

F2-A-Hanze lidar measurement campaign

Instrumentation report 2026

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Abbreviations

EPL	Europlatform
IEC	International Electrotechnical Commission
LEG	Lichteiland Goeree
Lidar	Light Detection And Ranging
MSL	Mean Sea Level
OWEZ	Offshore Wind farm Egmond aan Zee
TNO	Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek (Netherlands Organisation for applied scientific research)
TNW	Ten Noorden van de Wadden
VPN	Virtual Private Network
WGS 84	World Geodetic System 1984

Summary

In order to better understand the wind conditions at the North Sea for future offshore wind farms a ZX Lidars ZX300M lidar was installed on the F2-A-Hanze platform of Dana Petroleum Netherlands B.V. in February 2026. This report describes the background of the measurement campaign, the platform itself, the used lidar system and installation, data handling and operational aspects.

1 Introduction

1.1 Offshore wind energy deployment

The Netherlands has set clear ambitions to accelerate the energy transition and wind energy plays an essential role. The energy agreement outlines the route for implementation of offshore wind energy and by 2030 an installed capacity of 21.5 GW needs to be achieved. Upscaling the offshore wind capacity is happening across all North Sea national zones and this agreement is established in the Esbjerg Offshore Wind declaration [1].

The Offshore Wind Energy Act gives the government the option of issuing lots for the development of offshore wind farms. Recently the Dutch Government has planned to open five new areas for offshore wind farm development to accommodate these revised ambitions and targets [2], see fig. 1.1.

To enhance these developments, TNO performs offshore wind measurements at different platforms across the Dutch North Sea.

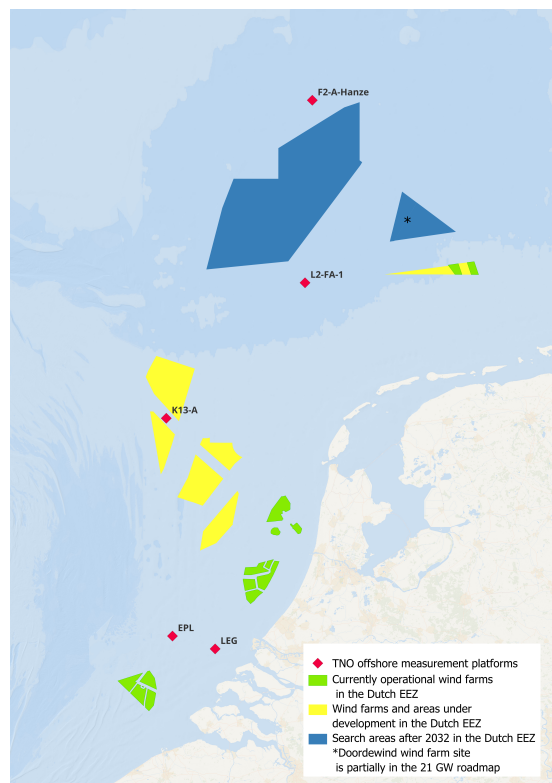


Figure 1.1: Locations of existing wind farms (green), wind farms under development (yellow), search areas after 2032 (blue) and TNO offshore measurement locations (red).

1.2 TNO's leading role on offshore measuring campaigns

Before the integration of lidars in offshore wind resource assessments, meteorological masts (met masts) have been widely used by TNO. Notable examples include the met mast IJmuiden (MMIJ), as well as the met mast at Offshore Wind farm Egmond aan Zee (OWEZ).

Since 2014, TNO is performing long-term lidar measurement campaigns at five strategically chosen locations in the North Sea, on behalf of the Dutch Ministry of Climate Policy and Green Growth. These campaigns are part of the 'Wind op Zee' project to support the Dutch wind offshore roadmap. These locations are: Lichteiland Goeree (LEG), Europlatform (EPL), K13-A, L2-FA and F2-A-Hanze, see fig. 1.1.

This report focusses on the instrumentation on platform F2-A-Hanze. A description of the F2-A-Hanze platform is found in chapter 2 and in chapter 3 detailed information can be found on the ZX lidars ZX300M lidar. The installation is elaborated on in chapter 4 and chapter 5 focusses on the data handling. Finally, chapter 6 covers the operation and maintenance aspects.

1.3 Open-access and public datasets

Since 2020 TNO has published annual reports on the wind conditions for each measurement campaign location. These reports are available at the TNO offshore wind measurements website: <https://offshorewind-measurements.tno.nl/en/> [3]. Here the data sets from all 'Wind op Zee' locations are available as well.

2 F2-A-Hanze offshore platform

The F2-A-Hanze offshore platform owned by Dana Petroleum Netherlands B.V. is located North of the Frysian Islands (Ten Noorden van de Wadden – TNW), 200 km North of Den Helder, see fig. 1.1. The platform serves as a production platform for oil and natural gas. Since beginning of 2026 wind measurements are carried out by TNO using a platform-mounted (49 m above MSL) lidar ZX300M, see fig. 3.1. An aerial picture of the platform can be seen in fig. 2.1.

