Rijkswaterstaat
Ministerie van Infrastructuur en Milieu

31122403-LD-Appendix 10-Required specification General (VSA) LiDAR

Requirement specification General (VSA) LiDAR

Case number: 3112 2403

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Rijkswaterstaat
Ministerie van Infrastructuur en Milieu

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Colophon

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1 Objectives

1.1 Aim of integration

The Customer intends to place a number of LiDARs on platforms (OSS) of wind parks in the North Sea for the benefit of the project MIVSP (Maritime IV Service point) of Rijkswaterstaat service Central Information Provision (CIV). In the Agreement work activities are prescribed which the Contractor is required to carry out. In some cases the Contractor is free to propose which measures must be tasks to meet the requirements.

As part of the Agreement the Contractor is expected to carry out the following:

- Supply of LiDARs on location;
- Carrying out/Supporting acceptance tests;
- Providing support to Site Integrator for the installation of sensors and systems on OSS and test setup;
- Configuring/fine tuning of sensors and systems on OSS;
- Supporting/Carrying out calibration and management and maintenance.

1.2 Objectives LiDAR

With this Agreement and the requirements included in the Requirement specification, the customer pursues the objectives below.

1.2.1 *Objectives 1: Qualitative data of wind directions at location of the OSS*

The primary aim of the LiDAR is to measure the wind direction in the wind park for the compensation scheme for offshore electricity network, "Regulation compensation scheme for offshore, No. WJZ/16007215". In this document the following requirements are relevant for the LiDAR:

- The wind direction is determined on the basis of the measurements by one of more LiDAR systems. These LiDAR systems are located in or near the wind region (article 5.1), provided that the LiDAR data are available of 95% of the time that the offshore electricity network was not available (article 8b).

1.2.2 *Objectives 2: Qualitative data of wind speeds at location of the OSS*

The other aim of the LiDAR is to measure the wind speed in the wind park for the compensation scheme. The wind speed however, is merely a basis in case the data at other stations is insufficient. In the document "Regulation compensation scheme for offshore, No. WJZ/16007215" the following requirements are relevant for the LiDAR:

- Measurements of nearby, offshore and/or onshore measuring stations, specified in the arrangement are used to determine the wind speed (article 2.1). If the wind speed corresponds with a wind direction between 0 and 180 degrees, only the data of the measuring stations at sea is used (article 2.2);
- In case of insufficient data (less than two measuring stations with a minimal availability of 95% for the wind speed and wind direction, article 8a) the wind speed is determined on the basis of measurements of the wind speed by one or more LiDAR systems in or near the wind region (article 2.3), provided that the LiDAR is available at least 95% of the time that the offshore electricity network was not available (article 8b);
- In order to determine the relevant wind speed, the measurements of the wind speed are vertically extrapolated up to the height of the shaft of the WTG's in the wind region (article 3.1).

1.3 Background information

1.3.1 *Background wind farms*

1.3.1.1 National Energy Agreement

In the National Energy Agreement has been agreed with more than 40 third parties that by 2023 16% of the energy generated has to be generated sustainable. To achieve this objective serveral sustainable energy sources are needed. Windenergy on sea is a crucial part of this. It has been agreed that windenergy on sea will generate 4.450 MW of engery by 2023. With which more than 5 million housholds can be supplied with energy. This means that 3.450 MW has to be built on top of the existing 1.000 MW that has already been build en under construcution.

1.3.1.2 Windparks at sea

In September 2014 the Dutch gouventment has chosen three areas where windparks can be developed at sea: offshore of the coast of Zeeland, Noor-Holland and Zuid-Holland. A new system has been set-up for the realization of these windparks and new legislation has been agreed.

The resolution about this are recorded in the "Routekaart". This routecard has the following high-level planning:

- 2015: 2 x 350 = 700 MW Borssele alpha
- 2016: 2 x 350 = 700 MW Borssele beta
- 2017: 2 x 350 = 700 MW Zuid-Holland
- 2018: 2 x 350 = 700 MW Zuid-Holland
- 2019: 2 x 350 = 700 MW Noord-Holland

The Ministry of Economics and Ministry Infrastructure and the Environment, the State Service of Enterprising and Rijkswaterstaat Zee en Delta work together for the realization of the objectives for the program "Wind op Zee". With the realisation of this program the windenergy sector, stakeholders at sea, coastal guard and coastal inhabitants are involved.

1.3.2 *Background LiDAR*

These LiDAR (Light Detection and Ranging) systems will be located on the TenneT hubs within the new offshore wind farms in the North Sea to continuously measure the wind conditions, such that in the event a unavailable offshore electricity grid compensation can be determined on basis of the actual wind conditions. The regulation is based on the "Regulation compensation scheme for offshore grid, Regulation Ministry of Economic Affairs, 22 March 2016", in which a method is described for measurement of losses. The regulation explicity states the use of LiDAR systems.

LiDAR is a remote sensing device that determines distances to objects by means of the reflection of laser signals generated by the device. Special types of LiDARs, typically wind LiDARs, determine the wind speed and wind direction, by measuring the reflection from naturally occurring aerosols that are carried by the wind. Commercial-of-the-shelf wind LiDARs operate at an eye-safe laser wavelength around 1.5 μm and provide a vertical profile of the wind speed and wind direction in a system specific height range.

1.4 Application LiDAR

Three areas were designated where the wind parks at sea are being developed. These areas are located outside the coast of the provinces North-Holland, South-Holland and Zeeland, see figure 1.

