Netherlands Enterprise Agency

Hollandse Kust (zuid) Wind Farm Zone

Wind Farm Sites III & IV

Project and Site Description

October 2018

>> *Sustainable. Agricultural. Innovative. International.*

Contents

Foreword

Since 2016, when the Netherlands began its journey towards firmly adding 3,500 MW of new offshore wind power by end 2023, we have seen remarkable progress. Four tender rounds, totalling 2,100 MW, have now been completed in line with our offshore wind energy roadmap: three in the Borssele Wind Farm Zone (including a 20 MW innovation site tender) and one in Hollandse Kust (zuid) Wind Farm Zone. Our proactive strategy of reducing risk and costs for developers and operators by providing a stable market framework, taking on more of the pre-construction work ourselves, and appointing TenneT to take on all the grid connection infrastructure responsibilities, continues to prove highly successful.

We have learned valuable lessons along the way and, with each tender, we have adapted our approach accordingly to help in our joint efforts with industry to ensure and maintain a downward cost curve for offshore wind power. Our goal was to see costs fall 40% by 2023. That has been achieved ahead of time. Indeed, the first two tenders (for Borssele) under our current offshore roadmap saw some of the lowest prices ever for offshore wind globally. With the 700 MW Hollandse Kust (zuid) Wind Farm Site I and II (HKZWFS I and II) tender, held December 2017, we surpassed all earlier expectations, entering a period of zero-subsidy development for offshore wind in the Netherlands (see Chapter 2).

This is something few had anticipated, even just a year ago. And yet, here we stand: the HKZWFS I and II projects will be the first zero-subsidy offshore wind farms to be operating anywhere in the world. All the companies who participated in the tender (which specified the zero-subsidy nature of the tender) are to be commended for helping us get to such a landmark point in offshore wind history. The final winner, Chinook c.v., a subsidiary of Dutch company Nuon (itself owned by Swedish utility Vattenfall), will now begin the process of working with its supply chain and with TenneT in making the zero-subsidy era of offshore wind power a successful operational reality.

With this Project and Site Description (PSD) for HKZWFS III and IV, we aim to replicate that success, again optimistic that the next 700 MW being offered to tender can also be developed without state subsidy. As this PSD shows, work for the request for tenders is firmly underway. The Netherlands Enterprise Agency, in Dutch known as RVO.nl, has maintained its emphasis on providing more complete and high-quality site data. We have followed a thorough quality assurance procedure for the HKZ site investigations, including verification against applicable standards by accredited certification bodies. DNV GL's overarching certification report confirms the quality of our site investigations (see Chapter 4.11). New with this PSD, is the Archaeological assessment of borehole data (Chapter 4.7). This is phase III in the chain of archaeological studies carried out in the course of the HKZWFZ development. The overall aim of our increased efforts is to further reduce risks for developers and stimulate design optimisation in the tender stage.

The tender round for HKZWFS III and IV will run in the first quarter of 2019. This PSD enables developers interested in participating in the tender to effectively optimise their project designs. The Ministerial Order for the HKZWFS III and IV tender will be published in Q4 2018.

Prospective participants in this tender should note one significant difference to the previous tenders. Part of each site is located in Dutch territorial waters (i.e within the 12 nautical miles zone). This means wind farm operators will have to make payments to the State of the Netherlands for the use of the seabed. The Order for the Seabed Lease will be published later this year.

The final requirements for applications and the legal framework to ensure companies can fully prepare a successful tender submission, and other relevant documents can be found in Appendix A.

Looking long term

Currently, in terms of installed capacity, the Netherlands is the fourth biggest offshore wind energy market in Europe. By end 2017, seven offshore wind farms, comprising 365 turbines and totalling a combined capacity of 1,118 MW, were operating in Dutch waters. By 2022, thanks to the Borssele and Hollandse Kust projects, the Netherlands is expected to top the European market in terms of annual installations and become the third biggest market in terms of cumulative installed capacity, according to WindEurope.

This success in meeting the goals of our offshore wind programme, and the lessons we have learned along the way, are now being shared with nations around the world, thanks to the launch of our international campaign, Wind & Water Works. Reflecting the expertise and professional approach of Dutch companies and government bodies in the field of offshore wind, the campaign was launched at an offshore wind energy master class for ten nations last year and soon after showcased at the WindEurope event in Amsterdam, reaching the 8,000 international policymakers and offshore wind energy experts from around the world who attended. Our hope is that other nations can replicate the success we have seen here in the Netherlands.

Through the Wind & Water Works initiative, we look forward to sharing future progress in the Dutch offshore wind market with our international counterparts too. The Netherlands is taking a long-term approach to offshore wind development, ensuring market and policy stability for project developers, operators, and other stakeholders. We understand that, as well as the Government taking responsibility for site investigations and transmission networks, this long-term approach is a key ingredient to reducing risk and spurring on innovation and investment by the industry.

This is why we are already looking beyond the 2023 timeframe of our current roadmap. The Government has published a second offshore wind energy roadmap, one that looks at the route from 4,500 MW installed in 2023 to 11,500 MW in 2030. This will require 1,000 MW of new offshore wind to be installed each year for seven years.

As Chapter 2 of this PSD notes, whilst public consultations with stakeholders (e.g. environmental and nature conservation and other industries such as shipping, fishing and recreation as well as the wind industry) are to take place to further develop the 2030 roadmap and related legal frameworks, the first wind farm zone expected to be developed under this second roadmap will be Hollandse Kust (west), where a total of 1.4 GW is expected. Preparations by RVO.nl and the transmission system operator, TenneT, for this zone are already underway. Other wind farm zones designated under the 2030 roadmap are the Ten Noorden van de Waddeneilanden (0.7 GW envisioned) and IJmuiden-Ver (4 GW).

The publication of the 2030 roadmap reconfirms our national commitment to providing a robust, cost-effective and sustainable offshore wind market. It is estimated that achieving the goals of the roadmap will involve some €15 billion to €20 billion worth of investments and create 10,000 jobs between 2024 and 2030. The government is already working with (coastal) municipalities, ports and provinces to identify the planning and location possibilities and to seize the associated economic opportunities. There will, of course, also be export opportunities related to the growth of offshore wind energy elsewhere in Europe, as well as in Asia and America.