Some specific data concerning the F2-A-Hanze are:

- › Coordinates (WGS 84): 54°56′43″N, 4°34′26″E
- › Water depth: Approx. 43 m to MSL
- › F2-A-Hanze platform heading: True North

A top view drawing of the F2-A-Hanze platform can be seen in fig. 2.2.

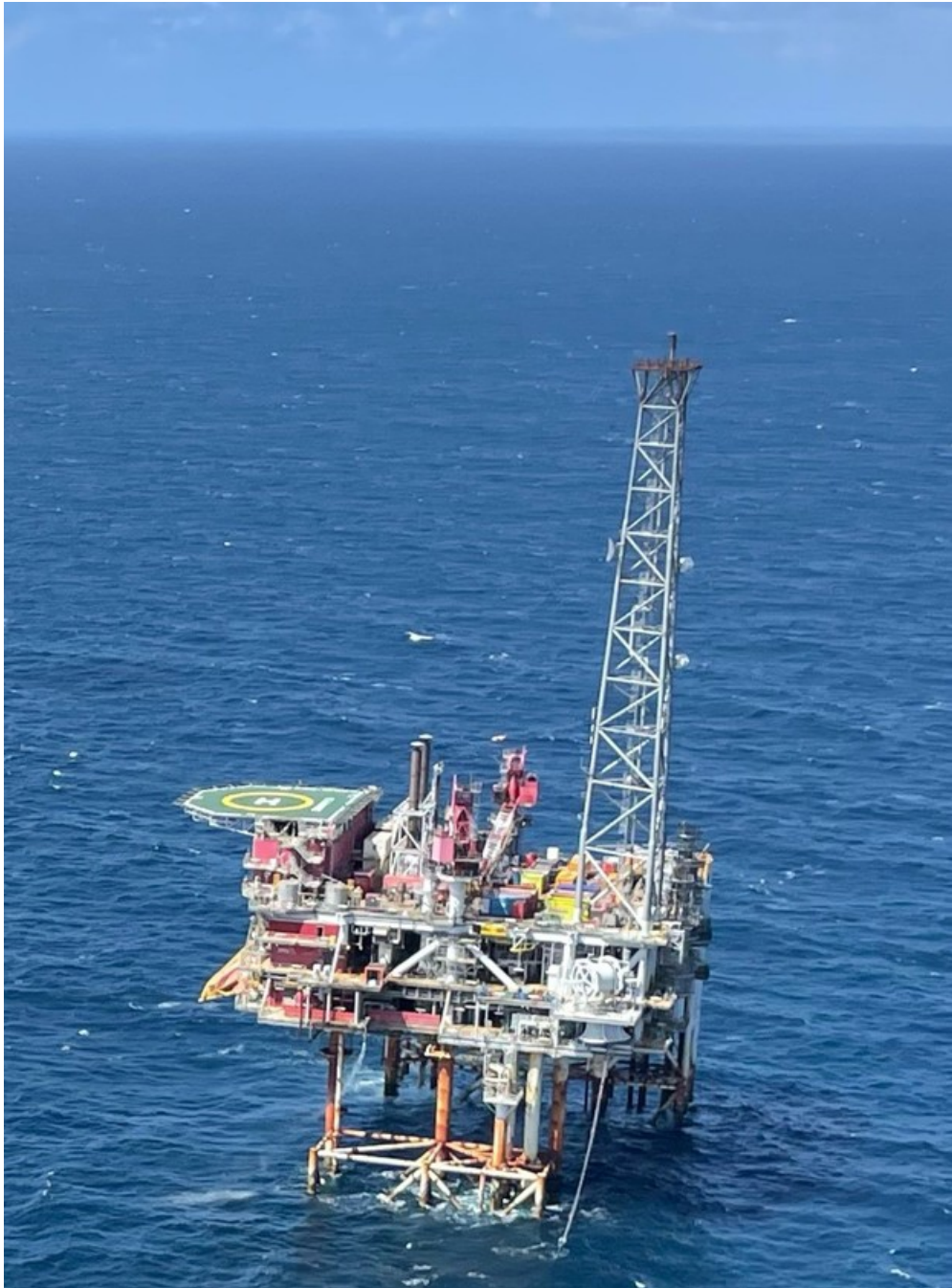


Figure 2.1: F2-A-Hanze platform.

