

Transition to Automated Ground-based Measurements

Workshop Day 4 Generic Automated Weather Station (AWS) Tender Specification

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU



WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

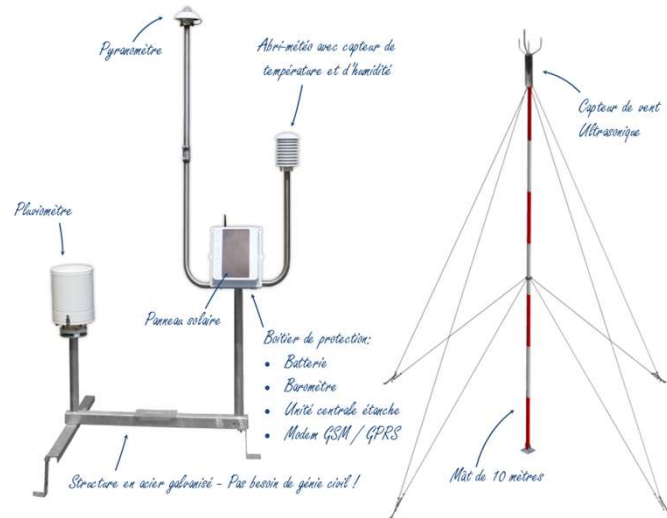
*Rabia Merrouchi
Mounir Aziz*

7 December 2021

Why a tender specification?

A **tender specification** is a **document** that **clearly, accurately** and **completely** describes **in detail** what the you need to purchase.

A clear, accurate and complete **specification** is the foundation of any AWS project.



Generic AWS Tender Specifications



WHO:

Initially developed by the Association of Hydro-Meteorological Equipment Industry (**HMEI**), with support from the **World Bank**, and then finalized in close collaboration between **WMO** and HMEI.

WHAT:

A set of **requirements, guidance and examples** intended to support the tendering for AWSs. They are based on and **are in line** with the WMO guidance documentation and **are neutral** with respect to manufacturers.

WHY:

To be used by WMO members **as a base for their tendering processes**, and amend them as needed, to fit their needs and their own tendering process regulations.

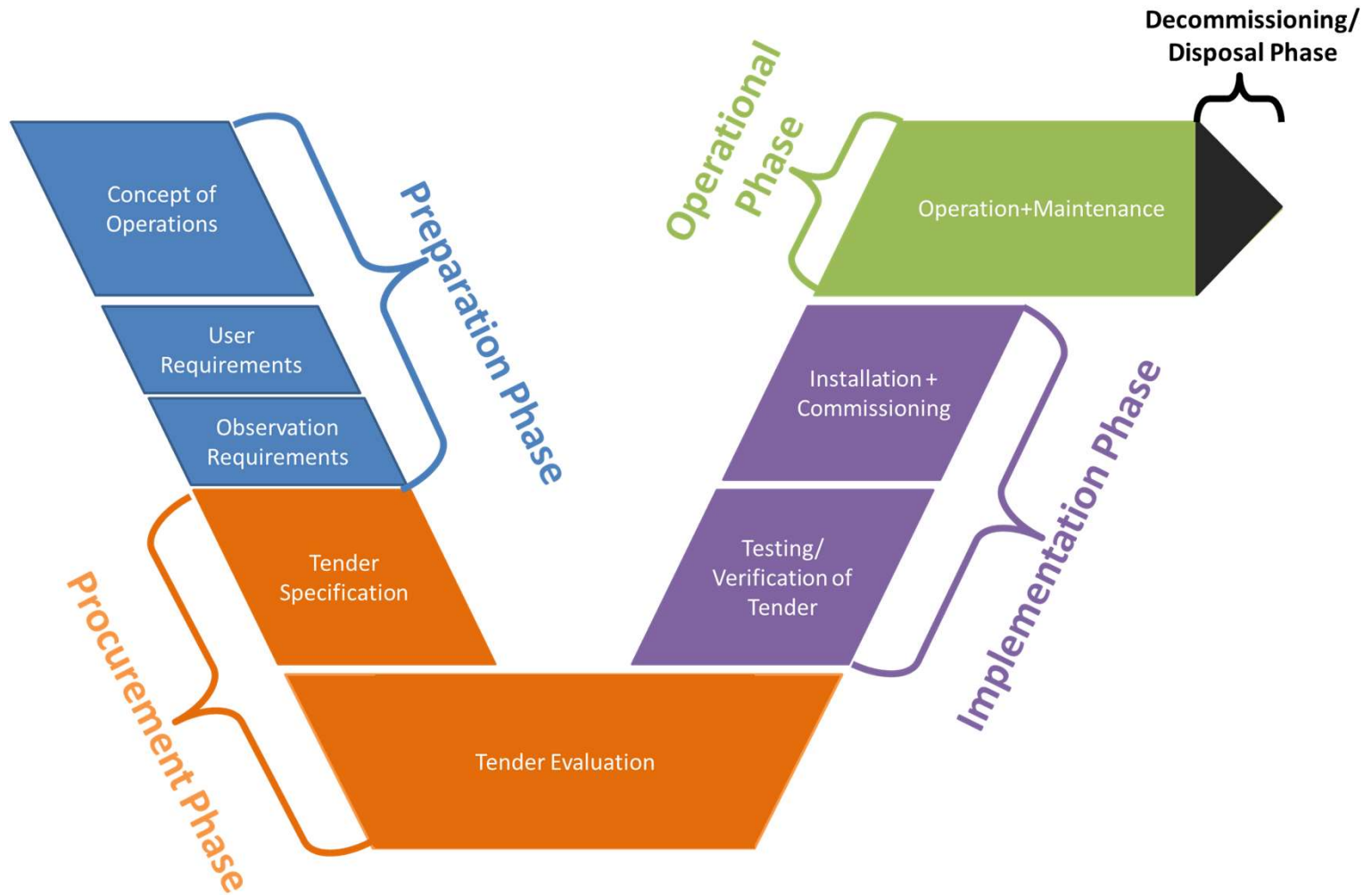
Generic AWS Tender Specifications: Objectives