With all of this momentum, we look forward to working with the sector to expand the industry here in the Netherlands and further afield through the Wind & Water Works initiative. This growth will not just be in terms of installed capacity, but in terms of economic revenue and job creation. The first step is to replicate or improve upon the success of the HKZWFS I and II tender by ensuring all the conditions are favourable for developers to optimise their designs and be successful in bidding for the permit for HKZWFS III and IV. With this PSD, we take that step and again invite companies to join us in making Wind & Water Work for the benefit of us all.

wind & water works®

DNV·GL

STATEMENT OF COMPLIANCE

Statement No.: SC-DNVGL-SE-0190-03691-1

Issued: 2018-03-29

Issued for:

Site Conditions Assessment

of

Wind Farm Zone Hollandse Kust (zuid) (WFS III and WFS IV)

Comprising:

Wind Turbines, Substation and Power Cables

Specified in Annex 1

Issued to:

Netherlands Enterprise Agency

Croeselaan 15
3521 BJ Utrecht
The Netherlands

According to:

DNVGL-SE-0190:2015-12
Project certification of wind power plants

Based on the documents:

CR-SC-DNVGL-SE-0190-03691-0 Certification Report, dated 2018-03-22

Changes of the site conditions are to be approved by DNV GL.

Hamburg, 2018-03-29

For DNV GL Renewables Certification

i.V. Fabio Pollicino
Service Line Leader Project Certification

DAkkS Deutsche Akkreditierungsstelle D-ZE-11053-01-00

By DAkkS according DIN EN ISO/IEC 17065 accredited Certification Body for products. The accreditation is valid for the fields of certification listed in the certificate.

Hellerup, 2018-03-29

For DNV GL Renewables Certification

For

Erik Asp
Project Manager

The accredited certification body is Germanischer Lloyd Industrial Services GmbH, Brooktorkai 18, 20457 Hamburg.
DNV GL Renewables Certification is the trading name of DNV GL's certification business in the renewable energy industry.

1. Objectives and reading guide

1.1 Objectives

This Project and Site Description (PSD) is for any party interested in participating in the planned permit tender for Hollandse Kust (zuid) Wind Farm Sites III and IV (HKZWFS III and IV) in the Hollandse Kust (zuid) Wind Farm Zone (HKZWFZ) in the Netherlands. Compared to PSDs for previous tenders, this one has been streamlined to provide a more direct focus on project specification and development requirements along with site data (including maps and tables) and site investigation results.

This PSD document therefore summarises:

- A description of the site, surroundings and characteristics of HKZWFS III and IV;
- All data collected by the Netherlands Enterprise Agency (RVO.nl) regarding the physical environment of the Hollandse Kust (zuid) area;
- A selection of constraints, technical requirements and grant related issues that are deemed to be most relevant for development of the Hollandse Kust (zuid) area.

This document has been produced for information purposes only and is not intended to replace any legal or formally communicated rules, regulations or requirements. More information on the site studies, including all reports and other deliverables mentioned in this PSD, can be found at ***offshorewind.rvo.nl***.

Readers should note that information relating to the tender and permit process itself, as well as to the overarching legal frameworks and regulatory decisions pertinent to development of offshore wind projects in the HKZWFZ, can be found in Appendix A. Furthermore, publications of relevant law and related bid documents and information can be found for ***www.rvo.nl/windenergie-op-zee***. When the tender is officially opened in first quarter of 2019, the application forms and related bid documents will be available to download at ***www.mijnrvo.nl***

1.2 Reading guide

This PSD for HKZWFS III and IV presents an overview of all relevant project requirements and site information for parties interested in preparing a bid for a permit to build and operate wind farms at these sites. This PSD covers the following aspects in the different chapters:

Chapter 1: **Objectives and reading guide**

Chapter 2: **Offshore wind power development in the Netherlands** - some background information on Dutch offshore wind development to date, including progress on achieving the goals of the offshore wind energy roadmap and tender results for the Borssele Wind Farm Zone and Hollandse Kust (zuid) Wind Farm Sites I and II.

Chapter 3: **Hollandse Kust (zuid) - Site III and IV - site description** - general information on the HKZWFZ, the location, surroundings, its bathymetry (submarine topography), existing cable and pipeline infrastructure, and nearby wind farms.

Chapter 4: **Site Studies** - an updated overview of all the studies, surveys and measuring campaigns performed to date on the HKZWFZ, covering the following:

- Obstructions: Archaeological desk study, Archaeological assessment of geophysical survey results, Archaeological assessment of borehole data, UXO risk assessment desk study;
- Soil: Geological desk study, Geophysical survey, Geotechnical survey, Morphodynamical desk study and a technical note on scour;
- Wind and Water: Wind Resource Assessment, Metocean desk study, Metocean measurement campaign.

Chapter 5: **Offshore grid** - TenneT's work on the offshore grid connection system for the Netherlands, including specific details for HKZWFS III and IV.

Chapter 6: **Specific project requirements and relevant information from the legal framework** - an overview of the most relevant design parameters, coordinates, permit requirements found in the various acts, decrees and Wind Farm Site Decisions (WFSD), described in chapters 3 and 5 and Appendix A. This overview does not replace any legal documents, but it aims to provide information that is relevant to prepare a tender bid submission in first quarter of 2019.

Chapter 7: **Resources for further information** - useful links for further information or help, and a list of applicable documents.

The PSD package also contains three appendices and a magazine on the Hollandse Kust region (published November 2017). The magazine includes a map of the Netherlands with the existing ports and manufacturing base. These can be found as follows:

Appendix A: **Applicable Law**

Appendix B: **Summary of Environmental Impact Assessment HKZWFS III and HKZWFS IV**

Appendix C: **Boundaries and Coordinates HKZWFS III and IV**

Magazine: **Hollandse Kust: where wind and water works**

2.
Offshore wind power development in the Netherlands

The Netherlands started developing wind energy technology in the mid 1970's and has been a key player ever since, both onshore and offshore, along the whole supply chain. In fact, the Netherlands was one of the first countries to install wind turbines offshore: in 1994 the Lely offshore wind farm was installed in the shallow waters of the 'IJsselmeer' and comprised four 0.5 MW NedWind 40/500 turbines which had a rotor diameter of 40 m.

2.1 European leader

Over the last two decades, with continued government support, the contribution of the wind industry to Dutch energy supply has grown steadily. In 1997, total installed (grid-connected) wind capacity in the Netherlands was just 319 MW. By the end of 2017, that total stood at 4,341 MW, with offshore wind accounting for 1,118 MW of that (source GWEC/WindEurope). This makes the Netherlands the fourth biggest market in terms of European cumulative installed grid-connected offshore wind capacity at end 2017, equivalent to a 7% market share. The UK, Germany and Denmark are the three countries currently ahead of the Netherlands.