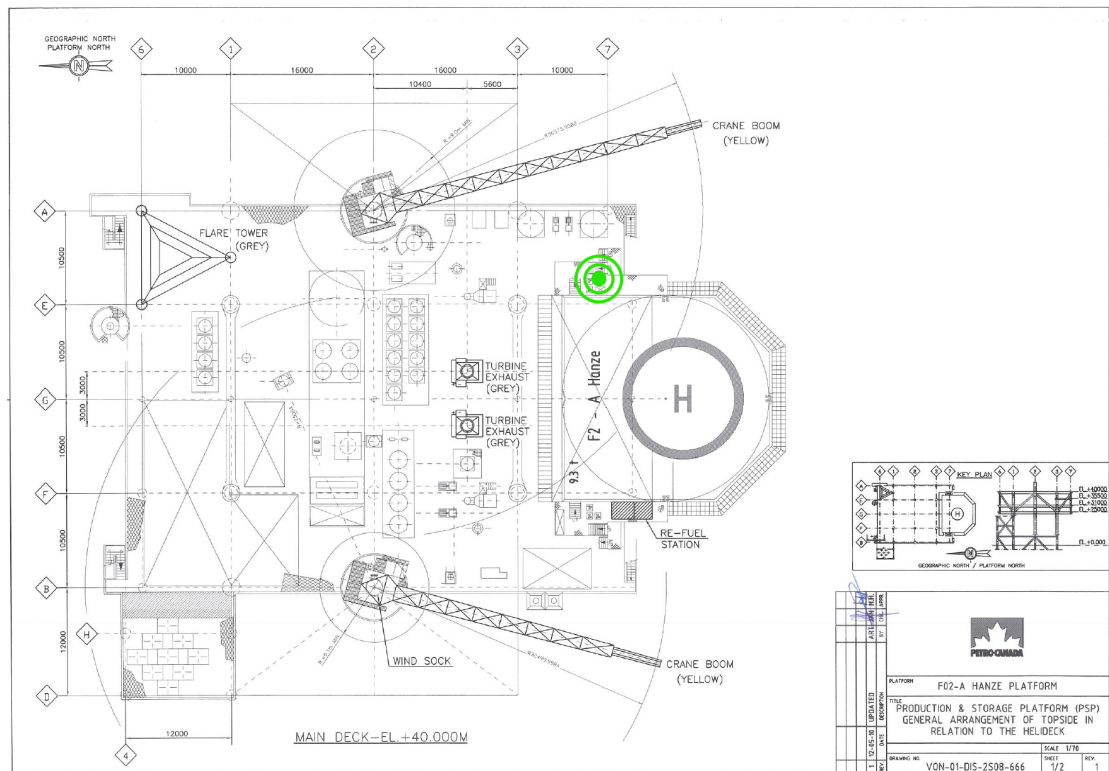


Figure 2.2: Top view the F2-A-Hanze helideck, with the position of the lidar marked in green.

3 Lidar ZX300M

The lidar ZX300M v2 consists of a tripod-shaped housing, with dimensions of ca. 90 x 90 x 90 cm. The inclined top of the housing contains the lens through which the laser beam is projected upwards. A picture of the system can be seen in fig. 3.1 and the dimensions in fig. 3.2.



Figure 3.1: Lidar ZX300M (v2).

The laser beam of this lidar points up with an angle of 30° with respect to the vertical, and sweeps to describe full circles, as can be seen in fig. 4.4.

The v2 version is the successor of the ZX300M initial version and has an improved robustness for offshore environments by, among other, applying a single user connector panel with MacArtney SubConn connectors.

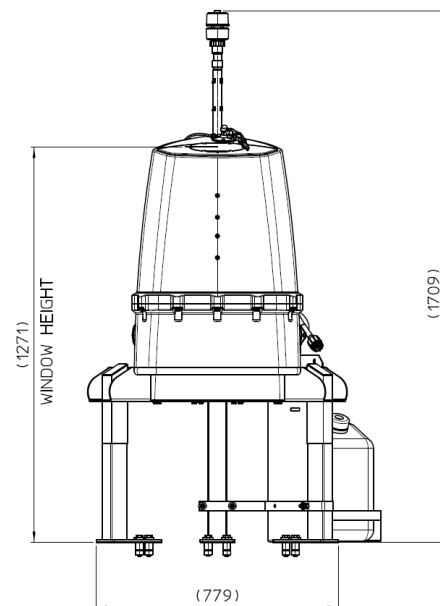


Figure 3.2: ZX Lidars ZX300M dimensions.

4 Installation lidar ZX300M

The lidar ZX300M is installed at the top of the accommodation building, just below and east of the helicopter deck, see fig. 4.1. The lidar mounting frame is bolted onto a mounting plate using six bolts. The lidar platform height is 49 m above MSL. From this location the lidar has a clear view in the configured scanning direction. The meteo station, providing among others additional air pressure, air temperature and wind direction measurements, is mounted on the railing with the sensor just below the helicopter deck height.