- To provide common and **suitable basis** for determining “Requirement specifications for meteorological observing systems”,
- To support WMO Members on **how to write tenders** ensuring that:
 - tenders can be clearly understood and responded to by manufacturers, and
 - the resulting measurements are fit-for-purpose (responding to user needs).
- To provide tender clauses that covers the whole life cycle of an AWS network including management, siting and exposure, test acceptance, maintenance, facilities and training.



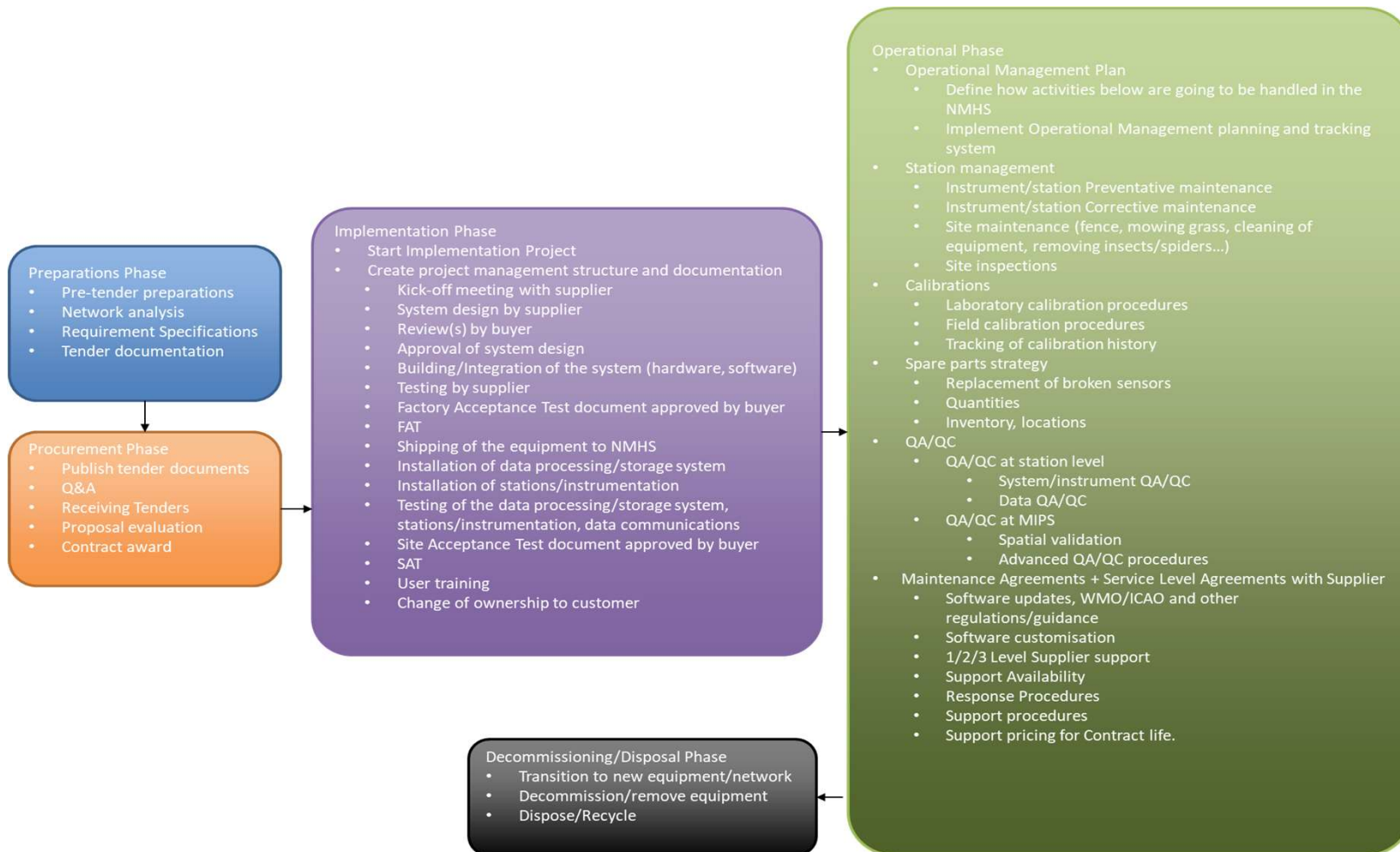
Generic AWS tender specification :

