



**EVALUATION REPORT  
SITE CONDITIONS -  
METOCEAN CONDITIONS  
PART B**

PREPARED FOR:

**ENERGINET ELTRANSMISSION A/S**

Order No.: 14772868

Report No.: R14772868-0-3, Rev. 2,  
2024-07-09

Wind Farm: Energy Island North Sea  
Wind Farms

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**DOCUMENT HISTORY**

<b>REVISION</b>	<b>RELEASE DATE</b>	<b>MODIFICATION</b>
0	2023-12-22	Initial Document
1	2024-06-28	Update of references /1.2.14/, /1.2.17/ and /1.2.18/.
2	2024-07-09	Editorial changes.

## 1 DOCUMENTS

### 1.1 Examined Documents

- /1.1.1/ DHI: Report  
"Energy Island, North Sea Metocean Assessment Part B: Data Analyses – Energy Island (Design) Metocean site conditions for detailed design of the energy island",  
Doc. No. 4500087261, Rev. 1.2, 2023-08-09, 163 pages  
(DEWI-OCC Order-No.: 14772868 - Doc No. -00+045)
- /1.1.2/ DHI: Data Folder  
"Digital Appendix A to Metocean Assessment Part B", 15 files  
MD5 checksum: 5617B2BC3BB58ACBCAB51C0DECBE90F6  
(DEWI-OCC Order-No.: 14772868 - Doc No. -00+036)

### 1.2 Noted Documents

- /1.2.1/ DHI: Report  
"Energy Island, North Sea Metocean Assessment Part A: Data Basis – Measurements and Models Establishment of bathymetry, measurements and hindcast",  
Doc. No. 4500087261 Rev. 1.1, 2023-11-20, 163 pages  
(DEWI-OCC Order-No.: 14772868 - Doc No. -00+044)
- /1.2.2/ DANAK: Certificate  
"Accreditation for testing DS/EN ISO/IEC 17025:2017 DHI A/S", 2019-06-24, 2 pages  
(DEWI-OCC Order-No.: 14772868 - Doc No. -00+020)
- /1.2.3/ Fugro: Report  
"SWLB measurements at Energy Islands Project Measurement Plan, All Lots",  
Doc. No. C75486\_Project\_Measurement\_Plan\_All\_Lots 05 Rev. 5, 2022-04-06, 53 pages  
(DEWI-OCC Order-No.: 14772868 - Doc No. -00+012)
- /1.2.4/ DNV GL: Report  
"Independent performance verification of Seawatch Wind Lidar Buoy at Frøya, Norway",  
Doc. No. 10281716-R-2 Rev. B, 2021-05-07, 45 pages  
(DEWI-OCC Order-No.: 14772868 - Doc No. -00+010)
- /1.2.5/ DNV: Report  
"Independent performance verification of Seawatch Wind Lidar Buoy at the LEG offshore platform",  
Doc. No. 10298247-R-1 Rev. A, 2021-07-09, 43 pages  
(DEWI-OCC Order-No.: 14772868 - Doc No. -00+011)
- /1.2.6/ DNV: Report  
"Independent analysis and reporting of ZX Lidars performance verification executed by ZX Lidars at the UK Remote Sensing Test Site",  
Doc. No. 10284581-R-61-A Rev. A, 2021-10-05, 38 pages  
(DEWI-OCC Order-No.: 14772868 - Doc No. -00+013)
- /1.2.7/ DNV GL: Report  
"Independent analysis and reporting of ZX Lidars performance verification executed by ZX Lidars at the UK Remote Sensing Test Site",  
Doc. No. 10284581-R-1 Rev. A, 2021-02-17, 82 pages  
(DEWI-OCC Order-No.: 14772868 - Doc No. -00+014)