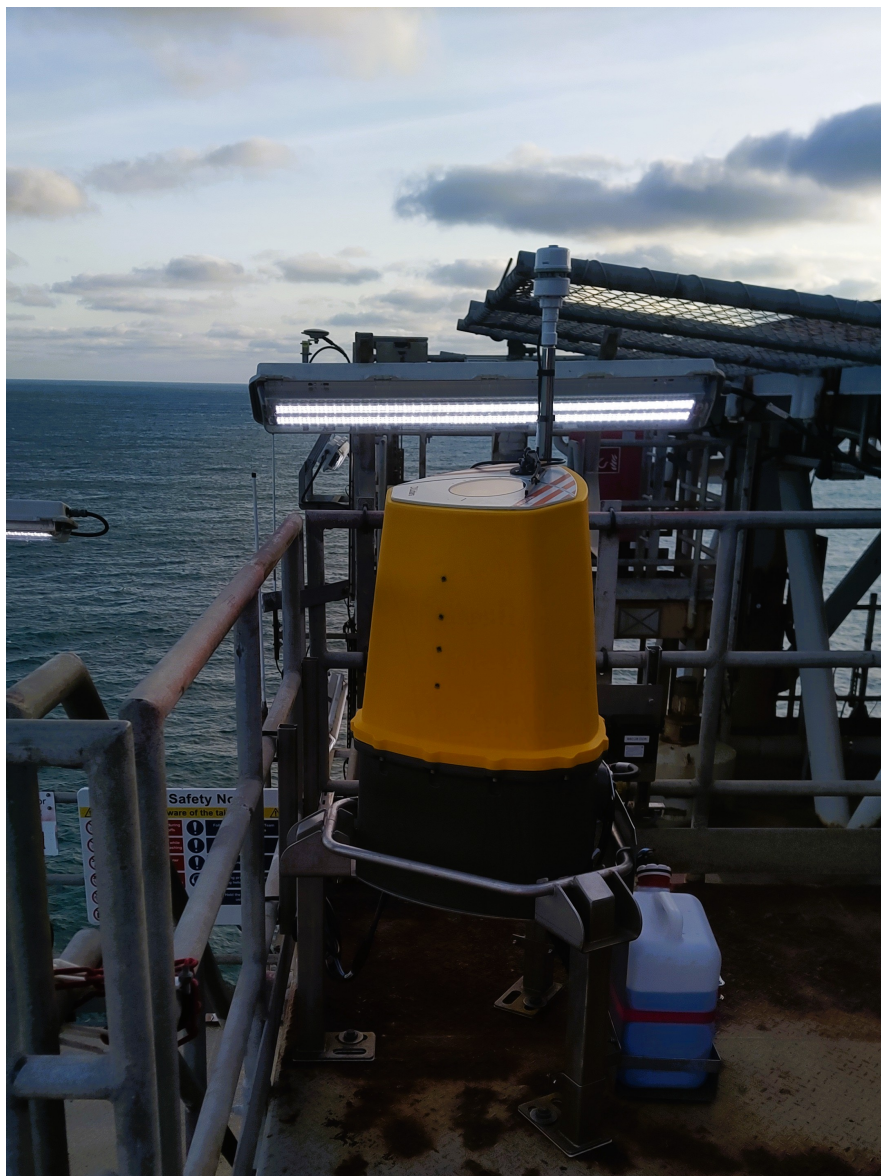


Figure 4.1: ZX300M lidar installed at F2-A-Hanze, at the platform east and just below the helicopter deck.

4.1 Electrical installation

4.1.1 Power supply

To be able to operate, the lidar needs a 12 VDC power supply. At the lidar platform a junction box is available with 230 VAC power supply. The 230 VAC is converted to 12 VDC by the AC\DC converter mounted at the bottom of the lidar. The power requirements of the lidar is 55 Watt. See appendix A for the basic lidar specifications.

4.1.2 Communication

To be able to transfer the data measured by the lidar to TNO, a TNO VPN router is installed inside the TNO data acquisition cabinet located in the radio room, see fig. 4.2. This router is wired to a Starlink open internet connection, available at F2-A-Hanze. From the TNO office a VPN connection is setup. Using this connection the local TNO PC and lidar can be accessed. An overview of the network layout can be found in fig. 4.3.