Key Stages in AWS Procurement



Generic AWS tender specification :

Key Stages in AWS Procurement



Generic AWS tender specification : Preamble

Steps in producing Specifications

Sensor requirements

- Finality of the observation: Forecasting, Climate, numerical modeling, public weather services...

- Location, number of stations to

User Requirements

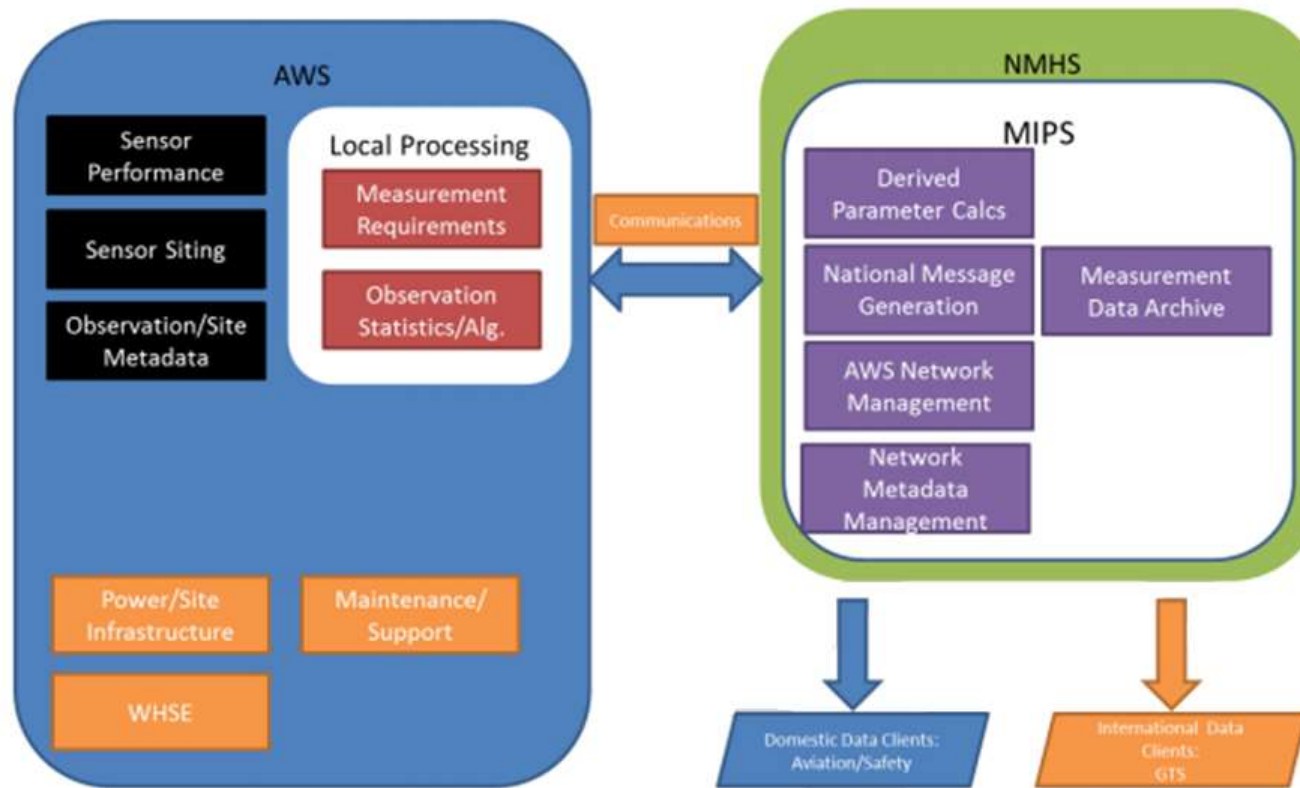
- presence
- Local/ Central MIPS
- ...