By 2022, the Netherlands is forecast to be the largest offshore wind market in terms of annual installations and the third biggest offshore wind market in terms of cumulative installed capacity. This is thanks to the approach adopted by the country and the long-term vision of its Energy Agreement for Sustainable Development (Energieakkoord voor Duurzame Groei, 6 September 2013), an agreement signed by 47 Dutch organisations that laid the foundations for a robust, future-proof energy and climate policy for the Netherlands. The Agreement calls for 3,500 MW of new offshore wind power to be installed by 2023, taking cumulative offshore capacity to 4,500 MW. (Find out more about the Energy Agreement for Sustainable Development at *www.energieakkoordser.nl*.)

2.2 Roadmap to 4,500 MW by 2023

In September 2014, the Government published its road map towards 4,500 MW of offshore wind in the Netherlands. This sets out a schedule of tenders offering 700 MW of development each year in the period 2015 - 2019, with all wind farms to be fully operational by 2023. Borssele and Hollandse Kust (zuid) were allocated 1,400 MW each, with 700 MW allocated for Hollandse Kust (noord). A goal to reduce offshore wind costs by at least 40% within that time frame is another key element of the road map.

Table 2.1 Current status of the Netherlands in European offshore wind market

COUNTRY	NO. OF FARMS	NO. OF TURBINES CONNECTED	CAPACITY IN-STALLED (MW)	CAPACITY INSTALLED/ DECOMMISSIONED IN 2017 (MW)
UK	31	1,753	6,835	1,679
GERMANY	23	1,169	5,355	1,247
DENMARK	12	506	1,266	-5
NETHERLANDS	7	365	1,118	0
BELGIUM	6	232	877	165
SWEDEN	5	86	202	0
FINLAND	3	28	92	60
IRELAND	2	7	25	0
SPAIN	1	1	5	0
NORWAY	1	1	2	0
FRANCE	1	1	2	2
Total	92	4,149	15,780	3,148

Source: WindEurope (For NL including Westermeer Wind in the IJsselmeer), not included in the infographic

So far, the tender rounds completed under the road map have been a resounding success. The first two were for a combined total of 1,380 MW in the Borssele Wind Farm Zone (BWFZ), comprising four sites in total. This was followed by 20 MW for innovation projects at Borssele Wind Farm Site V (BWFS V) and 700 MW at Sites I and II of the Hollandse Kust (Zuid) Wind Farm Zone (HKZWFS I and II).

With each subsequent tender, prices have fallen and the reduction of cost achieved represents a major breakthrough globally in the transition to more renewable energy. Significantly, the last of these tender rounds (for HKZWFS I and II) is ushering in an era of subsidy-free offshore wind power for the Netherlands. The hope going forward is that the downward cost curve can be maintained.

2.3 Borssele results

Ørsted won the tender for BWFS I and II, whilst Blauwwind II c.v. (a consortium of Shell, Van Oord, Eneco and Diamond Generating Europe) secured BWFS III and IV. Construction of these wind farms is now well under way and the companies have confirmed their final design plans. Ørsted will use 94 Siemens Gamesa 8.0 MW-167 wind turbines, resulting in a total installed capacity of 752 MW for BWFS I and II. For BWFS III and IV, Blauwwind will use 77 Vestas V164 – 9.5 MW wind turbines, resulting in a total installed capacity of 731.5 MW.

BWFS I, II, III and IV will be operational in 2020. The cost of building and operating these four BWFZ sites is much cheaper than previously estimated. For BWFS I and II, Ørsted bid €72.70 per MWh. Blauwwind II c.v. bid €54.5 per MWh for BWFS III and IV.

The Dutch Government's design of its tender process, the direct role it has taken in doing much of the preconstruction development work, and having the transmission substations and grid infrastructure constructed by TenneT, are key reasons why Ørsted and Blauwwind II c.v. can build and operate the wind farms at these low prices. The favourable site conditions of the Borssele sites (relatively shallow waters, short distance to shore, good seabed conditions and wind speeds) also help drive down cost, for example by enabling the use of conventional monopile foundations. Additional cost savings due to efficiencies of scale are also achieved by building the two projects offered in each tender as if they were one larger project.

At the innovation site Borssele V, the winner of the tender, Two Towers, will build two wind turbines with a combined capacity of 19 MW. In total, the BWFZ will have an installed capacity of TenneT's 1,502.5 MW, meaning almost all the overplanting capacity of Tennet's grid connection systems will be used. [See chapter 5 for more on the offshore grid].

2.4 Zero-subsidy breakthrough with Hollandse Kust (zuid)

For the HKZWFS I and II tender, held in December 2017, the Government decided to invite companies to submit zero-subsidy bids. This decision was made in light of the decreasing bids in the Netherlands (for the Borssele wind farms) and in Denmark as well as companies submitting zero-subsidy bids for similar projects in Germany.

The decision to see if companies could develop projects without the subsidies originally anticipated for the HKZWFZ proved right. On 19 March 2018, Chinook, a limited partnership of Nuon-Vattenfall was confirmed as the zero-subsidy winner for HKZWFS I and II.

These offshore wind farms will be the first built without state subsidy anywhere in the world. From the four zero-subsidy proposals RVO.nl received, Chinook's proposal received the highest score in a comparative assessment. The first wind power is foreseen in 2022.

