

Contractor will pack all systems and sensors in a manner suitable for international shipment.

5.2. Shipping

Contractor will take care of all shipping arrangements and insurance freights for the final delivery to the destination specified elsewhere.

6. TECHNICAL SPECIFICATIONS

Automatic Precipitation Station

Complete automatic precipitation Station for remote locations, consisting of:

- Tipping bucket automatic raingauge
- Snow Depth Sensor
- Air temperature Sensor
- Atmospheric Pressure Sensor
- Data Logger
- GSM/UHF/Iridium Modem
- Solar panel with backup battery
- Supporting pole and cross-arm

Automatic Raingauge Technical Specifications

The proposed instrument must satisfy the following criteria:

- Precision instrument for the measurement of rainfall accumulation/rate
- Suitable for remote sensing application, must interface with the data recorder
- Low power consumption
- Low maintenance

Specifications

Mechanical	Orifice Size (where applicable)	200cm ²
Operational	Sensitivity	0.2 mm
Resolution		0.02 mm
Accuracy		± 1% at 10 mm/hr; ± 2% at 50 mm/hr
Self-emptying		
Supplied with Tretyakov pattern wind-shield		

Air Temperature Sensor

The proposed instrument must satisfy the following criteria:

- Suitable for remote sensing application, must interface with the data recorder
- Low power consumption, no warm-up time
- Low maintenance
- High accuracy over full range of measure

Specifications

Range	-30°C to +70°C
Accuracy	+/- 0.1°C
Sensitivity	0.1°C
Time constant	better than 10 seconds

The instrument, to be mounted at 2 meters above the ground to comply with WMO standards, must include radiation shield and assembly cable.

Snow Depth Sensor

General

Power supply	Supply voltage: 10.5 ... 15 VDC
Current consumption: max. 200 mA	
Power consumption:	0.5Ah / day max
Operating temperature	-35 ... 60 °C
Protection	IP 66
Integrated lightning protection (discharge capacity 0.6 kA)	
Snow depth measurement	
Range of measurement	0 ... 8m
Minimum distance to the maximum expected snow depth	1m
Accuracy	0.1 % (FS)

Resolution	1mm
Principle of measurement	Ultrasonic

Integrated compensation of the air temperature

Interfaces

Analogue Snow depth measurement 0/4 - 20 mA signal
(configurable) Resolution: 12 Bit Max. load: 300 Ω

Digital Snow depth measurement; quality flag RS 232; serial
interface Protocol: Various ASCII formats

Atmospheric Pressure Sensor

Operating range 700mb to 1200mb (approx)

Operating Temperature -40°C up to +85°C

Sensitivity/output: 87mV/hPa at 12VDC

Power supply 5 - 24 V DC

Housing Rugged, non-oxidising

voltage output linearity 0.5%

Data Logger Technical Specifications

Memory	Sufficient for $\geq 200,000$ measured values
Battery Backup	Lithium Battery storage: 2 years min. (depending on environment) Backup Life: 1 year min.
Real- Time Clock	Accuracy of 1 minute/month
Watchdog Timer	System Reset upon microprocessor failure
Sample Intervals	5 sec. to 24 hrs. in 5 second increments
Registration Modes	Time-, dynamic- or event controlled. Comprehensive alarm management.
Data Retrieval	RS-232 Port and/or suitable interface for laptop/PDA or proprietary device
Visual Display	≥ 16 character alphanumeric LED

Serial Sensor	Connection through RS-232 port / RS 485
SDI-12	Fully supported through SDI-12 port
Communications	Via external peripheral device (Iridium Modem)
Power Supply	Internal Battery - solar panel input or DC 10-15 voltage
Consumption	Quiescent 1 mA, Max. 50 mA
Digital Inputs and Output	Minimum 8, under software control. Software Control of switched 12VDC power
Housing Protection	IP66 or NEMA4 minimum