User Requirement	Observational data sufficient to produce a Synoptic Observations Report
Outcomes	A required list of sensors to meet (at least) the mandatory content
	A reporting frequency
	Algorithms/Processes/Procedures that need to be applied to the data and metadata.
	AWS/IT Infrastructure (new or existing) where these algorithms/processes/procedures are applied
	AWS/IT Infrastructure (new or existing) where Synoptic Observations message content is generated
	IT Infrastructure (new or existing) where data/metadata is stored and archived
	Communications requirements to get data from sensors to IT Infrastructure
	Staff, appropriately trained and equipped, to maintain the equipment so that it continues to produce quality data.
	Training, calibration, maintenance, inspection, sustainability requirements



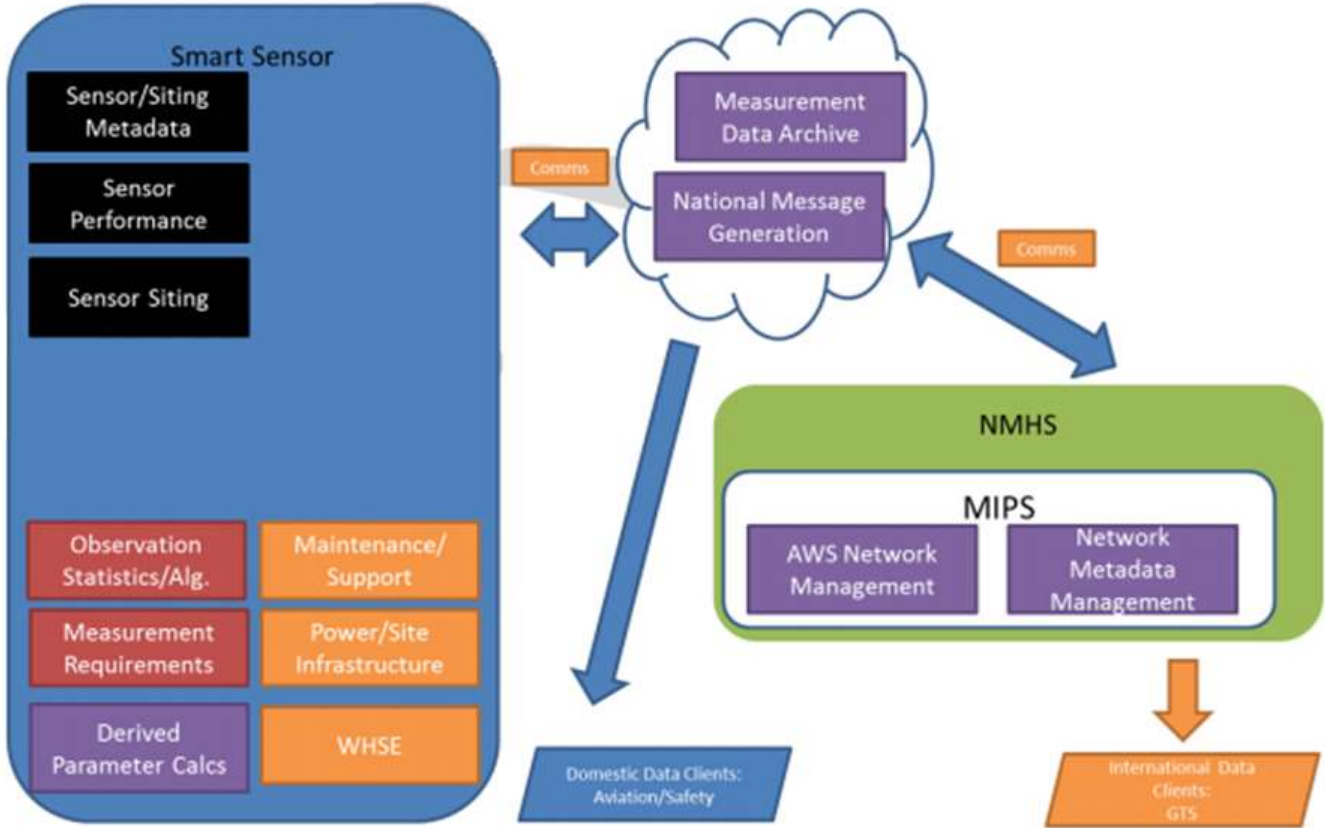
Generic AWS tender specification : Preamble