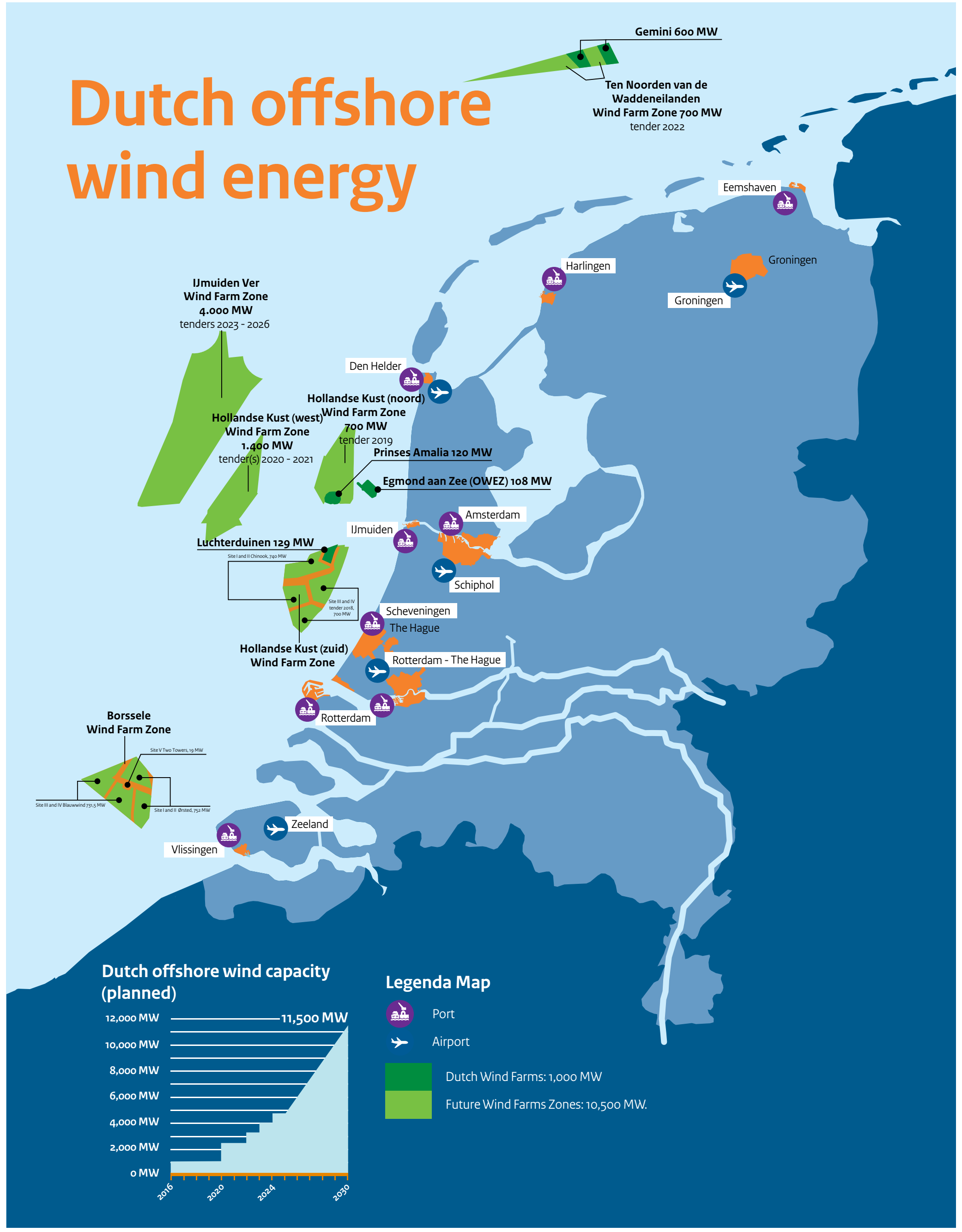
This PSD for HKZWFS III and IV concerns another 700 MW. The final 700 MW planned under the first offshore wind road map is located in the Hollandse Kust (noord) Wind Farm Zone (HKNWFZ) and will be offered for tender to developers next year.

2.5 Looking to 2030

In light of the success of the road map towards 4,500 MW, the Dutch Ministry of Economic Affairs and Climate Policy has announced a roadmap to 2030. This calls for the deployment of an additional 7,000 MW of offshore wind by 2030. This would bring the Netherlands' total offshore wind capacity to 11,500 MW. RVO.nl and TenneT have already started preparations for the first Wind Farm Zone to be developed under the 2030 roadmap, Hollandse Kust (west). The Government foresees 1.4 GW in this zone. The next zone planned under the new roadmap is Ten Noorden van de Waddeneilanden, where 0.7 GW is planned. After this the third zone under the 2030 roadmap, IJmuiden Ver, is planned. Here around 4 GW is planned.

The wind farms in the first two zones will most likely be connected to the grid in a similar way as prescribed under the current road map: using 700 MW platforms, infield voltage level 66 kV, exported to shore with 220 kV AC. RVO.nl will provide a set of site data comparable with those for HKZWFZ and HKNWFZ.

The Government will now conduct a series of public consultations with stakeholders (e.g. environmental and nature conservation and other industries such as shipping, fishing and recreation as well as the wind industry) to further develop the 2030 roadmap and related legal frameworks, including where the final 0.9 GW should be allocated.
The designation of (and corresponding assessment and decision regarding) the new wind farm zones will ultimately be implemented in an amendment to the National Water Plan or under the National Environmental Vision.



Roadmap 2030 schedule

Capacity (GW)	Wind farm zone	Shortest distance from the coast	Tender	Year of commissioning
1.4	Hollandse Kust (west)	51 km from Petten	2020/2021	2024 to 2025
0.7	Ten Noorden van de Waddeneilanden	56 km from Schiermonnikoog	2022	2026
approx. 4.0	IJmuiden-Ver	53 km from Den Helder; 80 km from IJmuiden	2023 to 2026	2027 to 2030

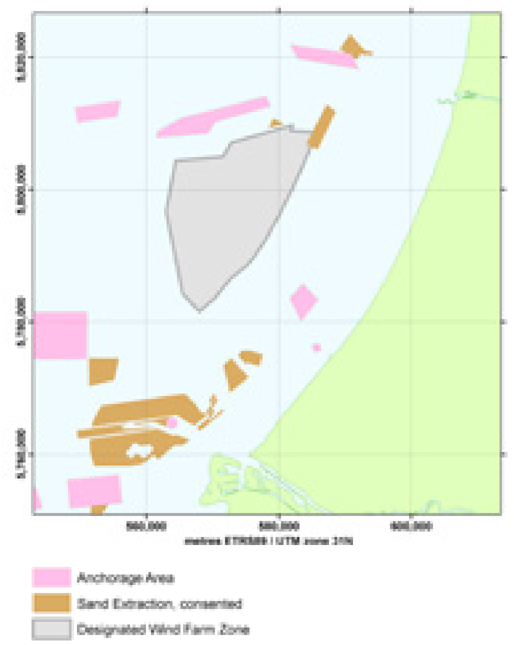
Please note: the schedule assumes the developments will fit within the ecological frameworks and that the permit procedures for the export and supply of electricity into the high-voltage grid will have been completed in a timely manner.