Iridium Modem Specifications

- Global coverage
- Small form factor
- 340 bytes per message
- SMA Antenna Connector to connect to small omni-directional L-Band antennas
- Simple AT Command Interface

Environmental

- Operating temperature range: –20°C to +60°C
- Operating humidity range: < 75% RH
- Storage temperature range: –40°C to +85°C
- Storage humidity range: < 93% RH

RF Interface

- Frequency range: 1616MHz to 1626.5MHz
- Duplexing method: TDD (Time Domain Duplex)
- SIM slot integrated
- Antenna (50 ohms)
- Multiplexing method: TDMA/FDMA

DC Power Interface

- Main input voltage: Nominal: 12V (10-18VDC)
- Complete with Iridium modem for PC receiving station

GSM Modem Technical Specifications

Frequency:	900MHz and 1800MHz (EGSM Dual Band) Minimum
HF Output max:	2W Class 4 at 900MHz and 1W Class 1 at 1900MHz
Antenna Impedance:	50Ω
SIM Card:	1.8V or 3V
Power Supply:	6V....30V DC
Operating temp.:	-30°C ...+85°C
Electric Current	30mA/12VDC (receipt) 0.5A (transmission)
Interface:	RS232
Antenna	Included with cabling
Protection	IP66
Functioning	Multi level Alarm dialout, pre-programmed dialout, remote interrogation facilities

Note: Modem may be integrated with data logger

Solar Panel

Solar panels must be designed for use in the nominal 12-volt systems. It must be covered with tempered glass, corrosion resistant with blocking diodes against current inverted flows during period without sunlight, with connection box for marine environment (NEMA type, or equivalent) and aluminum plate for further protection. A solar panel regulator, 2 amp continuous current, must be provided.

Solar Panel Technical Specifications

Solar Panels	20 Watt
Typical Peak Power	20 Watts
Voltage at Peak Power	17.1 VDC
Current at Peak Power	1.17 A
Minimum Peak Power	18 Watts
Short-Circuit Current	1.27 A
Open-Circuit Voltage	20.8 VDC
Wind Load Exceeding	55 m/s

Battery, 24 Ah Technical Specifications

- Rechargeable sealed lead-acid batteries
- Maintenance- free
- Overcharge protection
- Leak-proof
- Easy handling
- No special shipping container required
- Long service life
- Trouble-free, safe operation in any position
- No need to add electrolyte
- High-impact resistant battery case made of non-conductive ABS plastic with superior resistance to shock, vibration, chemicals and heat
- Batteries must operate 14 days with cloud cover

Radar Water Level Sensor

The proposed instrument must accomplish the following characteristics:

Standard precision instrument for the measurement of water levels

Suitable for remote sensing application, must interface with data logger

Low power consumption

Temperature compensation

Radar Sensor Technical Specifications

Range	0- $\geq$ 20 meters
Operation Principle	Pulse
Accuracy	$\pm 0.01\text{m}$
Protection Class	IP66 min
Output	4...20mA/ 0.4 – 2v
Sensitivity	0.001m
Power supply	Nominal 12V DC 9....15 VDC
Operating temp.	-20°C to +60°C
Interface	RS-485

Staff Gauges

Contractor will provide 10 complete sets of staff gauges to indicate water level at a site from 0 to 3.0 metres. The staff gauges will be supplied in 1.0 metre lengths, marked accordingly.

TECHNICAL SPECIFICATIONS FOR HYDROMETEOROLOGICAL EQUIPMENT

TECHNICAL SPECIFICATIONS

Supply of Hydrometeorological Equipment

1. GENERAL

Contractor will provide the following equipment:

- 1 Acoustic Doppler Current Profiler mounted on suitable streamlined pontoon and equipped with GPS equipment for precise location. To include necessary Windows™ software that shall indicate river profile, velocity profile and calculate discharge accordingly, as a minimum.
- 1 powered cableway system for a river span of approximately 100 metres, capable of suspending ADCP apparatus and traversing smoothly to enable measurement of river discharge
- 1 Portable Conductivity Meter with 5 m of cabling and sensor included.