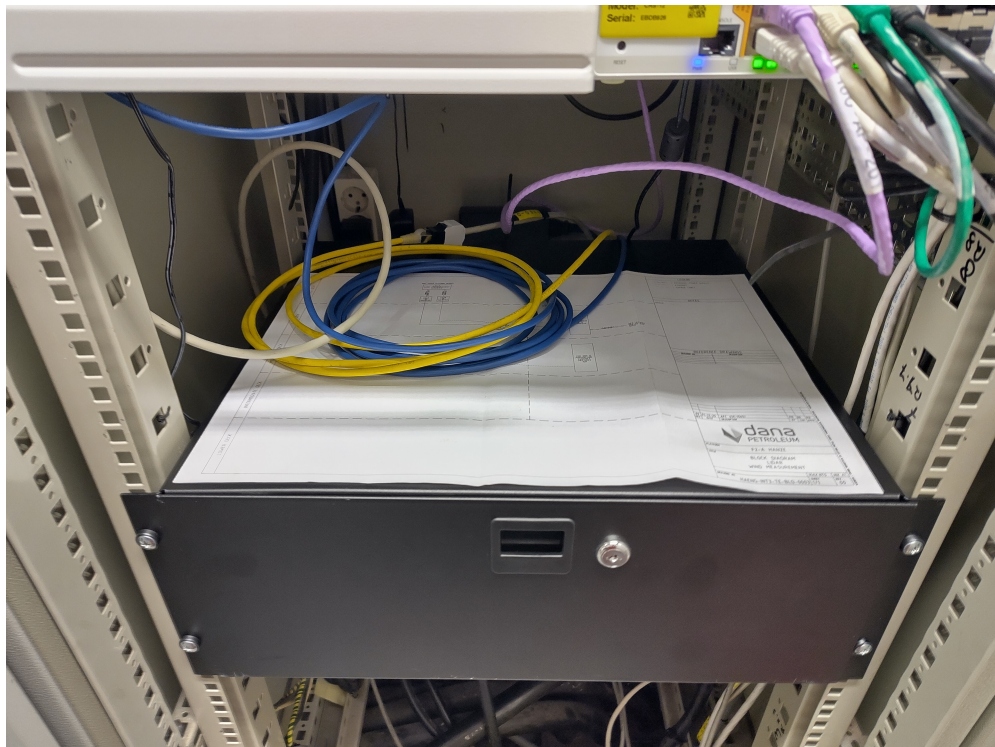


Figure 4.2: TNO data acquisition cabinet inside the radio room.

4.2 Orientation of the lidar

The lidar has been installed with the 'North' marker of the lidar 30° East to the platform North, which is aligned to True North. Therefore a 30° bearing is configured in the lidar settings, see fig. 4.4.

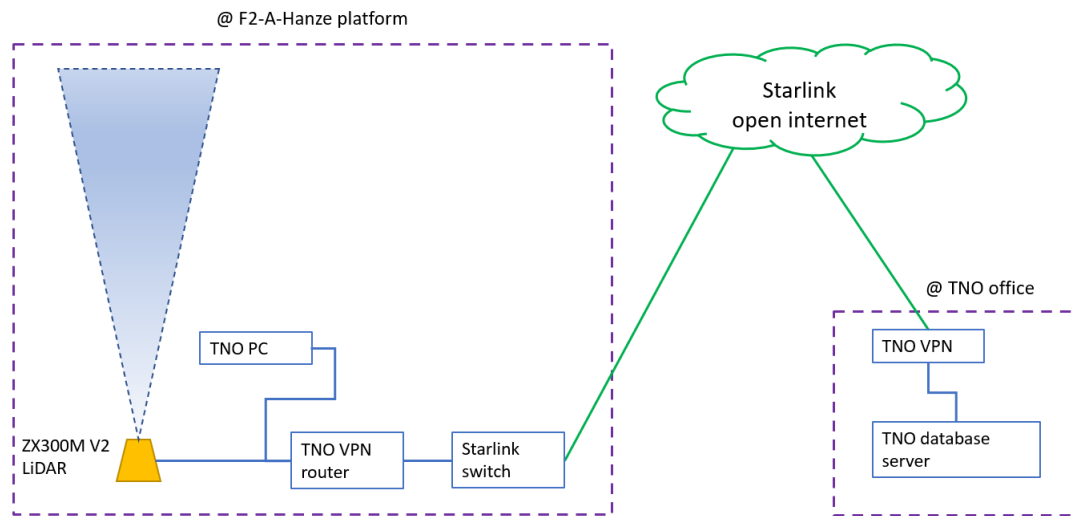


Figure 4.3: F2-A-Hanze lidar campaign network layout.