3. Hollandse Kust (zuid) Site III and IV - site description

3.1 General description of the Hollandse Kust (zuid) Wind Farm Zone

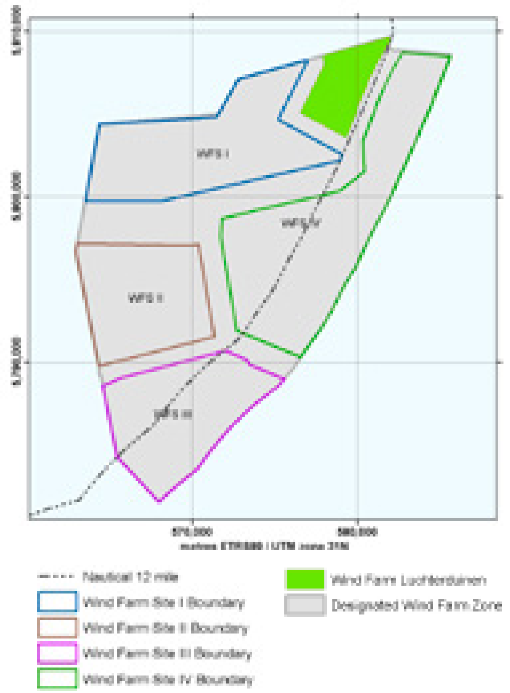
Covering an area of 235.8 km², the Hollandse Kust (zuid) Wind Farm Zone (HKZWFZ) shown below in Figure 3a is a designated wind farm zone located off the province of Zuid-Holland. It is enclosed by the main shipping routes of IJmuiden and Rotterdam and the coastline. There is one sand extraction area bordering the north of the HKZWFZ, while others are in the vicinity of the HKZWFZ. In addition anchorage areas lie to the north and south. The HKZWFZ encloses the Luchterduinen Wind Farm, operational since late 2015, in the north eastern part of the zone (see section 3.3.2 for more information on the Luchterduinen Wind Farm).

Figure 3a *The Hollandse Kust (zuid) Wind Farm Zone and surrounding areas*



Four wind farms are planned for the HKZWFZ in total. This PSD relates to the two projects planned at Wind Farm Sites III and IV (HKZWFS III and IV). The two other wind farms planned, HKZWFS I and II, were tendered in December 2017. In March 2018 Chinook, a limited partnership of Nuon/Vattenfall, was awarded to be the winner of the HKZWFS I and II.

Figure 3b *The Hollandse Kust (zuid) Wind Farm Sites I, II, III and IV*

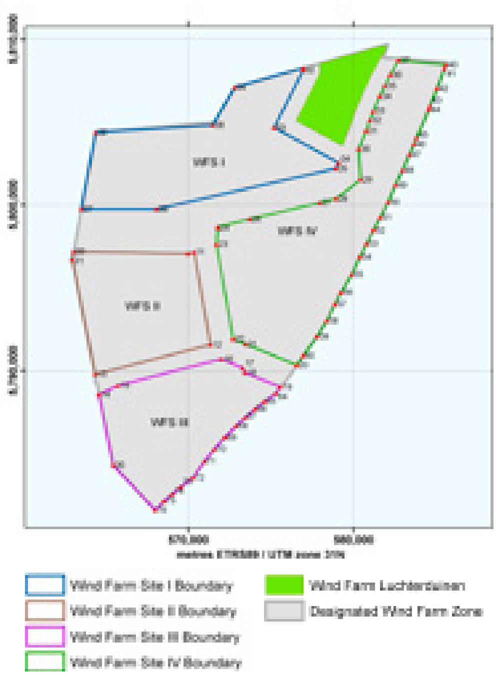


3.2 Layout and coordinates of HKZWFS III and IV

The HKZWFS III covers an area of 53.8 km². The area includes the maintenance zones of infrastructure (active cables crossing the site). This reduces the effective area available for new wind farm construction. On this basis, the effective area available for HKZWFS III is 46.3 km². For HKZWFS IV these areas are 90.1 km² and 63.5 km² respectively. Part of each of these HKZWFS are located within the 12 nautical miles zone. This means wind farm operators will have to make payments to the State of the Netherlands for the use of the seabed. The Order for the Seabed Lease will be published later this year and will be included in Appendix A.

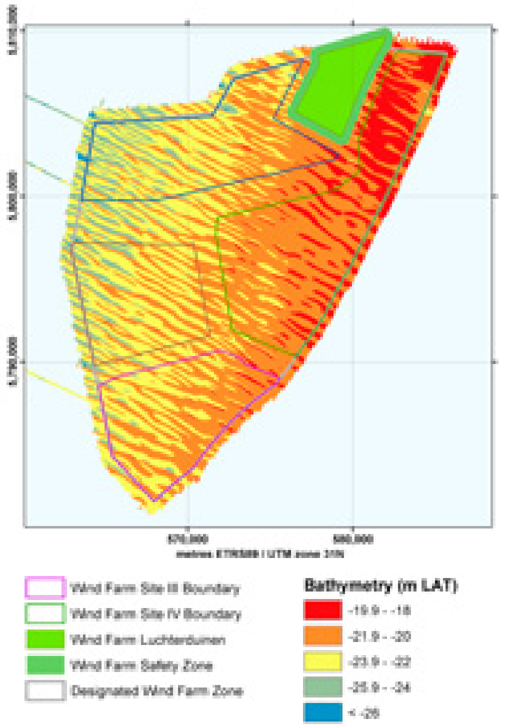
Figure 3c shows the boundaries of HKZWFS III and IV and the Luchterduinen Wind Farm. All coordinates tables for boundaries, maintenance zones, infield cable corridors and safety zones are published in the Memo Boundaries and Coordinates. This memo, published in April 2017, can be found in Appendix C. The memo and related GIS files can also be found on ***offshorewind.rvo.nl***. All figures in this document are based on this reference.

Figure 3c *The Hollandse Kust (zuid) Wind Farm Zone and the corner coordinates of all Wind Farm Sites*



The water depth ranges from 18.1 m to 25.3 m with respect to Lowest Astronomical Tide (LAT) across HKZWFS III and 15.6 m to 24.5 m LAT across HKZWFS IV. The bathymetry of HKZWFS III and IV is shown in Figure 3d and is discussed in more detail in Chapter 4 (Section 4.4.3a).

Figure 3d *Bathymetry of Hollandse Kust (zuid) Wind Farm Zone. Seabed levels are given in metres relative to Lowest Astronomical Tide (LAT)*



3.3 Existing infrastructure

3.3.1 Cables and pipelines

There are planned cables, several active and inactive existing cables and existing pipelines crossing the Wind Farm Zone. These can be seen in Figure 3e, while the characteristics of the different cables and pipelines are described in Table 3a.

An overview of all the existing infrastructure can be found in the GIS files at: ***offshorewind.rvo.nl***.