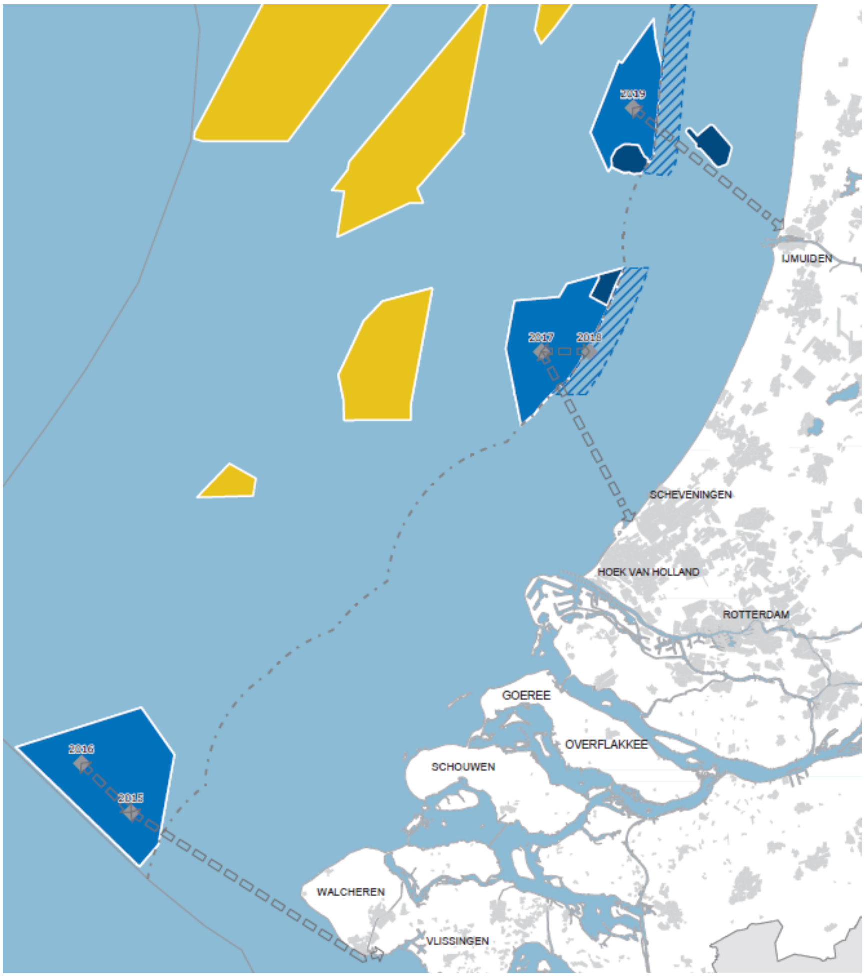

Figure 1: Designated areas

In each wind region one LiDAR must be placed. The Customer would therefore like to order one LiDAR for wind region Borssele and one spare LiDAR with the option to order more LiDARs. In total, two LiDARs will be ordered for Borssele with the option to order more LiDARs for the other wind regions.

1.5 Connection with Site Integrator

The Site Integrator shall integrate the different intended sensors, included the LiDAR, on the measuring location. The Site Integrator is responsible for placing the sensors on the OSS.

TenneT is responsible for plannable maintenance and the Site Integrator is responsible for Non-plannable maintenance on the OSS. The Site Integrator is first point of contact and should to organise this maintenance.

As the Site Integrator plays a major role, chapter two describes the tasks and responsibilities of the Site Integrator. The Site Integrator’

2 Collaboration with the Site Integrator

2.1 General role of the Site Integrator

2.1.1 *Testing approach*

As the Site Integrator plays a rather substantial role in the implementation of the project, an explanation of the working method to be expected with the Site Integrator is given below.

The support of the Contractor to the Site Integrator can be divided into a preparatory phase, a realisation phase and an implementation phase. These three phases are shown in figure 2 and 3. No rights may be derived from these figures.

For the preparatory phase the Contractor is required to have designed, tested and delivered internally. In the preparatory phase and the realisation phase, the Contractor is required to further support the design and tested situations, so that these can be integrated, realised and maintained.