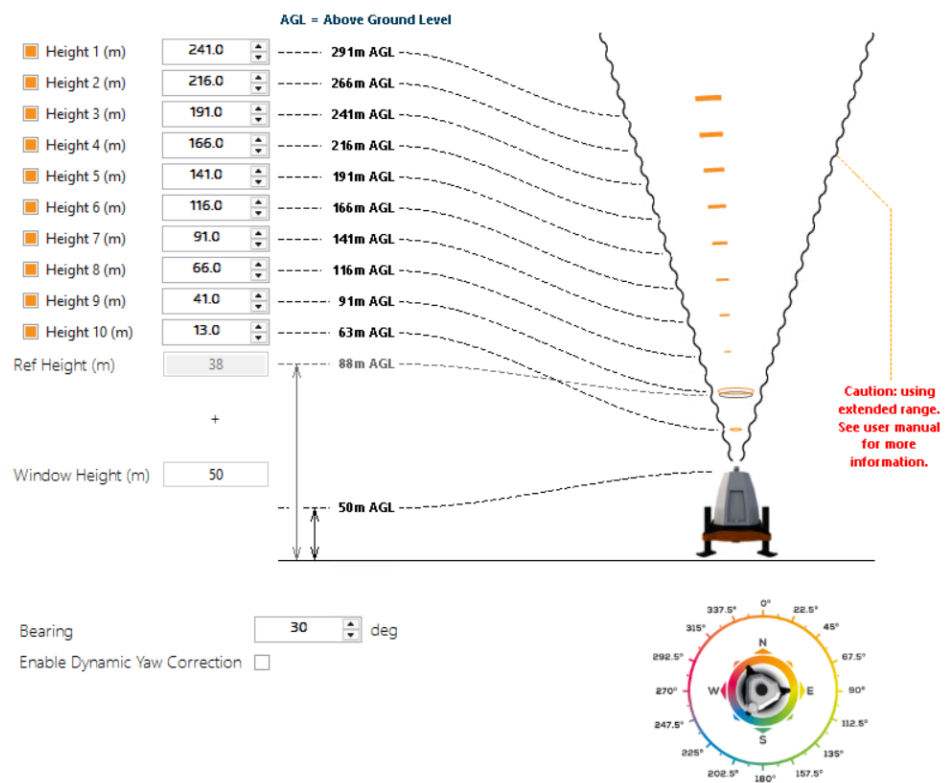


Figure 4.4: Height and bearing configuration of the ZX300M lidar.

4.3 Obstacles

The ZX300M lidar is installed just below the helicopter deck on the accommodation deck to the side of the helicopter deck, see fig. 2.2 and fig. 4.1, therefore the lidar experiences free sight for the complete scan circle of the lidar beam with an opening angle of 30° to the vertical. The meteo station of the lidar however experiences blockage and wake effects due to the platform. This can result in periods with a 180° offset as explained in section 5.4.

4.4 Lidar settings

We have chosen to configure the measurement heights (above MSL) at the F2-A-Hanze platform identical to the heights measured at the Lichteiland Goeree platform. These are based on the meteorological mast IJmuiden (MMIJ) measurement height configuration, which performed measurements from November 2011 to March 2016.

The lidar lens height is about 50 m meters above MSL. The heights configuration in the lidar is relative to the lens height. Based on the orientation of the lidar as elaborated on in section 4.2 the bearing of the lidar is 30°. The measuring heights and bearing as configured in the lidar can be seen in fig. 4.4. Table 4.1 gives the corresponding measurement heights above MSL as well.

Table 4.1: Lidar configured heights and measurement height to MSL.

No.	lidar height configuration	measurement height to MSL
	[m]	[m]
1	13	63
2	41	91
3	66	116
4	91	141
5	116	166
6	141	191
7	166	216
8	191	241
9	216	266
10	241	291

5 Data handling

In this chapter we will consider the three TNO data sources as well as the additional available data sources, namely:

- › Standard produced ZX300M data files, 10-minute statistical data and 1 Hz data
- › TNO database handling, checking, correction and filtering
- › TNO data export via <https://offshorewind-measurements.tno.nl/en/>

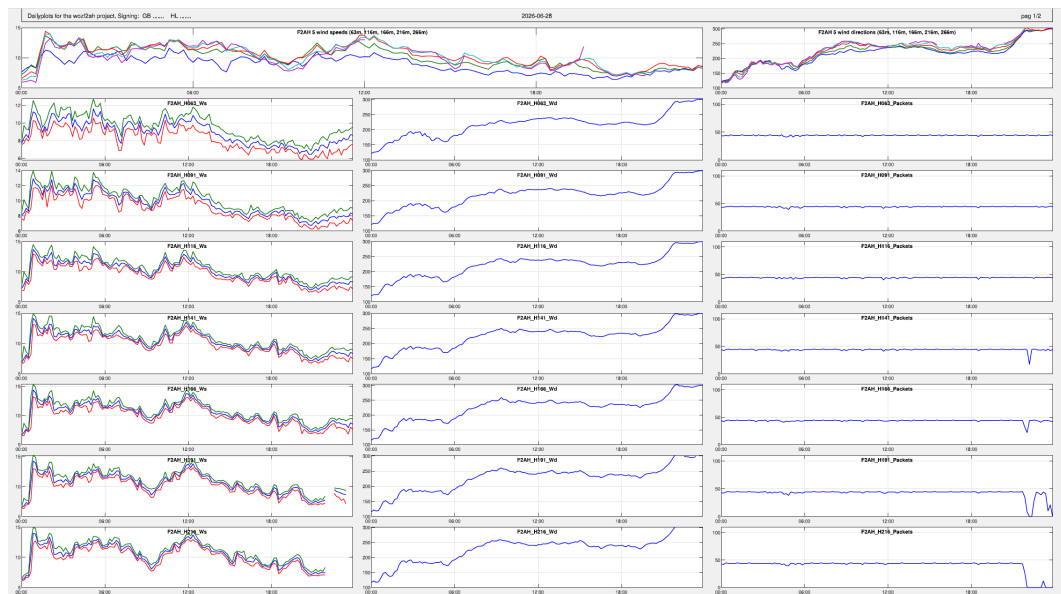


Figure 5.1: Automatically generated and distributed ‘daily-plot’ example of the F2-A-Hanze measurement signals.