Figure 3e *Existing infrastructure in the Hollandse Kust (zuid) Wind Farm Zone*

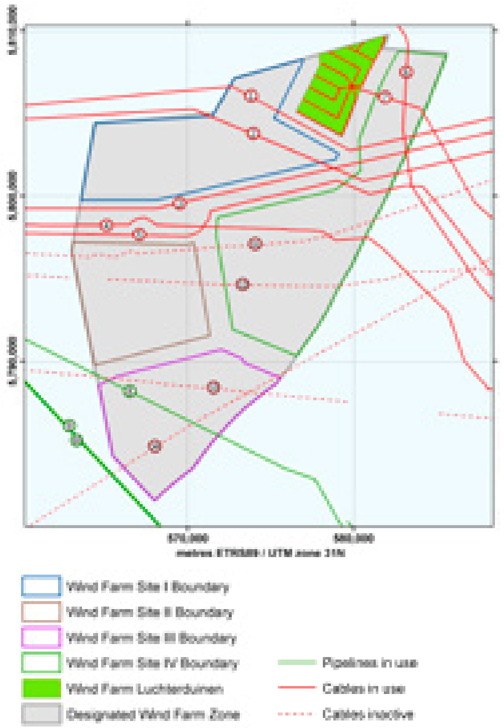
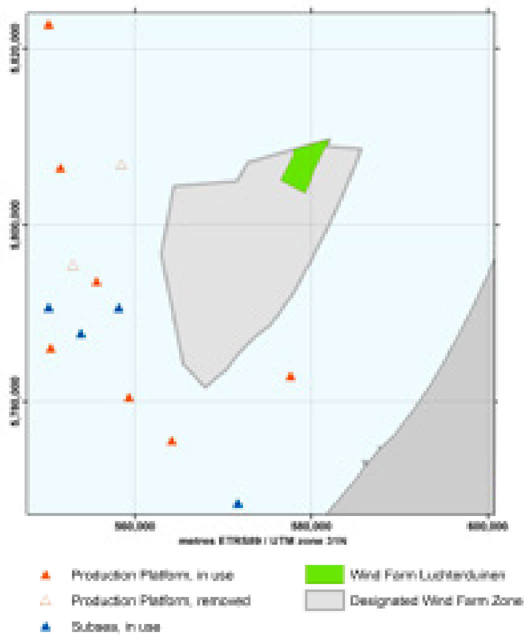


Table 3a *Description of pipelines and cables in the HKZWFZ*

Cables in use	Name	Route	Material	Type	Status
1	Concerto 1 Segment 1 North	Zandvoort (NL) to Sizewell (GB)	Fibre Optic	Telecom	In use
2	Circe 1 North	Zandvoort (NL) to Lowesoft (GB)	Fibre Optic	Telecom	In use
3	Ulysses 2	IJmuiden (NL) to Lowesoft (GB)	Fibre Optic	Telecom	In use
4	TAT14 Segment I	Katwijk (NL) to Saint Valery en Caux (F)	Fibre Optic	Telecom	In use
5	COAM	Cork (IR) to Katwijk (NL)	Fibre Optic	Telecom	Planned
6	TAT14 Segment J	Katwijk (NL) to Norden (D)	Fibre Optic	Telecom	In use
7	Luchterduinen	Noordwijk (NL) to Luchterduinen (NL)	Copper	Electricity	In use
Pipelines in use					
8	PL0228_PR	Q13a-A to P15-C	Pipeline	Oil	In use
9	PL0039_PR	P15-C to Hoek van Holland (NL)	Pipeline	Oil	In use
10	PL0099_PR	P15-D to Maasvlakte (NL)	Pipeline	Gas	In use
Cables inactive					
11	Hermes 1	Zandvoort (NL) to Aldeburgh (GB)	Fibre Optic	Telecom	Inactive
12	UK - NL 6	Katwijk (NL) to Covehithe (GB)	Coaxial	Telecom	Inactive
13	UK - NL 7	Katwijk (NL) to Covehithe (GB)	Coaxial	Telecom	Inactive
14	Concerto 1 Segment 1 East	Zandvoort (NL) to Zeebrugge (B)	Fibre Optic	Telecom	Inactive

Figure 3f *Location of the 43 turbines of the Luchterduinen Wind Farm*

Figure 3g *Oil and gas production platforms in the vicinity of the Hollandse Kust (zuid) Wind Farm Zone*



3.3.2 The nearby Luchterduinen Wind Farm

The Luchterduinen Wind Farm, commissioned late 2015 and operated by Dutch energy company Eneco, is located within the HKZWFZ. The 129 MW wind farm consists of 43 Vestas 3 MW V112 turbines which each have a tip height of 137 m. Figure 3f shows the lay-out of the Luchterduinen Wind Farm's turbines.

Wake effects from the Luchterduinen Wind Farm will have an impact on the energy yield of the wind farms being developed in the HKZWFZ and vice versa. This was the subject of a study by ECN in August 2016 called Scoping analysis of the potential yield of the Hollandse Kust (zuid) wind farm sites and the influence on the existing wind farms in the proximity (see ***www.ecn.nl/publicaties/ECN-E--16-021***). The OWEZ (Offshore Windpark Egmond aan Zee) and Prinses Amalia Wind Farm, located further away from the HKZWFZ, will have negligible impact on the energy production of wind farms in the zone. The wake effects of Luchterduinen on HKZWFS III and IV have been taken into account in the wind resource assessment for the HKZWFZ (see Chapter 4) but the wake effects of sites I and II have not. Appendix C includes detailed information about these wind farms.

3.3.3 Offshore platforms and other near by activities

Several offshore oil and gas production platforms are located in the vicinity of the HKZWFZ, see Figure 3g. Terminal Manoeuvring Areas (TMAs) around Amsterdam Airport (TMA 1 and 2) and Rotterdam Airport (TMA 1 and 3) are also located above the HKZWFZ. These are approach control areas surrounding military and civil airports where traffic approaching the airport is controlled. These TMAs do not impose any building restrictions on the planned wind farms.

3.3.4 Exclusion zones

A 500 m safety zone is defined around the Luchterduinen Wind Farm and the HKZWFZ (see Appendix C). No construction ships or building activities are allowed in this safety zone. Pipelines and cables, including their maintenance zones (500 m on both sides of the pipelines/cables), are also excluded from the different sites (see Appendix C). The turbines need to be constructed and located in such a way that their blade tips are within the site boundaries and outside the maintenance zones. There are not any shipping corridors within the HKZWFZ. However, under the National Water Plan 2016-2021, vessels up to 24 m are allowed to cross the entire area (under conditions).

4. Site Studies

The Netherlands Enterprise Agency (RVO.nl) is responsible for publishing the site information companies require to prepare bids for the permit tenders for the HKZWFZ. The site information package should be of sufficient detail and quality to be used as input for preliminary engineering design studies.