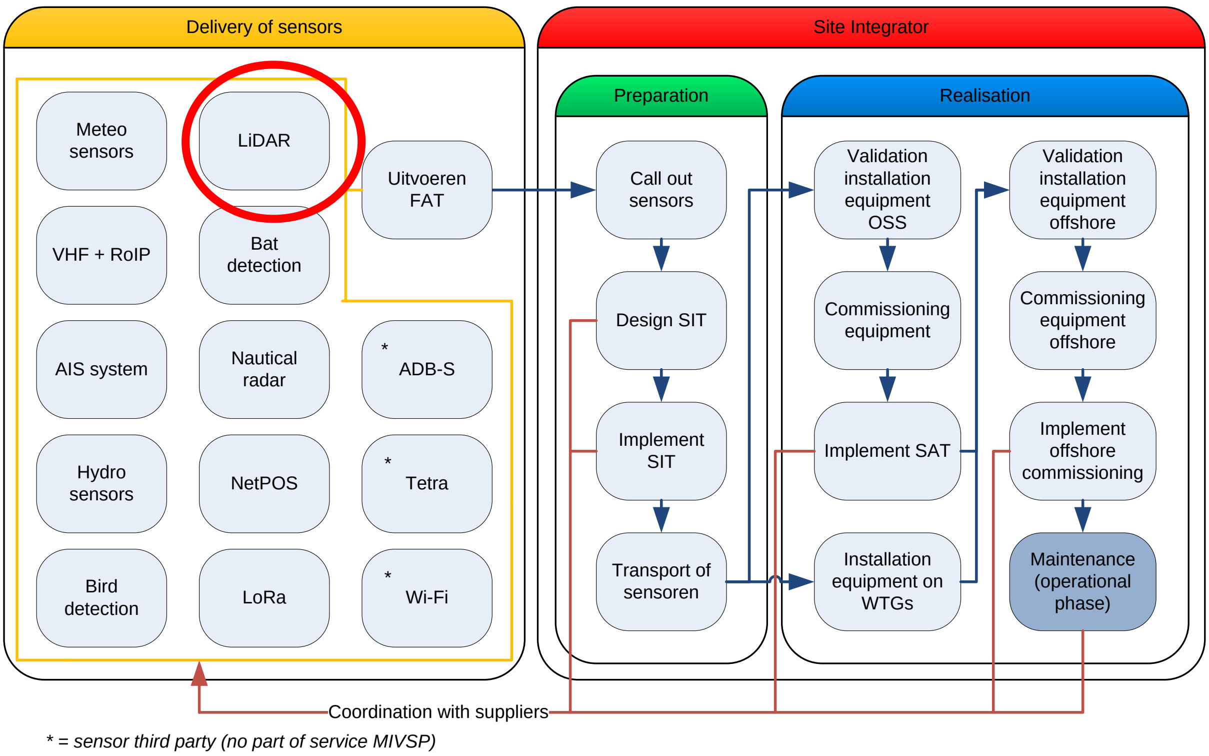

Figure 2: Site Integrator

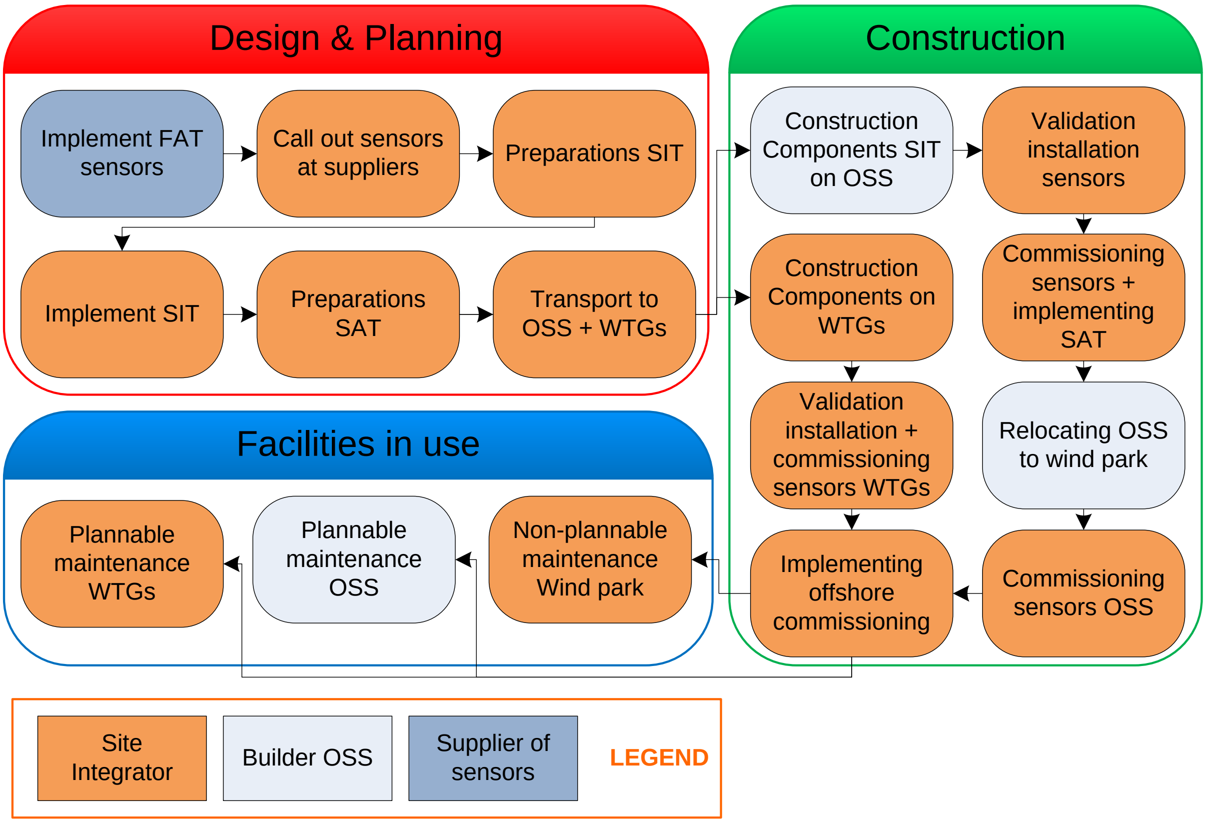

Figure 3: Tasks Sensors Site Integrator

The Site Integrator has the following tasks:

- Realisation of the optimal functioning of sensors and systems;
- Transportation of sensors and systems to the wharf;
- The integration of the sensors on the installation locations and connecting sensors into the RWS network.

2.1.2 *Validation*

On the basis of attending the FAT at the supplier's, the Site Integrator and RWS-CIV can assess whether the LiDAR to be delivered complies with the imposed requirements and is ready for integration.

By use of the SIT, the Site Integrator carries out a test that is attended by the Contractor and RWS-CIV to determine that the LiDAR still complies with the imposed requirements.

By use of the SAT, the Site Integrator performs a test that is attended by the Contractor and RWS-CIV to determine that the LiDAR is still in compliance with the imposed requirements on the OSS platform.

After the platform has been positioned in its definitive location, a validation will be done by the Site Integrator and the LiDAR system will be commissioned in cooperation with the Contractor and RWS-CIV. If this commissioning is successful, the system is eligible for maintenance.

2.1.3 *Transport*

The Contractor must supply all materials for the Site Integrator to compose the 'pluggable racks'. These are 19 inch racks/cabinets containing all the necessary hardware. This rack must be placed and connected in the OSS at the wharf. Contractor is also required to deliver the remaining sensors and systems to the Site Integrator.

2.2 Test strategy

In this paragraph the test strategy is described. The test strategy is based on risk. This means that first an analysis must be made based on the product risks. In the test strategy the time and resources are split, on the basis of the analysed risks.

The testing will focus more on high risk areas and less on low risk areas. The test results will be used to validate the estimated risks, which will be adjusted if necessary.

The tests must be carried out in conformity with the IEC standards, among which EN ISO/IEC 17025. These tests must comply and be reported. The documentation must be delivered in accordance with the J-STD-016.

Tests below focus on an optimal installation of sensors and systems aboard the OSS and WTG. With the activities deriving from this, the Customer intends to realise the objectives from paragraph 1.2. In RASCI table 1 the activities for this tender are shown in combination with the related responsibilities of the parties involved.

