



Royal Netherlands
Meteorological Institute
*Ministry of Infrastructure
and Water Management*

Annex 07

Verification Phase and Delivery

Pertaining to : New generation wind sensor and 3rd line
maintenance – 3D sonic wind sensors

According to a : Public European Tender Procedure

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1. Introduction

This document describes the Verification Phase that is part of the Descriptive Document pertaining to 'New generation wind sensor and 3rd line maintenance – 3D sonic wind sensors', reference no. TN-463889 dated 16 September 2024.

As outlined in the Descriptive Document, the Tenderer with the most economically advantageous tender while meeting all Mandatory requirements will be awarded the Agreement (see Annex 3 - Draft Agreement) and enters the Verification Phase. The Verification Phase, as well as the required sensors and support, are detailed in this document. The Verification Phase has a duration of approximately two (2) years so that the Contracting Authority can verify the performance of the sensors during all seasons. However, the Contracting Authority reserves the rights to change this period if necessary. The acceptance of the offered sensors and continuation of the Agreement occurs only after a successful completion of the Verification Phase.

The Tenderer with the second most economically advantageous tender enters the Waiting Room (Annex 4 Draft Waiting Room Agreement) and will be on stand-by during the Verification Phase. The stand-by Tenderer only enters the Verification Phase when the first Tenderer fails the Verification Phase.

In addition, this document outlines the delivery details of the sensors and the locations at which the sensors will be operated.

By submitting a Tender, the Tenderer fully and unreservedly agrees to the process described in this document.

2. Overview

First ranked party:

The Tenderer of the selected sensor shall make thirteen (13) sensors and all related products (mounting tools, calibrators, etc.) available to KNMI. These sensors and related parts shall be delivered to KNMI in De Bilt within four (4) weeks after signing the Agreement. See section 4.65.6 for further details of the Delivery Schedule.

The FAT and calibration reports shall be provided together with the sensor delivery.

The Tenderer will provide support, when requested by KNMI, during the entire period of the Verification Phase. Specifically, enquiries shall be answered by the Tenderer within two (2) working days.

The enquiries (or other support requests) shall be initiated by KNMI, for example, to clarify documentation, to solve problems and to ensure that the sensors operate correctly. The contact details of Tenderer's staff required for these enquiries shall be specified beforehand by the Tenderer.



KNMI will report any malfunctioning of a sensor, accompanying part or tool, directly to Tenderer. If the issue cannot be resolved by KNMI with Tenderer's support within five (5) working days then a spare or repair shall be provided by Tenderer within ten (10) working days. An analysis detailing the cause of the problem and an incident report shall be provided to KNMI stating the reason for the malfunction, the repair, and substantiation whether the malfunctioning affects the required MTBF, as stated in the Program of Requirements and Desirables (Annex 1).

The selected sensors will be subjected to field, wind tunnel and laboratory tests. The field tests will take place in De Bilt and at seven (7) other measurement locations of KNMI throughout the Netherlands (see section 3.3, Field Evaluation). However, KNMI reserves the right to perform tests partly or entirely at other locations.

The Verification Phase starts as soon as practical after the delivery of the first sensors.

During the Verification Phase information will be shared with the selected Tenderer in order to make sure that the sensors are configured, installed and operating correctly and that the results are interpreted correctly.

The Verification Phase will be used to verify that all Mandatory requirements are met, and all Desirables are met to the extent that Tenderer has indicated in their Tender. In addition, it will be verified that the offered sensors are indeed suitable for the intended use by KNMI. The performance of the sensors during the Verification Phase will be analysed and the results will be examined by representatives of several user groups (observers, forecasters, technicians, validation staff, R&D) and stakeholders (weather, climate, aviation). The final decision regarding the suitability of the offered sensors will be determined by these representatives in accordance with the reasons listed below. Note that when a sensor at one (1) or more locations is non-compliant or receives a negative decision on the suitability, the offered sensor is considered non-compliant or unsuitable.