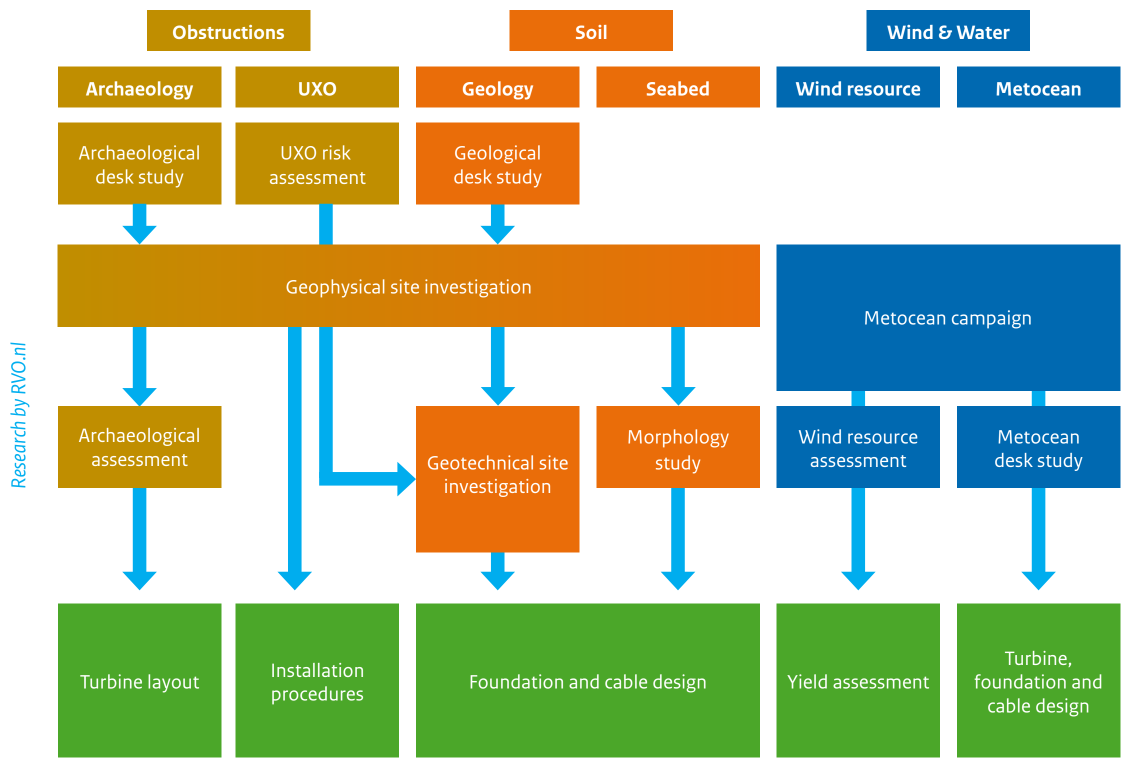
Results from previous tenders show that this approach will provide the basis for an optimal tender result. In providing a more comprehensive data package, risk is significantly reduced for the developer, as is the need for conservatism in the assumptions of the tender design, while the business case for the project and the overall planning can be optimised. In this chapter, the scope of work and results of the individual studies and investigations are summarised, covering the following:

- Obstructions: Archaeological desk study, Archaeological assessment of geophysical survey results, Archaeological assessment of borehole data, UXO risk assessment desk study;
- Soil: Geological desk study, Geophysical survey, Geotechnical survey, Morphodynamical desk study and a technical note on scour and scour mitigation;
- Wind and Water: Wind Resource Assessment, Metocean measurement campaign, Metocean desk study.

Figure 4a shows how the various studies and investigations relate to each other as well as to which element of the wind farm design they feed into.

The findings of the archaeological, UXO and geological desk study were used to define the scope of work and basis of the geophysical site investigation. The results of this more detailed geophysical site investigation refine and partly supersede those of the three earlier desk studies and further feeds into the main archaeological assessment, the geotechnical site investigation and the morphodynamical study. Meanwhile, the wind resource assessment takes into account the findings of the metocean measurement campaign. This PSD for HKZWFS III and IV includes a summary of the results of all final studies and site investigations.

Figure 4a *Site studies and investigations for the Hollandse Kust (zuid) Wind Farm Zone*



In the remainder of this Chapter, we provide an overview of the site studies and investigations. In sections 4.1 - 4.9 we discuss the studies and investigations regarding obstructions and soil conditions, while in sections 4.10 - 4.12, the studies and investigations relating to wind and water conditions (metocean measuring campaign, metocean desk study and Wind Resource Assessment) are discussed. Lastly, a detailed overview of the approach, the procurement of the studies and quality assurance follows in section 4.13 (site investigations quality and certification).

4.1 Archaeological desk study

4.1.1 Overview - aims, objectives and approach

The purpose of this study was to provide insight into any archaeological aspects that may have an impact on the development of the HKZWFZ using existing data and information gathered from previous research in the area. The main objectives of the study were to:

1. Assess whether archaeological remains (e.g. plane and ship wrecks or prehistoric life) are (or likely to be) present at the HKZWFZ;
2. If present, present the known information (location, size and dating) of these remains;
3. Assess possible risks of offshore wind farm installation on these remains;
4. Assess options to mitigate disturbance on these remains;
5. Determine whether further archaeological assessments should be carried out and make a recommendation on the scope of future investigations;
6. Specify obligations and requirements for any activity carried out in the wind farm zone (including site investigations or monitoring activities, installation activities and operational activities) that may affect the archaeological aspects.

4.1.2 Supplier

Periplus Archeomare was assigned by RVO.nl to conduct a maritime archaeological assessment of the HKZWFZ. This company has a track record in maritime archaeological preparatory research, most notably the archaeological deskstudy and assessment of geophysical data for the Luchterduinen Wind Farm and a desk study for a fibre optic subsea cable to be installed later, both of which are located within HKZWFZ.

4.1.3 Results

The results of this desk study indicated that, within the HKZWFZ as a whole, the presence of ship and plane wrecks (mostly resulting from WWII) is likely.