Acti-vities		SI	ON (LiDAR)	Builder OSS	RWS CIV	TNO	Users	Wind park owners
A1	**FAT**	I	A, R	I	I	C	-	C
A2	**SIT**	A, R	S	C	I	C	-	C
A3	**Transport to OSS**	A, R	C	I	I	-	-	-
A4	**Installation of sensors on OSS**	S	C	A, R	I	C	-	-
A5	**Commissioning sensors and systems at SAT**	A, R	C	S	I	I	I	-
A6	**SAT**	A, R	S	S	I	C	C	I
A7	**Transport OSS to sea**	C	C	A, R	I	-	-	-
A8	**Transport to WTG at sea**	A, R	-	-	I	C	I	S
A9	**Installation sensors on WTG**	A, R	-	-	I	C	I	S
A10	**Validation and Commissioning of sensors and systems at sea (WTG + OSS)**	A, R	C	S	I	I	I	S

A11	**Offshore commissioning**	A, R	S	S	I	C	C	S

RASCI: R = responsible, A=accountable, S=support, C=consult, I=inform

Table 1: Activities sensors and systems

The testing activities to be carried out are divided into a series of tests, see figure 4. The purpose of these tests is to detect non-functioning parts at an early stage and improve the integration of the sensors.

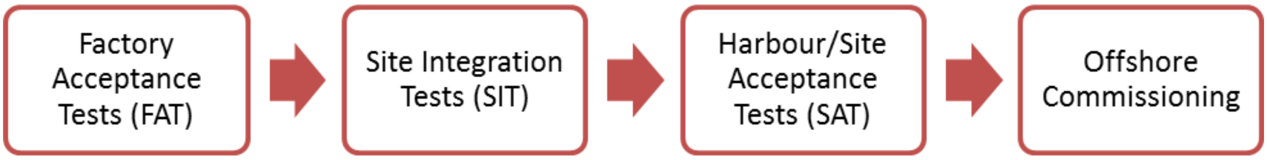

Figure 4: Series of tests

2.2.1.1 Factory Acceptance Test

<u>Objective</u>

In these tests the Contractor proves that his product meets the imposed requirements.

<u>Subject of test</u>

The sensors and systems are tested against the imposed requirements. The focus is on suitability of the sensors.

2.2.1.2 Site Integration Test/Mock-up

<u>Objective</u>

At the SIT, the transfer of the equipment of sensor suppliers takes place by means of a delivery protocol. Upon reception the Site Integrator is responsible for all equipment. Using an SIT it is established that a number of sensors, systems, installations and other related system parts work together in a correct manner and without interferences. The sensors are composed conforming to the TNO antenna plan. For the SIT, the definitive situation at sea is representatively reconstructed for both the planned sensors on the OSS as well the WTGs.

<u>Subject of test</u>

During these tests the connections to the RWS-network and the interferences with other sensors and systems play an important role. If certain network elements have not been completed yet, stubs will need to be built by the Site Integrator.

2.2.1.3 Harbor/Site Acceptance Test

<u>Objective</u>

After the SIT has been carried out, the equipment is transported to the wharf. After transfer protocol the wharf is liable for the equipment. The Builder of OSS will install the equipment conforming to the design of the Site Integrator. After installation a validation is done by the Site Integrator before commissioning. The commissioning falls under the responsibility of the Site Integrator. When the installation is completed, the Site Integrator will carry out the SAT at the wharf of the Builder.

<u>Subject of test</u>

During this test it is checked whether the sensors and systems are functioning as expected. In the SAT the sensors and systems are placed at the definitive position on the OSS. However, in the SAT it is not possible to place the sensors on the definitive position on the WTG. For this reason, the sensors that are required to be placed on the WTG's are not included in the SAT.

2.2.1.4 Offshore Tests and Commissioning

Objective

After shipping the OSS to its position at sea inspections are carried out by the Site Integrator. Subsequently, integration tests are re-runned in connection with the operating environment and to take electro-magnetic fiels, WTGs, etc. into account.

Subject of test

During this test it is checked whether the sensors and systems meet the previous test results. In the offshore tests the sensors and systems are tested in the definitive situation. These tests are carried out including the sensors and with systems on the WTG, if present.

2.2.2 *Maintenance*

The maintenance methods are divided into two main groups.

Plannable: Maintenance that is carried out to prevent future defects.

Non-plannable: Maintenance that is carried out to repair any defects.

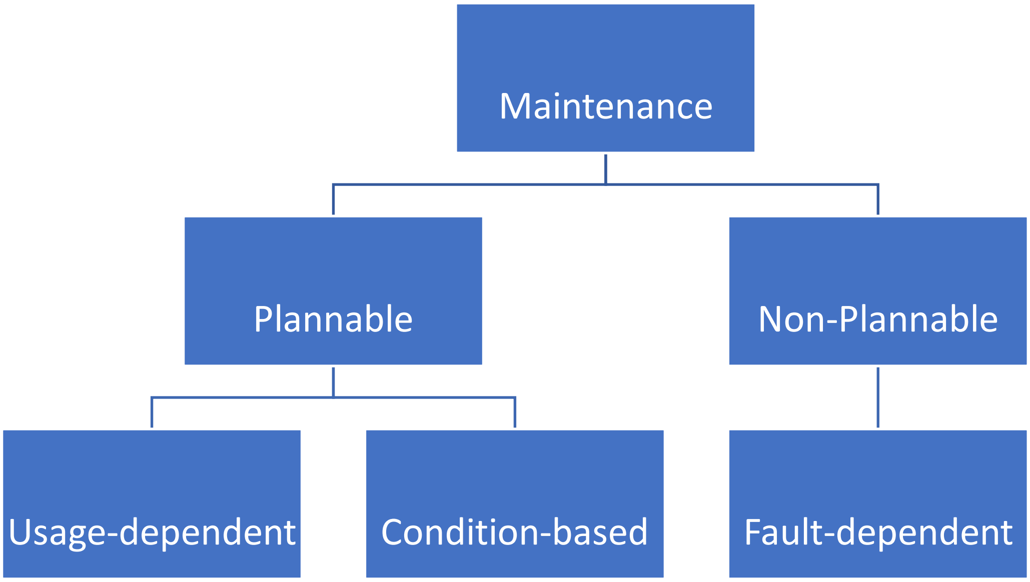

Figure 5: Maintenance

2.2.2.1 Non-plannable maintenance

Non-plannable maintenance is realised through the application of Fault-dependent Maintenance (SAO). The maintenance service will only start acting in case of a malfunction or failure of the production tool.

2.2.2.2 Plannable maintenance

We distinguish two types of plannable maintenance.