Traditional AWS architecture with datalogger and MIPS



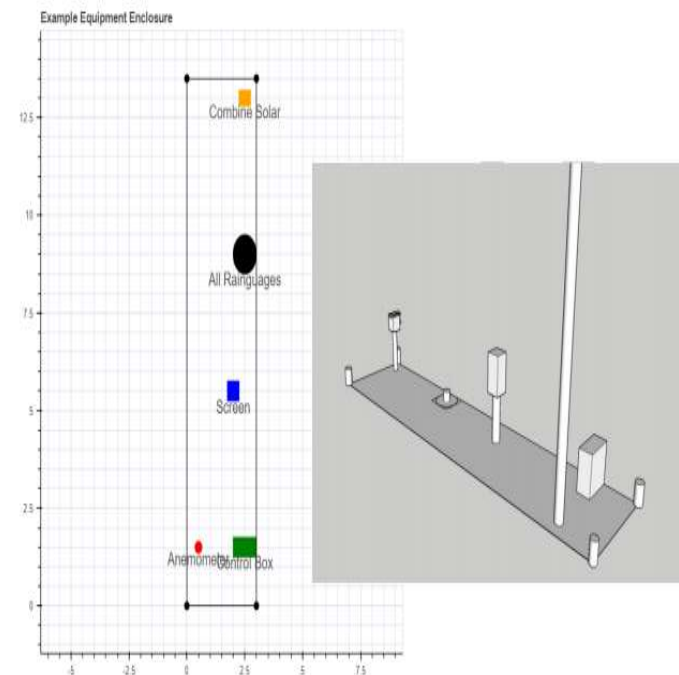
Generic AWS tender specification : Preamble

FULL AWS architecture with IOT consideration



Example of Guidance utilized for Siting/Enclosure requirements

Requirement		Relevant Guidance
Temperature/solar radiation equipment is not shaded		(4) Annex 1.D 2
The airflow around radiation shields/screens, precipitation gauges and wind measurement equipment is not significantly impacted	Temperature/Humidity	(4) Annex 1.D 2
	Precipitation	(4) Annex 1.D 3
	Wind	(4) Annex 1.D 4 (4) Volume 1, 5.9.2
Temperature/solar radiation equipment is not located near heat sources		(4) Annex 1.D 2
Solar Radiation equipment is not placed so that reflected radiation from other equipment impacts the measurement	Global/Diffuse Radiation	(4) Annex 1.D 5
	Direct Radiation/Sunshine Duration	(4) Annex 1.D 6
Maintenance of equipment (particularly anemometer masts) can be done safely and without unduly impacting other observations		(2)2.4.1.7



(2) *The WMO Manual on the WMO Integrated Global Observing System*

(4) *WMO-NO.8 Volume I, Chapter 1 Annex 1.D*

Example of Guidance utilized for Sensor/ Siting performance

7.3.1 Sensor/Siting Performance

This Table summarises the current WMO Guidance for Sensor/Siting Performance. Many NMHS have their own Measurement Range which reflect local conditions/climatology.