In the following paragraphs technical characteristics of equipment are specified. The Contractor may offer better or different instrumentation, that can guarantee fulfilment of objectives.

2. LIST OF EQUIPMENT

5.1 Acoustic Doppler Current Profiler

The Contractor will provide 1 no pontoon-mounted Acoustic Doppler Current Profiler for the measurement of river discharges up to $1200\text{m}^3/\text{sec}$ and velocities up to 5m/s . It shall incorporate a GPS system that will permit precise location of the apparatus during its transit of the river and provide an accurate recording of the river and velocity profile. The unit will be supplied with software (based on the Windows Operating System) that, as a minimum, will permit the mapping of the bed profile, the position of the instrument, the velocity profile, calculate average velocity at the section and also calculate the instantaneous river discharge at the section.

5.2 Powered Cableway System

The Contractor will provide 1 powered cableway system (mains power is available at the site, but the equipment should also include a suitable electric generator) for the express purpose of transiting an ADCP across a span of approximately 100 metres of river width. The system shall be capable of transiting at various speeds, but all speeds shall be continuously maintained, once selected. It is not anticipated that the apparatus will be required to transit a standard propeller current meter.

5.3 Portable Conductivity Meter

The Contractor shall supply 1 portable Conductivity Meter, complete with 5 metres of cable and equipped with conductivity sensor. The equipment shall be capable of recording and storage of data at user-selected intervals, from 1 second to 30 seconds. The apparatus shall be housed in a suitable water-resistant housing and be of rugged construction, with carrying handle and digital illuminated display.

3. ASSOCIATED ACTIVITIES

3.1 Civil Engineering Work

All minor civil works required for the final installation of the equipment to be supplied will be undertaken by others. The Contractor is not required to undertake any additional construction works in association with his offer.

3.2 Fabrication, Integration, and Factory Testing

Contractor will fabricate and assemble each unit at the factory. He will conduct preliminary system testing on each field unit, and will then verify operating functions as designed. Finally, he will prepare the necessary documentation, for both software and hardware associated with this system.

4. SPARES

Contractor will recommend a detailed list with costs of the necessary set of spares, for 1-2 year system sustainability.

Moreover, he will guarantee availability of spare parts for a minimum of 10 years, with prices updating through price actualization formulas.

5. SHIPPING AND HANDLING

5.4 Packing

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5.5 Shipping

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6 TECHNICAL SPECIFICATIONS

Acoustic Doppler Current Profiler

Purpose

The Acoustic Doppler Current Profiler (ADCP) is to be used for automated discharge measurements from a small boat on rivers and canals. Typical applications are verification of velocity-area data, discharge measurements at important locations and discharge measurements on large rivers. The ADCP will be deployed in a roving mode, being transported from the one site of interest to the other.

Conditions & Requirements

The ADCP shall be of such a design that it operates reliably and accurately under the prevailing environmental and hydraulic conditions.

The ADCP shall be easy to operate and maintain.

All materials on the ADCP exterior shall be non-corrosive.

The ADCP shall be small, light and easy to transport.

The sensor-head shall be sturdy and impact resistant.

The ADCP shall be supplied ready mounted on suitable floats

The X-direction of the ADCP shall be in parallel with the longitudinal axis of the boat.

A portable PC, meeting the requirements of the current profiler is to control the ADCP, to monitor the data acquisition process, to store the collected data and to visualise collected data files.

A compass for direction referencing shall be part of the ADCP to relate the velocity data to East-West and North-South direction..

The compass shall have calibration functions, amongst others by sailing a circle with ADCP installed in the boat. The calibration shall compensate for any local magnetic conditions on the compass reading.

A GPS system shall be part of the delivery and included in the bid price. The GPS shall meet the following requirements.

fully compatible with the ADCP system, hardware and software

same power supply (car battery)

update rate of ≤ 1 second

position conversion to the co-ordinate system used for the streams

proper and accurate referencing to boat in order to allow accurate conversion of Doppler velocity into actual water velocity (including direction)

the combination of ADCP and GPS systems shall meet the accuracy requirements as specified below under Specifications.