- /1.2.8/ DNV: Report  
"WS191 Independent performance verification of Seawatch Wind Lidar Buoy at Frøya, Norway",  
Doc. No. 10332389-R-4 Rev. A, 2022-04-04, 37 pages  
(DEWI-OCC Order-No.: 14772868 - Doc No. -00+017)
- /1.2.9/ DNV: Report  
"ZX862 Independent analysis and reporting of ZX Lidars performance verification executed by ZX Lidars at the UK Remote Sensing Test Site",  
Doc. No. 10284581-R-84-A Rev. A, 2021-11-12, 38 pages  
(DEWI-OCC Order-No.: 14772868 - Doc No. -00+018)
- /1.2.10/ Energinet: Data Sheet  
"Deployment record for Lot 1, North Sea", 1 page  
(DEWI-OCC Order-No.: 14772868 - Doc No. -00+015)
- /1.2.11/ Energinet: Data Sheet  
"Deployment record for Lot 2, North Sea", 1 page  
(DEWI-OCC Order-No.: 14772868 - Doc No. -00+016)
- /1.2.12/ DNV GL: Certificate  
"ISO 9001 Management System Certificate Fugro Norway AS",  
Doc. No. 10000409040-MS-NA-NOR, 2020-12-16, 2 pages  
(DEWI-OCC Order-No.: 14772868 – Doc. No. -00+038)
- /1.2.13/ Fugro: Report  
"SWLB measurements at Energy Islands Project Measurement Plan, All Lots",  
Doc. No. C75486\_Project\_Measurement\_Plan\_All\_Lots 09, Rev. 9, 2023-05-30, 56 pages  
(DEWI-OCC Order-No.: 14772868 – Doc. No. -00+039)
- /1.2.14/ Energinet: Excel-File  
"Stations and deployment record - EINS",  
MD5 checksum: D7ED6B74294B9BEA11E246CD9BA6F4B1, 79 kB  
(DEWI-OCC Order-No.: 14772868 – Doc. No. -00+047)
- /1.2.15/ Energinet: Folder  
"Buoy predeployment validation reports", 11 files  
MD5 checksum: 31C235877CAA7B49E65ED01B63F81E11  
(DEWI-OCC Order-No.: 14772868 – Doc. No. -00+041)
- /1.2.16/ Energinet: Folder  
"Instrument certificates and reports", 103 files  
MD5 checksum: 4E57DF8944CAB3F13F0B921B83C8A57E  
(DEWI-OCC Order-No.: 14772868 – Doc. No. -00+042)
- /1.2.17/ Energinet: Folder  
"Service reports",  
MD5 checksum: F751DC01543860C133EFFBAF40EA631D, 11 files  
(DEWI-OCC Order-No.: 14772868 – Doc. No. -00+048)
- /1.2.18/ DEWI-OCC GmbH: Evaluation Report  
Site Conditions – Measurement Campaign for Wind and Metocean Conditions  
Doc. No. R14772868-0-5, Rev. 1, 2024-06-27, 7 pages

## 2 CERTIFICATION SCHEME

- /2.1/ IECRE OD-502: Operational Document, "Project Certification Scheme", Edition 1.0, 2018-10

## 3 STANDARDS AND GUIDELINES

The conformity evaluation was carried out based on the following standards and guidelines:

- /3.1/ DNV-RP-C205: Recommended Practice, "Environmental Conditions and Environmental Loads", Edition September 2019, amended September 2021
- /3.2/ IEC 61400-3-1: "Wind energy generation systems - Part 3-1: Design requirements for fixed offshore wind turbines", Edition 1.0, 2019-04
- /3.3/ IEC 61400-1: "Wind energy generation systems - Part 1: Design requirements", Edition 4.0, 2019-02

## 4 SCOPE OF EVALUATION

The metocean conditions data analysis (Metocean Conditions Assessment Part B) for the Energy Island North Sea island area documented in chapter 1 shall be evaluated for conformity with IECRE OD-502 /2.1/ with consideration of the additional standards listed in chapter 3.

The documents in 1.1 shall be reviewed for completeness, correctness and consistency.

Measurement validation and the creation of a metocean data basis as well as presentation of design parameters for wind conditions, soil conditions and electrical conditions are not subject of this evaluation report.

## 5 REMARKS

### 5.1 General

The Energy Island North Sea site is located in the North Sea off the Coast of Jutland, Denmark. The location and extent of the artificial energy island are not yet defined.

The documents listed in chapter 1 present the data analysis and determination of design values for the metocean conditions assessment for the Energy Island North Sea island area. The documentation details the results of the assessment for water levels, current conditions, and waves climate well as wind conditions for the purpose of correlation of wind and waves. Additionally, other atmospheric and oceanographic conditions are included. In /1.1.1/ and /1.1.2/ relevant input parameters to be used for the design basis for the offshore energy island structure are presented.

The location of the planned island area is given in /1.1.1/. The metocean assessment is established on the base of a hindcast model which is compared against local and regional measurements. The responsible company "DHI" holds an accreditation for testing according to DS/EN ISO/IEC 17025 /1.2.2/.

Presentation of hindcast models, presentation of measurement data at the project site and validation of models and measurements are not part of the scope of the documents in chapter 1.

Results of the geophysical and geotechnical campaigns and electrical network conditions are not part of this report.

## 5.2 Site Conditions

### 5.2.1 Wind conditions

Wind conditions for the site of the Energy Island North Sea energy island area are given in /1.1.1/.

Wind data was derived on the basis of hindcast modelling, validated with on-site measurements. Wind conditions for the island area were determined as described in /1.2.1/.