A negative decision on the suitability can occur when:

- The sensor demonstrably does not meet one or more of the Mandatory requirements, as listed in Annex 1 - Programme of Requirements and Desirables.
- The quality of the measurements of the offered sensor is substantially lower compared to the current sensor (there are 50% more observations indicated as suspect or faulty) and/or:
- The offered sensor requires substantially more 1st and/or 2nd line maintenance compared to the current sensor (there are 50% more corrective events) and/or:
- Two (2) or more of sensors fail during the Verification Phase and a solution cannot be provided within one (1) week.

Note that the first two items are evaluated by comparison to the current sensor since the quality of the measurements and the required 1st and 2nd line maintenance depends on the actual conditions that will occur during the Verification Phase. Here, the total number



of suspect or faulty observations or corrective maintenance events for all sensors during the Verification Phase period will be considered.

A negative decision on the compliancy or suitability of the offered sensor can occur at any point during the Verification Phase. If this occurs, the Tenderer is informed immediately. The Tenderer has ten (10) working days to resolve the problem to the satisfaction of KNMI.

Second ranked party:

The sensor of the Tenderer with the second most economically advantageous tender will be stand-by during the Verification Phase. The sensor of the second ranked Tenderer only enters the Verification Phase when the first sensor of the first ranked Tenderer fails the Verification Phase. In that case, the Verification Phase with the second Tenderer starts anew after implementing those sensors.



3. Verification Phase

The Verification Phase will start as soon as possible after signing of the Agreement. The verification will take place at the test field in De Bilt and at other KNMI locations. KNMI's test field in De Bilt is equipped with a wide variety of meteorological sensors and wind sensors taking into account experiences with the current sensors after more than 10 years of operational use. Furthermore, the measurements of auxiliary sensors, webcam images and the evaluation of the meteorological situation by forecasters and data validation experts will be considered during the Verification Phase. During the Verification Phase, if sensors are demonstrably non-compliant with the Program of Requirements and Desirables and faults cannot be resolved by the supplier, then KNMI will dissolve the Agreement for this reason and the stand-by supplier (second ranked party) will take supplier's place.

In case of a negative outcome of the Verification Phase, the Agreement is cancelled. The sensors and related materials and tools are returned to the Tenderer and the purchase costs shall be reimbursed (see Annex 3 - Draft Agreement).

The Verification Phase is divided in four stages. These stages must all be successfully completed in order to successfully conclude the Verification Phase. The stages are presented in order but may run concurrently as far as reasonably practical.

3.1. Stage 1: Implementation, Laboratory tests and field installation

The selected sensor will be inspected upon receipt and verified in the laboratory using the Verification Protocol provided by the Tenderer. This process includes the Delivery acceptance (see section 05.2. Other means of verification will be investigated during this stage and may for example include methods to simulate contamination of the transducers. Tests will be performed in order to verify that the requirements are met. KNMI will decide whether all or just a subset of the requirements will be verified. All requirements remain obligatory even if not tested directly by KNMI during the Verification Phase. The Verification Protocol (provided by Tenderer after initial award, see Mandatory Requirement #46) must be successfully completed by KNMI before installing the sensor at the test field of KNMI in De Bilt or in another test location. The procedures for 1st and 2nd line maintenance that are carried out by KNMI will be evaluated and implemented.

A sensor interface will be developed by KNMI for the selected sensor. KNMI will be using the Campbell Scientific CR1000X datalogger to verify the communication with the sensors and to facilitate implementation of the sensors in the meteorological network of KNMI. The sensor data will be polled and archived together with technical status information at a 12 second resolution. Raw data from all sensors will be archived during the field verification as well, unless not reasonably possible due to the specific location. Next, two of the selected sensors will be installed at the test field of KNMI in De Bilt using the mounting tools and documentation provided by the Tenderer.



This stage will start as soon as possible after signing of the Agreement, and the total duration is dependent on several factors, including the complexity of the sensor and safe access to field locations for installation. The latter is especially relevant with respect to North Sea platform locations used in the Verification Phase. This stage will require an estimated time of approximately 3 to 6 months.