All relevant data from ADCP, (GPS), compass, echo-sounder and other devices shall be stored on PC for validation and post processing.

A small portable generator will be required to charge the batteries used for the current profiler.

The current profiler shall be supplied with the required accessories, software and operator's manual

Technical Specifications

1. Sensor

Mode of Operation	Real time from purpose-built streamlined float
Measuring range	± 10 m/s (velocity relative to instrument)
Stream velocity range	-5 to +5 m/s
Stream velocity accuracy	$\leq 0.25\% \pm 0.005$ m/s
Resolution	≤ 0.01 m/s
Ping Interval	≤ 0.1 s
Configuration	3 or 4 beams
Beam angle	$\geq 20^\circ$ and $\leq 30^\circ$
Acoustic Frequency	Highest possible frequency for adequate bottom tracking at depths of 30m in fast flowing sediment laden waters
Number of Depth Cells	Programmable, 1 to 128
Depth Cell (bin) size	Programmable 0.25 to 2m

2. Bottom Tracking (or GPS)

Accuracy	1 cm/s @ 5 m/s
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Stream Velocity Range	0 to 5 m/s
Depth Range	30 m or more

3. Tilt Sensor

Range	20° to +20°, both X and Y axis
Accuracy	2°

4. Compass

Type	In-built flux gate
Accuracy	0.5°
Repeatability	0.2°
Resolution	0.1°
Permissible Tilt	15°

Auxiliary Comms Interface	Serial RS232 C at PC end. The communication between ADCP and PC shall be suitable for the cable lengths involved
Baud Rate	9600 or more
Power Supply	220 VAC ± 25%; 47 to 53 Hz and 10 to 15 VDC or 20 to 30 VDC
Housing	Corrosion proof
Ingress Protection	waterproof, compliant with IP68, 20 m
Operating Temperature	10 to 60°C
Humidity	up to 100 %

5. Software

Operating System	MS Windows
Setup	Preparation of the instrument for data collection, setting of depth-cell size, number of depth cells and ping rate, averaging, storage interval. In case the instrument features an in-built compass then software assisted compass calibration shall be

	supported.
	set-up of bottom tracking and/or on line DGPS
Data Collection	The PC software shall control the data collection process, record the data in a file system on disk and report aberrations. The collected data shall be graphically visualised.
Monitoring processing	Calculation of bin-wise discharge and total discharge; User input/selection of extrapolation methods to bottom, surface and stream banks Display of input data and processing results in graphical and numerical format
Data Export	Data export to spreadsheet and ASCII formats shall be supported.

Cableway (for transit of ADCP)

Complete suspension system for transiting an Acoustic Doppler Current Profiler across a span of approximately 100 metres, bank to bank. Consisting of:

- Support stanchions on either side of river;
- Fixed support cable of stainless steel
- Endless cable for transit of ADCP
- Hoist lifting capacity: 100Kg. min
- Lifting and transit mechanisms electrically controlled from bankside.

Portable Conductivity Meter Technical Specifications

Cable Length for probe	5 m
Temperature Compensation	Automatic
Ingress Protection	IP67
Data Logger	Internal ≥ 800 data points
Conductivity Range	0.0 $\mu\text{S}/\text{cm}$... 500 mS/cm in 5 measuring ranges or AutoRange, 0.00 ... 19.99 $\mu\text{S}/\text{cm}$ for $K=0.1 \text{ cm}^{-1}$, 0.000 ... 1.999 $\mu\text{S}/\text{cm}$ for $K=0.01 \text{ cm}$
Accuracy	2% max

Temperature Range & Accuracy	-5°C – 100°C @ <0.5°C
Conductivity Probe	Included
Calibration Solutions/accessories	Included
Power Supply	Internal Rechargeable Batteries (charger included)