Observation	Installation Height	Measurement Range	Reporting Resolution	Sensor Performance Constant	Achievable Sensor Uncertainty
Air Temperature	1.25 - 2.0m (4) Volume 1, 2.1.4.2.1	-80°C - 60°C (4) Volume 1, Annex 1.A	0.1°C (4) Volume 1, Annex 1.A	Time Constant: 20s (4) Volume 1, Annex 1.A	0.2°C (4) Volume 1, Annex 1.A
Direct Solar Radiation	1.5m [or non obstructed height] (4) Volume 1, 7.2.2	0 – 2000 W/m ² [or local requirement >1500W/m ²] (4) Volume 1, 7.2.1.1	1 W/m ² . (4) Volume 1, Annex 1.A	Response Time [95%]: < 30s (4) Volume 1, Table 7.2 [Good Quality]	1 min totals [0.9%]/1 hour totals [0.7%]/daily totals [0.5%] (4) Volume 1, Table 7.2 [High Quality]
Global/Diffuse Sky/Reflected Radiation	1.5m [or other unobstructed height] (4) Volume 1, 7.3.3	0 – 2000 W/m ² (4) Volume 1, 7.2.1.1	1 W/m ² (4) Volume 1, Annex 1.A		1 hour totals: 3%/daily totals: 2% (4) Volume 1, Table 7.4 [High Quality]
Long Wave Radiation	1.5m [or other unobstructed height] (4) Volume 1, 7.4.4	-250 – +250 W/m ²	1 W/m ² (4) Volume 1, Annex 1.A		daily totals: 10% (4) Volume 1, Annex 1.A
Precipitation Amount	Local Requirements (4) Volume 1, 6.1.4.1	0-500mm/day (4) Volume 1, Annex 1.A	0.1mm (4) Volume 1, Annex 1.A		5% or 0.1 mm (4) Volume 1, Annex 1.A
Precipitation Intensity	Local Requirements (4) Volume 1, 6.1.4.1	0.02 – 2000 mm/hour (4) Volume 1, Annex 1.A	0.1mm/hr (4) Volume 1, Annex 1.A		Under constant flow conditions in laboratory: <ul style="list-style-type: none"> • 5% for > 2 mm/h • 2% for > 10 mm/h. In the field: <ul style="list-style-type: none"> • 5 mm/h • 5% above 100 mm/h. (4) Volume 1, Annex 1.A
Pressure	No Installation Height Requirement protected from draughts and vibrations (4) Volume 1, 3.1.4	500-1080HPa (4) Volume 1, Annex 1.A	0.1hPa (4) Volume 1, Annex 1.A	2s (4) Volume 1, Annex 1.A	0.15 hPa [Tendency 0.2hPa] (4) Volume 1, Annex 1.A
Relative Humidity	1.25 - 2.0m (4) Volume 1, 4.3.3.3/2.1.4.2.1	0-100% (4) Volume 1, Annex 1.A	1% (4) Volume 1, Annex 1.A	Time Constant: 40s (4) Volume 1, Annex 1.A	+/- 3 %RH (4) Volume 1, Annex 1.A
Snowfall/Snow Cover	Local Snowfall conditions determine height (4) Volume 2, 2.3.2.2	0-25m (4) Volume 1, Annex 1.A [Note difference to G2G Part III, Appendix III.1]	1 cm (4) Volume 1, Annex 1.A	Time Constant: 10s (4) Volume 1, Annex 1.A	1cm (4) Volume 1, Annex 1.A
Soil Temperature	5/10/20/50/100(opt)/150(opt)/300(opt) cm (4) Volume 1, 2.1.4.2.2	-50 °C to +50 °C (4) Volume 1, Annex 1.A	0.1 °C (4) Volume 1, Annex 1.A	20s (4) Volume 1, Annex 1.A	0.2°C (4) Volume 1, Annex 1.A

Generic AWS Tender Specifications :

Guidance on AWS and sensors

Sensor performance
(T°, Humidity, Pressure...)

Functional
|
specifications

- Measurement Range
- Instrument time constant
- Reporting Resolution
- Sensor Uncertainty
- Exposure Uncertainty
- Operational uncertainty...