5.1 Lidar ZX300M data files

The ZX300M lidar delivers data files in CSV format. Two different files are created by the lidar on a daily basis, one file with the 10-minute statistical data, recognized from the prefix ‘Wind10_’ and one file containing the fast data with prefix ‘Wind_’. Approximately every 1.5 s one height is measured. So with 10 configured measuring heights the refresh rate is close to 15 s. All produced CSV files are transferred on a daily basis to the data server at TNO. Only the 10-minute statistical data is imported into the project database and processed. The fast data is stored and available for further processing when requested.

The complete filename is build up as described below:

Wind10_”ID”@Yyyy_Mmm_Ddd.CSV (Wind_”ID”... in case of the fast data file)

“ID”: ZX300M serial number

yyy: year of data

mm: month of data

dd: day of data

For an overview of the measured signals see Appendix B.

5.2 TNO data base

After data transfer, the data is imported into the project data base and then an automated 'daily-plot', see fig. 5.1, of the measured signals is created. This is distributed by email to the project team as PDF file who evaluate the signals on a daily basis. If needed TNO can perform a post-validation on the data in the database so that a specific data period is marked 'invalid' and is no longer visible.

The wind directional signals are manually corrected for the 180° shifts, see section 5.4.

5.3 Data export F2-A-Hanze

TNO makes the 10-minute statistical data available via the TNO offshore wind measurements website: <https://offshorewind-measurements.tno.nl/en/>. Here you can find the historical data of the lidar measurement campaign, as well as data for the other measurement locations.

The order for export and presentation on the website will be as follows:
F2AH-yyyy-mm.CSV for the previous month(s)

After a quarter is completed the monthly files will be replaced by:
F2AH-yyyy-Qx.CSV (where x stands for the actual quarter)

After the year is completed the quarterly files will be replaced by a yearly file:
F2AH-yyyy.CSV

5.4 Wind direction correction

The ZX300M is a continuous wave, homodyne detection lidar instrument. It changes focus point for every measurement height. Using the Doppler shift in the backscattered data, the absolute value of the wind speed can be determined. However, as a result of the homodyne detection scheme, the sign of the wind speed cannot be determined, which result in a 180° wind direction ambiguity. These shifts are most of the time easy identifiable by looking into the wind direction data. Comparing the data to an available reference wind direction can help to identify the periods in which the direction is off by 180° however at the F2-A-Hanze platform no reference wind direction data is available.

For the wind direction correction an in-house developed tool is used, which helps to identify the shifted periods and efficiently convert the identified periods to wind direction corrections in the project database. This correction is done on a monthly basis before the data is made publicly available.

6 Operational and maintenance aspects

The first TNO lidar at the F2-A-Hanze platform was installed on 18-02-2026. In table 6.1 an overview is given of the used lidar and the start date. Before installation the lidar is verified against an IEC compliant meteorological mast [4]. As defined by TNO's ISO17025:2017 quality system, the lidar should be replaced every three years and serviced every year. All operational aspects with respect to installation and maintenance of the lidar are recorded in the logbook.

Table 6.1: Overview of the installed lidar (s) at the F2-A-Hanze platform.

lidar	TNO code	Period	Reason for replacement
ZX6482	25005279	18-02-2026 to	initial installation

The quality of the signals is checked on a daily basis via the automatically distributed 'daily-plot', see fig. 5.1. Using the manufacturers software Waltz, we can directly connect to the lidar and monitor the measurements and status, see fig. 6.1.

Waltz v6.5 (basic options)

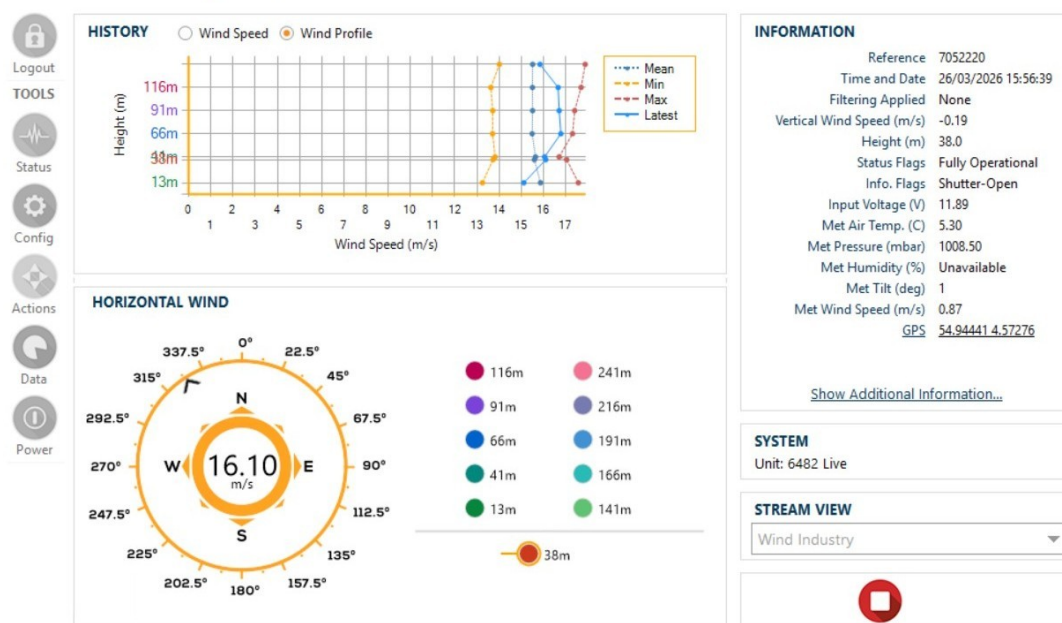


Figure 6.1: Screenshot of ZX Lidars software Waltz.