1. Condition-based Maintenance (TAO);
2. Usage-dependent Maintenance (GAO).

At TAO the condition of critical parts must be determined by means of inspections and diagnosis. The condition of these parts determines whether maintenance is required.

At GAO worn parts must be replaced at specific times and either the sensor or the entire system will undergo maintenance. For GAO the following actions are required to be carried out:

- Keeping the uptime of the critical parts;
- Timely planning of the maintenance;
- Reserving necessary parts and auxiliaries;
- Carrying out maintenance accurately and at the time planned.

Main-tenance		Site Integrator	ON (LiDAR)	Builder OSS	RWS CIV	Wind park owner
O1	**Plannable maintenance OSS**	A, R	C	S	I	-
O2	**Plannable maintenance WTG**	A, R	-	-	I	S
O3	**Non-plannable maintenance OSS**	A, R	S	I	I	-
O4	**Non-plannable maintenance WTG**	A, R	-	-	I	S

RASCI: R = responsible, A=accountable, S=support, C=consult, I=inform

Table 2: Maintenance

2.2.3 *Management*

In figure 6 the management philosophy for the project MIVSP is displayed. This figure shows that Rijkswaterstaat maintains control via MKO (Mission Critical Support) and TAB SVM (Technical Application Management Shipping Traffic Management). TAB SVM is responsible for the management and coordinates the maintenance via the Site Integrator.

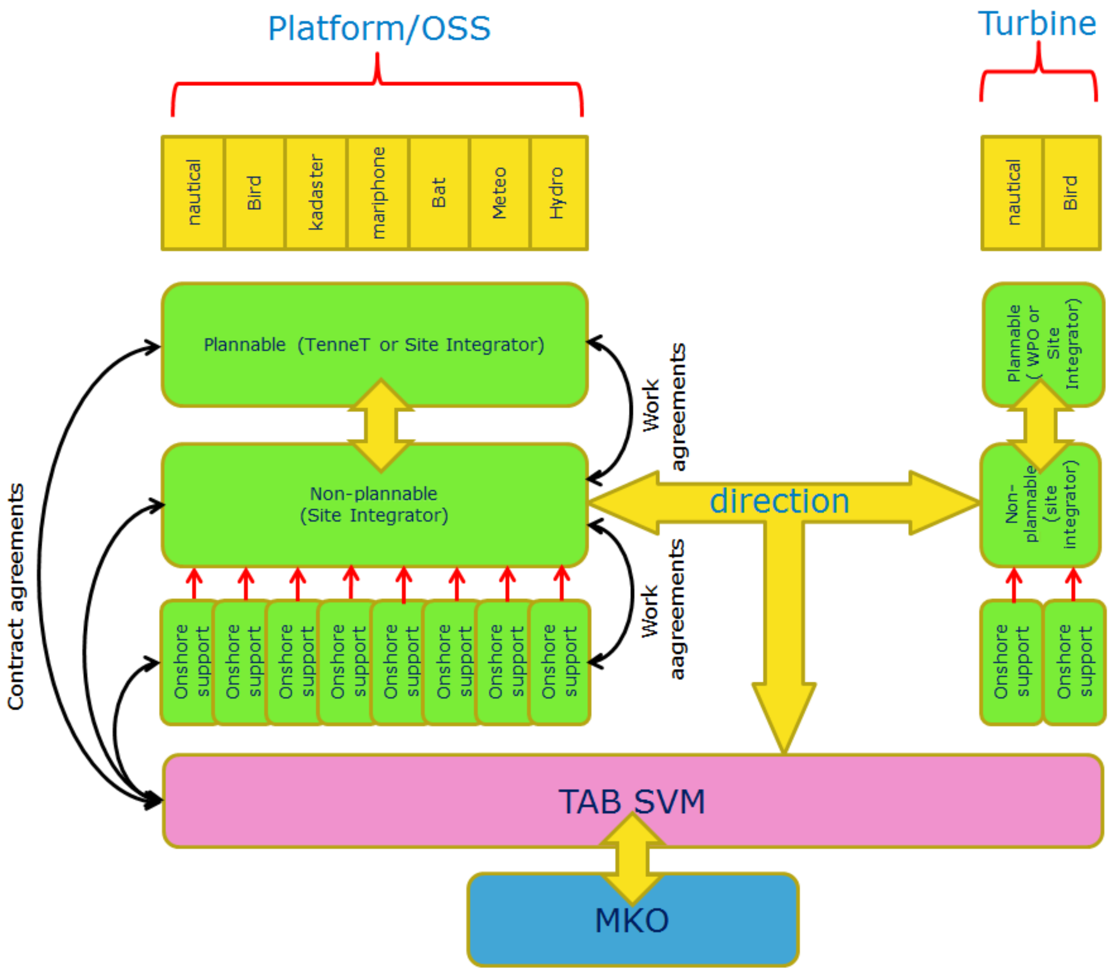

Figure 6: Management philosophy

3 Scope ande work activities in accordance with the Agreement

3.1 Activities contractor

See reference (ref. Ax) table 1 RASCI table activities contractor or reference (ref. Ox) table 2 maintenance.

3.1.1 *Activity 1: (ref. A1) Early detection of non-functioning parts*

The contractor implements the FAT for ensuring early detection of non-functioning parts.

3.1.2 *Activity 2: (ref. A2) Deliver documentation, materials and support for LiDAR*

Work activities of the SIT shall be implemented as result that all systems in place are easy installed, transported and meet the expectations. De contractor delivers installation manuals, materials and support for the work activities to the Site Integrator for proper functioning of the LiDAR.

3.1.3 *Activity 3: (ref. A3) Supporting SIT*

Work activities of the Site Integrator must be carried out in such a way that the sensors and systems can be connected to the RWS network. This should allow for the acquired data to be transported to the users. Also the Contractor should be enabled to carry out remote maintenance and management. There is a risk of some parts of the RWS network not being ready yet upon commencement of the tests. In that case the Site Integrator is required to build stubs to be able to simulate these parts.

The contractor shall deliver a stub to support the Site Integrator (for example RDP, test tool, temporary building block of missing parts.