**Siting/
Exposure**
specifications

- Installation Height
- Installation in Screen
- Operational Conditions
- Actively or Passively Aspirated Screen ...

QC & QA
specifications

- Rate of Change Check
- Jump Check
- Stuck Sensor
- Insufficient Measurements for Averages
- Monitoring Actively Aspirated Screens
- Calibration certificate

**Observation/
Metadata**
Specifications

- Sensor type
- Units
- Derived Parameters
- NMHS Calculated Parameters
- Serial Number....



Generic AWS Tender Specifications :

Guidance on AWS and sensors

Sensor performance (T°, RH, Pressure, Rain gauge, Wind...)

Operating
conditions

Many NMHS have their own Operational Conditions requirements which reflect the conditions across their networks. In the absence of these, (6) Appendix B, 3.1 recommends

- Temperature Range: -40 to 55°C
- Humidity Range: 0-100%
- Wind Speed: 50m/s

However,
in applying these to individual
sensor requirements the following
should be considered:



Many sensors are mounted inside other infrastructure, for example temperature/humidity sensors are typically installed in a screen. In this case, the infrastructure needs to meet the Operating Conditions.

Generic AWS Tender Specifications : AWS sensors

Relative Humidity

Functionality	WMO Tag
Sensor/Hardware Performance	U.SP.1 U.SP.9
Sensor Siting	U.SS.1 U.SS.4
Measurement/Functional Requirements	U.MR.1 U.MR.5
Observation Statistics/Algorithms	U.OS.1U.OS.9
Observation/Site Metadata	U.OM.1 U.OM.2
Power/Site Infrastructure	U.PSI.1



Evaluation of a Procurement

• Evaluating Value for Money

- A Procurement demonstrate that the greatest benefit is being achieved for the available funding.

This analysis consists of Technical and Commercial Evaluation process

Technical Evaluation

each requirement may be given an importance category:

Essential/Mandatory:

The proposed equipment/service must meet this requirement. Failure to do so results in exclusion from further consideration

Other Categories [for example, Very Important, Important, Desirable]:

The proposed equipment/service should meet this requirement. However, failure to do so does not result in exclusion, but there may be rules that an acceptable solution must meet a percentage of the requirements for each Category. Each Category is typically given a weight (or scaling factor) related to its importance

Commercial Evaluation

consider 2 main aspects – Price and Vendor Commercial Viability:

a calculation of the Total Cost of the Contract (sometimes called, Total Cost of Ownership) should be undertaken based on:-
expected equipment and service utilization numbers
startup/initialization costs (for example, installation, training, new equipment)
ongoing costs (for example, maintenance, spare parts, MTBF, repairs).
This may require exploring the respective costs of different scenarios. Care should be taken that the Total Cost scenarios include all the expected equipment and services, and takes into account any inflation or other increases.

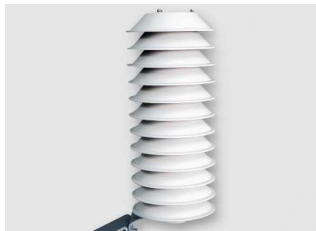


Example of Functional requirements

ID	WMO Tag	Requirement Heading	Requirement	Test	Importance
69	U.SP.1	Sensor Performance Constant	The instrument time constant under controlled conditions shall be 40 s or better over the entire operational range. NB. For field measurements in non-actively aspired radiation screens this may not be achievable.	Inspection	Essential
154	U.SP.2	Multiple Outputs	If the instrument is equipped with both an analogue output and a smart interface , it should be possible to connect both at the same time and collect data from both outputs without any physical damage to the instrument's electronics.	Demonstration	Very Important
155	U.SP.3	Service port	If the instrument is equipped with a (smart) service port/connection , it should be possible to connect to the service [using PC/laptop/wifi/...] while the instrument is collecting data. Through the service connection it should be possible to perform instrument maintenance, do diagnostics, configuration, to stop/start the regular data collection mode, etc. Software tools to perform such actions should be supplied with the instruments.	Demonstration	Very Important
160	U.SP.4				Regional
475	U.SP.5				Essential (Regional Input)
481	U.SP.6	Sensor Uncertainty	The sensor measurement uncertainty shall be better than ± 3 % RH . If the sensor reports directly a Dew Point Temperature, the sensor uncertainty shall be 0.25°C	Inspection	Essential (Regional Input)
501	U.SP.7				Regional
1069	U.SP.8				Regional
1073	U.SP.9	Uncertainty	There shall be sufficient information provided to enable a calculation of the uncertainty budget, as well as calibration/maintenance intervals.		Regional