3.2. Stage 2: Wind Tunnel tests

The selected sensor will be tested in a Wind Tunnel of KNMI's choice. This can be in the Netherlands or another country. The sensor will be tested at several different angles of relative wind, and at wind speeds up to and including the maximum wind speed as stated by the Tenderer in their bid. This campaign should not have a negative effect on the overall performance of the sensor. The cost of any external Wind Tunnel campaign that is used for these tests will be borne by KNMI. This stage will require an estimated time of approximately 4 months.

3.3. Stage 3: Field evaluation

The selected sensors are verified in the field, during which the sensors will be inspected and maintained by KNMI on a regular basis. The calibration will also be checked on a regular basis. Two (2) units of the selected sensor will be installed at the test field of KNMI in De Bilt. The other sensors will be installed at other locations, either parallel to the currently deployed sensor or stand alone.

The envisioned Verification Phase locations and their reasoning are as follows:

Location	Reason
Testfield De Bilt (1,5m)	Comparison to operational temperature measurement.
Testfield De Bilt	Birds & high turbulence environment.
Schiphol Airport	Aircraft vortices.
Cabauw	Stability measurements, low turbulence environment.
IJmuiden	Salty & sandy environment. High vertical wind from seawall.
Hupsel	Birds, snow & ice.
Volkel Airbase	Birds, aircraft vortices.
Euro Platform	Maritime environment. Low bias relative to Harmonie model.
Bonaire	Different climate compared to European Netherlands.

Note that this list is indicative. KNMI may decide to measure in different locations for different reasons, and/or not perform measurements in the listed locations.

The performance, maintainability, and overall quality of the sensor will be analyzed during the field evaluation in accordance with the requirements and wishes set out in the Program of Requirements and Desirables. The quality of the sensor will be examined statistically for the overall performance and for specific conditions by comparison with reference instruments and with the current sensor, but allowing for the latter's known



shortcomings. Also, the agreement between the results obtained with two (2) co-located units of the selected sensor will be evaluated. The effect of sensor contamination and the suitability of the maintenance interval will also be investigated by maintaining one (1) sensor as good as possible while letting the other deteriorate until the sensor starts reporting warnings or errors or the results of the sensor become obviously affected. Special attention will be given to the sensitivity and impact of external influences on the sensor, such as rain, spider silk, flying insects, and possible damage to the sensor caused by birds. Due to external (aviation) requirements, this stage will take a minimum time of at least 12 months. KNMI intends to measure for a much longer time period in order to determine climatology transfer functions.

3.4. Stage 4: Evaluation continued and completion

The evaluation of the selected sensor is continued, and the results are finalized in a technical report.

When certain meteorological conditions have not occurred during the evaluation or when specific aspects need special attention according to KNMI, an evaluation of the selected sensor at other locations may take place, including locations outside The Netherlands.

At the end of the field evaluation, each sensor will be inspected and verified in the laboratory using the Verification Protocol provided by the Tenderer. Additionally, 2nd line maintenance is applied and the Verification Protocol must be successfully completed. These sensors will be sent for ISO 17025-accredited re-calibration in accordance with the Mandatory requirements.

An overall analysis of the Verification Phase is prepared and examined by KNMI representatives of several user groups (observers, forecasters, technicians, validation staff, R&D) and stakeholders (weather, climate, aviation). The result of this examination is the decision whether the offered sensor meets all Mandatory requirements and Desirables to the extent Tenderer has indicated in their tender and is therefore considered suitable for the intended use by KNMI. Finalizing the Verification Phase after conclusion of the Field Evaluation will take an estimated 6 months.

At the end of the Verification Phase and in case of a successful completion of the Verification Phase, the Waiting Room Agreement (Annex 4) with the second party will officially expire. Upcoming orders will then exclusively be placed with the selected primary supplier for the duration of the Agreement.