3.1.4 *Activities 4: (ref. A4) Deliver information and support installation LiDAR for SAT on OSS*

The builder of the OSS shall install the systems in accordance with the design. The validation is done by the Site Integrator after installation. If necessary, the contractor supports the Site Integrator with the installation and validation of the LiDAR on the OSS.

3.1.5 *Activity 5: (ref. A5) Deliver support for commissioning of the LiDAR for SAT on the OSS*

If necessary, the contractor supports the Site Integrator for commissioning of the LiDAR on the OSS. Inclusive the additional required tools for commissioning.

3.1.6 *Activity 6: (ref. A6) Deliver support SAT*

The final situation (sensors wind farm, incl. OSS) shall be tested in the SAT to ensure the quality. The contractor delivers the needed support for correctly technical delivery and delivers support for testing (SAT).

3.1.7 *Activity 7: (ref. A10) Deliver information and support for commissioning LiDAR on OSS*

If necessary, the contractor delivers support to the Site Integrator for commissioning the LiDAR offshore.

3.1.8 Activities 8: (ref. A11) Offshore tests & commissioning

If necessary, the contractor delivers support to the Site Integrator for the integration tests of the LiDAR offshore.

3.1.9 Activity 9: (ref O1) Supporting Site Integrator for carrying out maintenance on sensors

The Site Integrator is responsible for the maintenance of the sensors in the wind park. Plannable maintenance on the OSS is carried out by the Builder. If necessary, the contractor shall support the Site Integrator for carrying out maintenance. The contractor delivers support for remote maintenance if it is appropriate to do so.

3.1.10 Activity 10: (ref O3) Supporting Site Integrator for carrying out maintenance on sensors

The Site Integrator is responsible for the maintenance of the sensors in the wind park. The Site Integrator is responsible for the non-plannable maintenance on the OSS. If necessary, the contractor shall support the Site Integrator for carrying out maintenance. The contractor delivers support for remote maintenance if it is appropriate to do so.

3.1.11 Summary

The contractor shall support and deliver information for work activities to be carried out by the Site Integrator. These activities beneficial for the realisation and the management include at least the list below:

1. General work activities
    a. Project management;
    b. Technical management;
    c. Managing sensor suppliers;
2. Work activities preparation phase (SIT)
    a. Designing SIT;
    b. Defining, planning and implementing work activities;
    c. Building up SIT environment;
    d. Simulating final situation, if necessary building stubs;
    e. Testing;
    f. Inspection and acceptance;
    g. Preparation activities SAT
3. Work activities realisation phase (SAT and Offshore commissioning)
    a. Designing SAT;
    b. Support building SAT;
    c. Validation SAT and Offshore Commissioning;
    d. Commissioning;
    e. Testing;
    f. Deliver documentation;
    g. Follow-up care;
    h. Realisation sensors in wind farm (with exception of the OSS)
4. Work activities operational phase
    a. Managing sensor suppliers;
    b. Supporting and maintening sensors and systems.

3.2 Relation contractor with basic service MIVSP

The basic service of MIVSP is the collection and transportation of data to other parties. Figure 7 provides insight of the basic service.

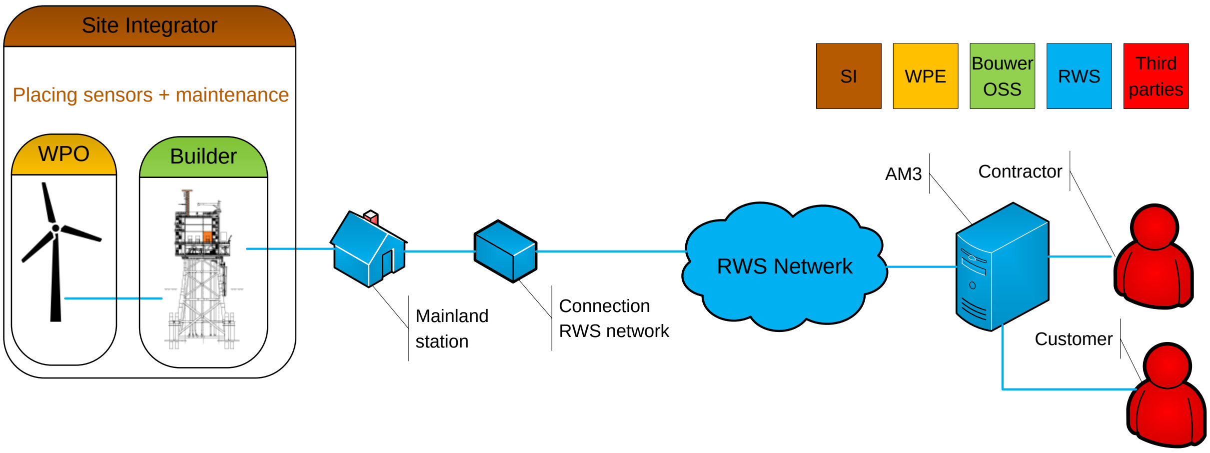

Figure 7: Basic service MIVSP

De work activities of the Contractor can be broken down into three main tasks:

1. Deliver and Calibration on the LiDAR system;
2. Support of the Site Integrator during the tests;
3. Support of the Site Integrator for maintenance on the LiDAR.

The SIT must imitate a similar situation of the sensors and systems in the entire wind park (OSS+WTG's). Figure 8 provides a sketch of the SIT. No rights may be derived from the sketches.