Normal wind conditions including the normal wind profile, the normal wind rose, the Weibull distribution and monthly statistics are presented in /1.1.1/ for the location EINS-2. Extreme wind conditions in /1.1.1/ include the extreme wind profile and the directional and omnidirectional distribution of extreme wind speeds for several return periods including 1 year, 5 years, 50 years, 100 years and 1000 years for a height of 10 m and 30 m.

Under consideration of all remarks, wind conditions as detailed in /1.1.1/ are suitable for application in the design basis for the island.

### 5.2.2 Hydrographic conditions

Hydrographic conditions for the site of the Energy Island North Sea island area are detailed in /1.1.1/ and /1.1.2/.

Results are presented for 5 analysis points spread over the project area. A justification is given for the choice of analysis points and their coordinates are included. The location "EINS-2" is chosen for the presentation of design values in /1.1.1/.

Measurements of wind conditions, water levels, wave data and current data at the project site were executed by the company "Fugro" /1.2.3/. Independent testing and verification of the utilized buoys is documented in /1.2.4/ to /1.2.9/. The availability period of the different buoys and replacement of single buoys is presented in /1.2.10/ and /1.2.11/.

The company "Fugro" is not recognized by IECRE as a testing laboratory for wind and metocean measurements. The qualification of the testing laboratory and the involved personnel as well as the quality of the measurement campaign were therefore confirmed by DEWI-OCC on the basis of the additional documentation /1.2.12/ to /1.2.17/. The evaluation of the measurement campaign is documented in /1.2.18/.

Hydrographic data was derived on the basis of hindcast modelling, correlated with on-site measurements and regional measurements.

Water levels, currents and waves for the island area were determined from the hydrodynamic model described in /1.2.1/.

Tidal water levels are presented in /1.1.1/ with reference to mean sea level (MSL). Extreme water levels are given for various return periods including 1 year, 50 years, 100 years and 10000 years.

Normal and extreme current conditions are presented. Current roses are given for total current, tidal current and residual current. Information on applicable current profiles is included in /1.1.1/ as well as an overview of directional and omnidirectional distributions for extreme current speeds at different depths for various return periods including 1 year, 50 years, 100 years and 10000 years.

Wave characteristics are presented in /1.1.1/ for normal and extreme conditions. Wave roses are presented for total waves, wind sea and swell. Various scatter diagrams are given. Directional and omnidirectional distributions for the extreme significant wave height, the peak wave period, the zero-crossing period, the maximum wave height and the maximum crest height for various return periods including 1 year, 50 years 100 years and 10000 years. According to /1.1.1/ wave breaking is expected at the project site and recommendations regarding breaking waves are presented.

Under consideration of all remarks, hydrographic conditions as detailed in /1.1.1/ are suitable for application in the design basis.

### **5.2.3 Other site conditions**

Other site conditions for the Energy Island North Sea island area are detailed in /1.1.1/. They are separated into other atmospheric conditions and other oceanographic conditions.

Given information for atmospheric conditions includes rainfall, air temperature, humidity, solar radiation, lightning and visibility.

Given information for oceanographic conditions includes water temperature, salinity, water density and marine growth.

Under consideration of all remarks, other site conditions as detailed in /1.1.1/ are suitable for application in the design basis.

## **6 INTERFACE TO OTHER EVALUATION MODULES**

- 6.1 The measurement campaign is evaluated in R14772868-0-5
- 6.2 The wind conditions at the site are evaluated in R14772868-0-1
- 6.3 The data basis for metocean conditions at the offshore wind farm and island site (Metocean Assessment Part A) is evaluated in R14772868-0-2
- 6.4 The analysis of metocean conditions at the offshore wind farm site (Metocean Assessment Part C) is evaluated in R14772868-0-4

## **7 CONDITIONS**

- 7.1 Soil conditions and electrical conditions shall be presented in additional expertises and will be evaluated separately.
- 7.2 When additional measurements are available, the results and validation, especially for the long-term site conditions, shall be reassessed and updated.

## 8 CONCLUSION

The metocean conditions data analysis (Metocean Conditions Assessment Part B) for the Energy Island North Sea artificial island area documented in /1.1.1/ and /1.1.2/ was found plausible and in conformity with IECRE OD 502 /2.1/ and the respective technical standards in chapter 3.

There are no objections against the application of the metocean conditions data analysis in the design basis for the Energy Island North Sea artificial island and its structure.

Changes in the metocean condition data analysis shall be approved by DEWI-OCC GmbH; otherwise this report loses its validity.

Bremen, 2024-07-09

Expert in Charge

Rebecca Ley

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