4. Delivery of Sensors

The offered sensors are accepted when the Verification Phase is completed successfully. Thereafter, KNMI/Contracting Authority will order the Wind sensors and related products in batches. Specifically, the sensors will be delivered in partial amounts determined by KNMI with four (4) weeks' notice. These deliveries will be spread out as indicated in section 4.65.6.

4.1. Delivery location

All the sensors shall be delivered to the KNMI in De Bilt. From there, KNMI will transport and install the sensors at the measurement locations.

Royal Netherlands Meteorological Institute (KNMI)
F.a.o. Calibration Laboratory WO
Utrechtseweg 297
3731 GA De Bilt
The Netherlands

4.2. Delivery acceptance

Each shipment of sensors that is delivered will be checked and tested at the calibration laboratory in De Bilt. The acceptance of a delivery is divided into two phases.

Phase 1:

The shipment will be checked at the KNMI for completeness and damage to the instruments, parts or tools.

Each instrument must be delivered with a passed FAT protocol and an ISO 17025-accredited calibration certificate, as per the Mandatory Requirements.

Phase 2:

The verification and calibration protocols (provided by supplier along with their offer) will be performed in accordance with the procedures specified by the supplier.

This process includes checking that the settings and firmware version of the sensors are correct. This procedure involves placing and removing the sensor in the laboratory and performing the verification and calibration protocols.

Once a sensor is approved (considered complete and functioning), a calibration certificate will be created for the sensor, which will be used internally for proof of well-functioning of the sensor.

The delivery acceptance process has a total lead time of up to one (1) week.



4.3. Payment

Payment for a delivery will be made when each sensor of the delivered batch has successfully passed the acceptance as explained in section 4.2 - Delivery acceptance. When one (1) or more sensors in a batch are returned with a problem, new sensors or a new invoice will be requested for the remaining sensors that have been accepted.

4.4. Delivery on hold

KNMI retains the right to put the ordering process on hold if there is reasonable justification for doing so. The deliveries will be stopped when problems have been detected during the deployment of the sensors in the field or when more than five (5) sensors are returned after delivery (see section 4.2). Delivery will resume when both the supplier and the KNMI agree that the underlying problem has been resolved.

4.5. Installation

The installation of the sensors at the measurement locations is carried out by KNMI employees. Based on experience, we anticipate that installation at a location should take no more than one day per sensor.

The timeline of one installation is as follows:

- Remove current sensor
- Adapt infrastructure to facilitate new sensor.
- Install the new sensor
- Data communication testing of sensor.
- Sensor is ready.

Installation of the sensors at the measurement locations will be planned as swiftly as reasonably possible by KNMI employees. For efficiency reasons, installation of sensors after completion of the Verification Phase will be combined with other visits of KNMI employees to the locations for as much as reasonably possible.

4.6. Delivery schedule

The delivery schedule below is given in weeks starting after signing the Agreement (T=week 0). The number of sensors in each delivery is indicated. Note that these numbers and times are indications only and the actual schedule may change. In such a case, a new delivery schedule shall be determined together with Tenderer. The sensors shall be delivered with the associated parts.



Date	Delivery details	Number of sensors
T=0	Agreement signed	
T+4 weeks	1st delivery Delivery of thirteen (13) sensors for testing and Field Evaluation	13
T+6 months	Start of Field Evaluation	
T+18 months	End of Field Evaluation	
approx. T+24 months	Conclusion of Verification Phase, with acceptance of sensors. After conclusion of the Verification Phase, KNMI will proceed with operational deployment of the sensors.	
V=0	Internal KNMI 'Go' decision to purchase the new sensor	
approx. V+1 months	2nd delivery Delivery of batch of sensors.	40
approx. V+6 months	3rd delivery Delivery of batch of sensors.	50
approx. V+12 months	4th delivery Delivery of batch of sensors.	50
approx. V+18 months	5th delivery Delivery of batch of sensors.	61
Total number of sensors		214