References

- [1] M. Frederiksen. *THE ESBJERG DECLARATION. on The North Sea as a Green Power Plant of Europe*. Regeringen, May 18, 2022.
- [2] *Kamerbrief aanvullende routekaart windenergie op zee 2030, Den Haag*. DGKE-E / 22235501.
- [3] *Offshore Wind - TNO - Expansion of wind energy at sea*, <https://offshorewind-measurements.tno.nl/en/>.
- [4] G. Bergman. *Verification of the Wind@Sea LiDAR system ZX6482 at the EWTW test site near meteorological mast MM6*. TNO 2026 R10065. TNO, 2026.

Signature

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Author(s)	G. Bergman		
Principal(s)	Ministry of Climate Policy and Green Growth		
Project number	060.63180		
Programme(s)	Wind Energy		
Abstract As part of the ‘2026 Wind Conditions @ North Sea’ project the ZX Lidars ZX300M 6482 lidar is installed at offshore location F2-A-Hanze. This report describes the measurement location, lidar system, installation, data handling and operation and maintenance of the lidar at F2-A-Hanze.			
Task	Name	Role	Signature
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Expert review	H. Links	Engineer	ValidSigned door Harmen Links op 09-07-2026
Generic review	M.F. van Dooren	Project manager	ValidSigned door Marijn van Dooren op 08-07-2026
Authorization	E.D. Nennie	Research manager	ValidSigned door Erik Nennie op 09-07-2026

Appendix A

ZX Lidars ZX300M specifications

Range	10 – 300 metres (Lidar measurement) 0 – 10 metres (onboard met weather station)
Probe length	± 0.07 metres @ 10 metres ± 770 metres @ 100 metres
Height measured	10 User configurable 1 Additional met weather station measurement
Sampling rate	50Hz (up to 50 measurement points every second)
Averaging rate	True 1-second averaging 10 Minute averaging
Accuracy wind speed	0.1 m/s*
Direction variation	< 0.5°

Figure A.1: Measurement specifications.

Service interval	36 months from new
Size	805 x 845 x 966mm
Weight	53.4kg
IP Rating	IP68
Power consumption	55W
Power input	12V
Temperature range	-40 to +50°C
Warranty	3 years
Maintenance	No annual maintenance or calibration in this period

Figure A.2: Product specifications.

Appendix B

ZX300M measured signals

Name	Location	Short name (Signal name)	Sensor	Unit	installed	Freq	Campaign
Height independent signals							
Battery Voltage		F2AH_Battery		V			
Lower temperature inside Lidar		F2AH_Lower_Temp		deg C			
Upper temperature inside Lidar		F2AH_Upper_Temp		deg C			
Relative humidity inside Lidar		F2AH_Pod_Humidity		%			
Relative humidity inside Lidar		F2AH_Met_Air_Temp		deg C			
Lidar met station bearing		F2AH_Met_Compass_Bearing		deg			
Lidar met station relative humidity		F2AH_Met_Humidity		%			
Lidar met station air pressure		F2AH_Met_Pressure		hPa			
Lidar met station tilt angle		F2AH_Met_Tilt		deg			
Lidar met station wind direction		F2AH_Met_Wind_Dir		deg			
Lidar met station wind speed		F2AH_Met_Wind_Speed		m/s			
External supply voltage		F2AH_Generator		V			
LIDAR status flags		F2AH_Status_Flags		-			
LIDAR info flags		F2AH_Info_Flags		-			
Proportions of packets		F2AH_Proportion_Of_Packets_with_Rain		#			
Error flags		F2AH_Proportion_Of_Packets_With_Fog		#			
For every measuring height (m):		xxx : 63, 91, 116, 141, 166, 191, 216, 241, 266, 291					
Horizontal wind speed average		F2AH_Hxxx_Ws		m/s			
Horizontal wind speed std deviation		F2AH_Hxxx_Ws_std		m/s			
Horizontal wind speed minimum		F2AH_Hxxx_Ws_min		m/s			
Horizontal wind speed maximum		F2AH_Hxxx_Ws_max		m/s			
Vertical wind speed average		F2AH_Hxxx_WsV		m/s			
Wind direction		F2AH_Hxxx_Wd		deg			
Turbulence intensity		F2AH_Hxxx_TI		-			
Package in average		F2AH_Hxxx_Packets		#			

Figure B.1: ZX300M measured signals.

Energy & Materials Transition

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