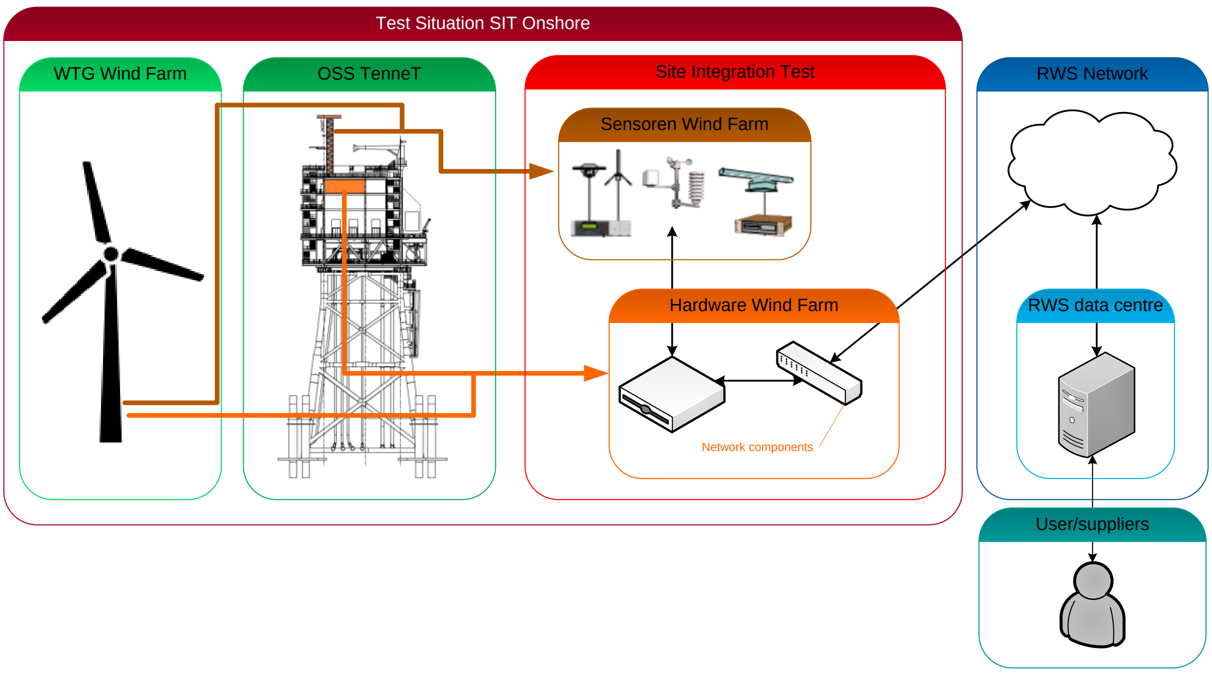

Figure 8: Test situation Onshore

In the ultimate situation all sensors and systems will be installed in the wind park at sea. During tests the situation at sea will be simulated. At the test location all factors that may influence the functioning of the sensors and systems at sea, will be taken into account. These factors are simulated in the tests to be able to test the final situation at an early stage.

On the OSS different sensors are installed. They are delivered to the Site Integrator. The following sensors are involved:

- ADB-S;
- AIS/AtoN;
- Differential GPS
- Hydro;
- LiDAR;
- LoRa;
- Nautical radar;
- Meteo;
- Tetra;
- VHF+RoIP;
- Bat detection;
- Bird detection;
- Wi-Fi.

On the OSS Borssele Alpha several sensors from the list above will be positioned. On the other OSS-es variations may be applied on the basis of increased insight.

3.2.1 *Summary*

The work activities to be carried out by the Site Integrator for the benefit of the realisation and the management include at least the list below. For these work activities support can be requested from the Contractor:

- General work activities:
    - Project management;
    - Technical management;
    - Contact sensor suppliers.
- Work activities preparatory phase;
    - Design of SIT;
    - Simulate final situation, build stubs if necessary;
    - Implementation;
    - Testing;
    - Inspections and acceptance;
    - Preparatory work activities for SAT.
- Work activities realisation phase
    - Follow-up care & Warranty;
    - Realising sensors in the wind park (with the exception of the OSS).
- Work activities usage-phase:
    - Contact sensor suppliers;
    - Management & maintenance.

3.3 Planning

The planning of the work activities of the Contractor are largely dependent on the planning of the Site Integrator and TenneT for the realisation of the OSS. In table below an indication of the planning's main points is described. This means that the first LiDAR should be delivered around Q3 2017.

Indication Planning of Integration of sensors				
	SIT	**SAT**	**Sensors WTG**	**Offshore Commissioning**
Borssele Alpha	Q1/2018	Q3/2018	Q1/2019	Q1/2019
Borssele Beta	Q1/2019	Q3/2019	Q1/2020	Q1/2020
Dutch coast south Alpha	Q3/2019	Q1/2020	Q3/2020	Q3/2020
Dutch coast south Beta	Q3/2020	Q1/2021	Q3/2021	Q3/2021
Dutch coast north	Q3/2021	Q1/2022	Q3/2022	Q3/2022

Table 3: Planning realisation sensors

4 Definitions

Term	Definition
Stub	Temporary (IT)- function of test tool

Table 4: Definitions

4.1 Abbreviations

Abbreviation	Description
AIS	Automatic Identification System (IALA)
AtoN of A-to-N	Aids to Navigation
AWS	Automatic Weather station
CIV (RWS-)	RWS Central Information Provision
DGNSS	Differential Global Navigation Satellite System; DGNSS data is used to improve the integrity and accuracy of via GNSS received position data.
FAT	Factory Acceptance Test
GAO	Usage-dependent Maintenance
GPS	Global Positioning System: a satellite based system of the Ministry of Defence of the USA that suitable receivers on earth can accurately determine their position with.
HAT	Harbor Acceptance Test
I&C	Integrator & Coordinator
IALA	International Association of marine aids to navigation and Lighthouse Authorities
IEEE	Institute of Electrical and Electronic Engineers
IVEF	Inter VTS Exchange Format
IT	Information Technology
ITU	International Telecommunications Union
LAN	Local Area Network
Lat/Long	Latitude/Longitude coordinates (WGS84 date, unless indicated otherwise)
LiDAR	Light Detection and Ranging
LSS	Logical Shore Station (IALA-AIS-WG)
MKO	Mission Critical Support
MMSI	Maritime Mobile Service Identity
MPLS	Multi-Protocol Label Switching
NM	Nautical Mile
NNV	New Network Facilities (nationwide RWS network)
OG	Customer
ON	Contractor
OSS	Offshore Substation
PMR	Project Management Requirements
QoS	Quality-of-Service
RF	Radio Frequency
RFC	Request For Comments
RFI	Request For Information
RFP	Request For Proposal