Example of Requirements for Sensor Exposure / Siting

ID	WMO Tag	Requirement Heading	Requirement	Test	Importance
144	U.SS.1	Installation in Screen	The sensor/instrument for RH measurements shall be mounted in a radiation/thermometer screen . The presence of the screen shall not affect the measurements in any way.	Inspection	Essential (Regional Input)
145	U.SS.2	Actively or Passively Aspirated Screen	If ice rime accretion is expected to significantly reduce the air circulation in the instrument screen in which the RH Measurement is made, then artificial/forced ventilation may be used. The Tenderer shall demonstrate that the RH measurements are not influenced by wet deposition and then evaporation during precipitation, drizzle or fog. The Tenderer shall also demonstrate that screen provides sufficient protection from pollution that the sensor is not affected.	Inspection	Essential (Regional Input)
146	U.SS.3	Monitoring Actively Aspirated Screens	If an aspirated screen is used, sufficient monitoring parameters should be provided to enable the health and status of the ventilation device to be checked.	Inspection	Very Important
147	U.SS.4	Installation Height	The sensor/instrument for RH measurements shall be mounted inside the radiation screen at a height between 1.25 and 2.0 m above ground level	Inspection	Essential (Regional Input)




Example of Requirements for Observation / Site metadata

ID	WMO Tag	Requirement Heading	Requirement	Test	Importance
148	U.OM.1	Serial Number	Each instrument shall be supplied with a unique serial number .	Inspection	Essential
149	U.OM.2	Calibration Certificate	<p>Each instrument should be supplied with a calibration valid for at least 90% of the calibration period as recommended by the manufacturer. The initial calibration should be done by an accredited calibration laboratory or at least be fully traceable to such an ISO17025 accredited laboratory.</p> <p>Each instruments should be supplied with a paper and electronic (pdf) calibration certificate that at least specifies:</p> <ul style="list-style-type: none"> • Manufacturer • Model • Instrument type/Principle of Operation • Serial number • Hardware/Software version [if applicable] • Calibration Date • Validity period of calibration/Recommended next date of calibration • Calibration range • Traceability of calibration (including applicable standard) • Calibration method • Calibration factor and uncertainty • Name and signature of calibration technician that performed the calibration. [**] 	Inspection	Very Important (Regional Input)

CERTIFICATE OF CALIBRATION


ISSUED BY H & D FITZGERALD LTD.

DATE OF ISSUE 06 April 2018 CERTIFICATE NUMBER 12345



H & D Fitzgerald Ltd.

Cefn Du, Tremerchion,
St. Asaph, LL17 0US, UK
☎ +44 (0)1352 720774
calibration@density.co.uk
www.density.co.uk



UKAS
CALIBRATION
0291

Page 1 of 1 pages
 Approved signatory H. Fitzgerald
 I. Edge

Client Somebody Ltd., Box Rd, Atown,
 Instrument Paar DMA 35N
 Serial number 123456 Date calibrated April 2nd, 2020



Example of Requirements for Power / Site infrastructure

ID	WMO Tag	Requirement Heading	Requirement	Test	Importance
156	U.PSI.1	Excitation Power	<p>If the instrument requires an excitation voltage or a permanent power supply, this should be described fully by the Tenderer.</p> <p>The electrical voltage required by any aspect of the system should not exceed 36 volts. [[Voltages suitable for solar power (12V) may be advantageous]]</p>	Inspection	Very Important



Example of Guidance provided for Maintenance conditions

- The generic AWS tender specifications provides some guidance on Maintenance Conditions that should be taken into consideration during the procurement process.

Contents

1	INTRODUCTION	3
2	MAINTENANCE CONDITIONS	4
2.1	General	4
2.2	Maintainability	4
2.3	Specific Requirements	4
2.4	Spare Components	4
3	CONTRACTOR LOGISTIC SUPPORT	5
3.1	Definitions	5
3.2	Contents of CLS	5





WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

**Thank You for your
attention**