Abbreviation	Description
RTCM	Radio Technical Commission for Maritime Services. The RTCM is for instance involved with establishment of standards related to GNSS and DGNSS.
RWS	Rijkswaterstaat, Director General of the Ministry of Infrastructure and the Environment – implementation organisation
RWS-CIV	RWS-Central Information Provision
SAO	Fault-dependent Maintenance
SAT	Site Acceptance Test
SBAS	Satellite Based Augmentation System
SCB	System-focused Contract control
SI	Site Integrator
SIT	Site Integration Test
TAB SVM	Technical Application Management Shipping Traffic management
TAO	Condition-based Maintenance
TNO	Netherlands Organisation for Applied Scientific Research
VDS	Bird detection system
VHF	Very High Frequency
VPN	Virtual Private Network
VSA	General Tender Specification
VSE	Tender Specification Requirements
VSS	Tender Specification Site Integration Test
VTM	Vessel Traffic Management
VTS	Vessel Traffic Services
WTG	Wind Turbine Generator
WPE?WPO	Wind park Owner / Wind Park Owner

Table 5: Abbreviations

5 Aspect requirements

5.1 Introduction

In addition to the technical and system requirements, *aspect requirements* are identified. These requirements should be interpreted as preconditions that the installations delivered by the Site Integrator must comply with.

5.2 Types of aspect requirements

The types of aspect requirements applicable to this VSE are shown below in table 8.

Aspect	Description	See
Safety	Requirements with regard to safety during realisation and safety in the usage-phase of realised installations, for both the user and the environment. Nb. for safety requirements applicable during the implementation of the work, see §5.3.	§5.3
Availability	Requirements with regard to availability of (parts of) the installation and the lifespan of (parts of) the installation.	§5.4
Sustainability	Requirements with regard to, inter alia, environmental impact (for instance avoiding scarce and toxic raw materials and energy inefficient devices) and social aspects (among which the working conditions and the like).	§5.5
Offshore Substation	Requirements with regard to the Offshore Substation.	§5.6

Table 6: Types of aspect requirements

5.3 Safety

5.3.1 *General*

VSA-01	**Electro-magnetic Interference (EMI)**
Requirement:	The Site Integrator must take measures for working safely around the installation locations.
Explanation:	The Site Integrator must, for instance, consider the EMI of the radar sensors.
Verification:	Inspection, documentation, measurements

5.3.2 *Electrical installations and equipment*

VSA-02	**Electrical installations and equipment**
Requirement:	All work activities on electrical installations (up to 1000V) and electrical equipment will be carried out in accordance with [NEN1010], NEN3140], [EN50110] en [RWS-ELEK}.
Explanation:	
Verification:	Inspection, measurements

VSA-03	**Electrical protection general**
Requirement:	All protections against lightning and overvoltage are required to conforming to the applicable standards and directives, including [IEC62305], [NEN-EN-IEC62561], [NEN1010], [NPR1014] and [NPR8110].

Explanation:	
Verification:	Inspection, measurements

VSA-04	**Safety grounding of 19” rack**
Requirement:	The metal frame of the 19” rack must be equipped with an own protective earth.
Explanation:	
Verification:	Inspection, measurements

VSA-05	**Grounding and potential equalisation**
Requirement:	All conductive metal frames positioned or relocated during the work are required to be grounded. Earthing cables, measuring points and connections to the main earthing rail must be fitted with detachable connections to be able to perform measurements.
Explanation:	
Verification:	Inspection, measurements

5.3.3 *Fire safety installations*

VSA-06	**Fire protection of applied cabling**
Requirement:	All cabling supplied by Site Integrator must be halogen-free and extremely fire-resistant, and issue little smoke in case of incineration.
Explanation:	
Verification:	Documentation, certificate or certificates

VSA-07	**Fireproof cable glands**
Requirement:	All cable glands must be fireproof and prevent air displacement between mutual spaces and the roof.
Explanation:	
Verification:	Inspection

5.3.4 *Mechanical safety*

VSA-08	**Security against tipping over**
Requirement:	All positioned constructions, including the 19” racks and antenna installations must be sufficiently secured against tipping over.
Explanation:	Causes of tipping over in any case include light and unintentional pressure by persons near the construction and the implementation of work activities on that construction (among which adding or removal of equipment and/or parts). At locations in The Netherlands where earth tremors may occur, this should be considered in particular.
Verification:	Inspection

VSA-09	**Proper wall fitting**
Requirement:	Objects fitted to walls must be affixed by means of a suitable and proper method.
Explanation:	
Verification:	Inspection

VSA-10	**No cables on floors**
Requirement:	For hygienic and safety reasons (preventing tripping) it is not permitted to have cables lying on the floor.
Explanation:	
Verification:	Inspection

VSA-11	**Avoiding protruding of (sharp) elements**
Requirement:	Protruding parts are not permitted at locations where persons tend to be present. At other locations the presence of protruding parts must be prevented as much as possible and if that turns out to be impossible, they must be marked by means of clear colours. Sharp protruding parts must be finalised burr-free or covered.
Explanation:	This concerns for instance cable clamps on antenna masts/tubular piles, parts of 19" racks, cable ducts and so on.
Verification:	Inspection

5.4 Availability

VSA-12	**Minimal lifespan of components, materials and equipment**
Requirement:	Unless explicitly indicated otherwise, the following requirements apply with respect to the *minimal* (not average) lifespan for which all components, materials and equipment, delivered by Site Integrator, were designed, taking account of the operational conditions to be expected: 1. Externally mounted or positioned components, materials (including cabling) and equipment: at least 15 years; 2. Internally mounted or positioned equipment (including climate control and Ethernet converters): at least 10 years; 3. Internally mounted or positioned components and materials (including cabling): at least 15 years.
Explanation:	
Verification:	Documentation (specifications), certificate or certificates

5.5 Sustainability

VSA-13	**Sustainability general**
Requirement:	Site Integrator is required to apply sustainable materials. In any case of reasonable option, the use of environmentally harmful (including toxic) materials and energy inefficient active components must be avoided.
Explanation:	For instance in the event of climate control installations the more economical units are preferred.
Verification:	Inspection, documentation (specifications), certificate or certificates

5.6 Offshore Substation

VSA-14	**Employer's Requirements**
Requirement:	The Site Integrator must comply with the Employer's requirements TenneT, ONL-TTB-03871.

Explanation:	TenneT is responsible for the Offshore Substation
Verification:	Documentation, inspection