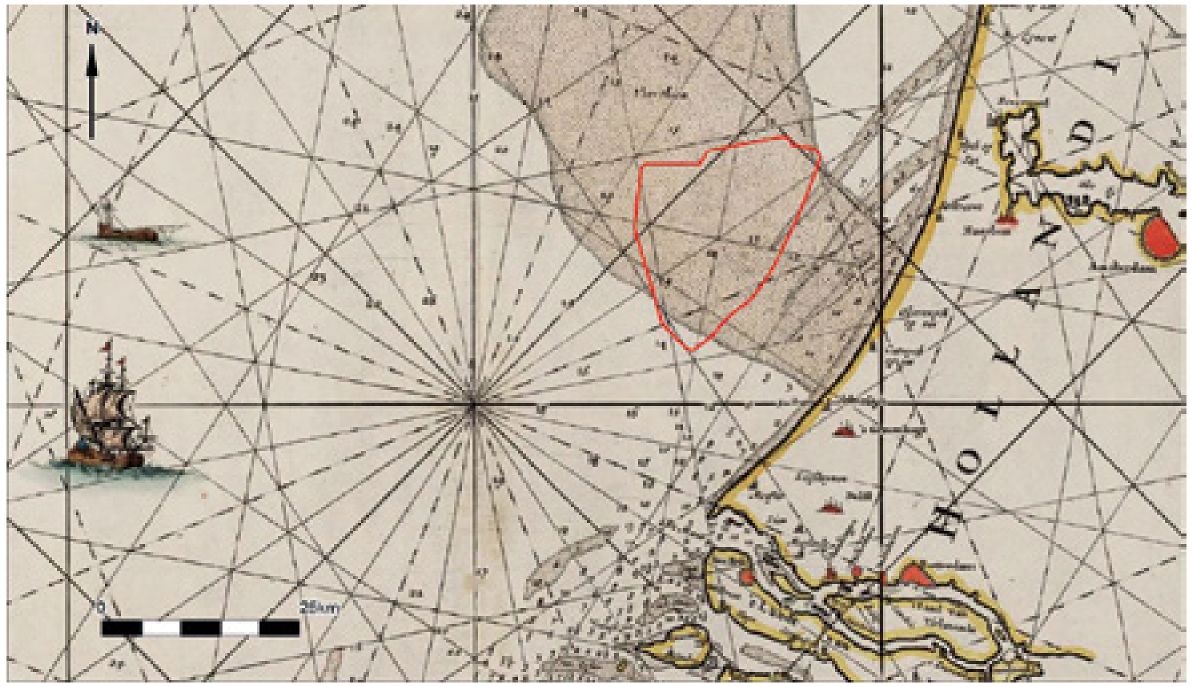
The desk study also concluded that locally, in situ remains of prehistoric sites may also be present. Meantime, Periplus Archeomare found two previous geophysical surveys of the area - one covering 5% of the area for the Luchterduinen Wind Farm and the other for Delta Hydrocarbons (2% of survey area). Just three objects were classified as of possible archaeological value, all identified in the Luchterduinen survey. Over 90% of the surface of the HKZWFZ has not previously been investigated by detailed geophysical surveys.

Figure 4b *The maritime archaeological desk study of the Hollandse Kust (zuid) Wind Farm Zone suggested that 19 known shipwrecks could be present in the area. However none of these were detected in the geophysical survey*

4.1.4 Conclusions and recommendations

Within the investigated area of the wind farm zone there is a high probability for the presence of (remains of) ship and plane wrecks, mostly resulting from WWII. During the geophysical survey no objects have been detected in HKZWFS III. In HKZWFS IV, five objects known from the NCN database, have been found. Moreover one cluster of objects which is considered to be of potential archaeological interest has been found exposed at the seabed in HKZWFS IV; this location was not known from reference databases. And finally one buried magnetometer contact in HKZWFS IV is labeled to be of potential archaeological interest.

Figure 4c *Historic chart of the Hollandse Kust (zuid) Wind Farm Zone and its surroundings*



Periplus Archeomare recommended that further exploratory field investigation should be conducted in order to:

- Map the locations of known and unknown wreck sites in detail to be able to assess their archaeological value; and
- Create an inventory of the parts of the HKZWFZ which have not been investigated in previous surveys.

The findings of this desk study have served as a starting point for subsequent investigation, most notably the geophysical site investigation (section 4.5) and, following that, an archaeological assessment of the geotechnical site investigation (section 4.7). The results of this desk study are now to a large extent superseded by the findings of these reports.

4.2 Unexploded ordnance (UXO) risk assessment desk study

4.2.1 Overview - aims, objectives and approach

The UXO desk study provided the initial insight into the risk of encountering unexploded ordnances (UXOs). The main objectives of this study were to:

1. Identify risks and/or constraints for offshore wind farm related activities in the HKZWFZ as a result of the presence of UXOs;
2. Identify areas within the HKZWFZ where wind farm construction or cable installation should be avoided;
3. Identify requirements from a UXO perspective that should be taken into account for:
   - Determining the different sites in the wind farm zone
   - Carrying out safe geophysical and geotechnical investigations;
   - Safe installation of wind turbine foundations;
   - Safe installation of cables.

The UXO desk study was performed in Q4 of 2015. In Q1 of 2017 the study was extended with an additional report containing newly available information from historical archives of the Bundesarchiv-Militärarchiv in Germany and The National Archives in the United Kingdom. The new information provides more details regarding the type of ordnances (mines) to be expected in the area and recommendations for UXO detection operations that follow from this new information.

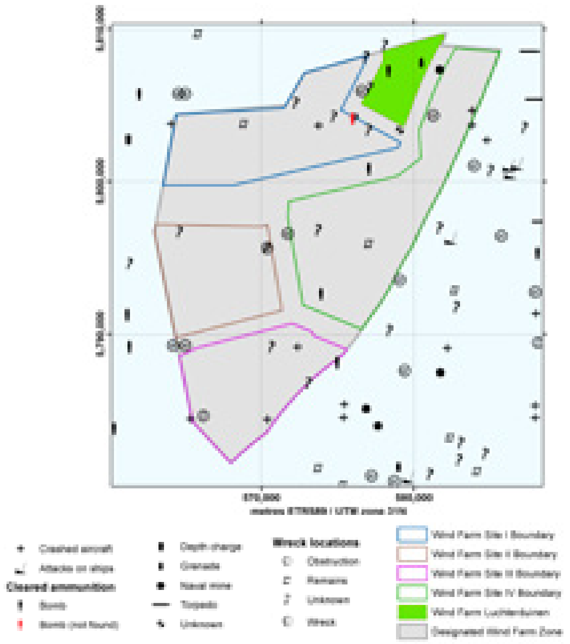
4.2.2 Supplier

REASeuro performed the UXO desk study including the additional report. The company is specialised in (offshore) UXO desk studies, risk assessments and UXO clearance operations. Since 2012, REASeuro has been involved with several offshore projects in the North Sea and Persian Gulf, performing data analysis, project risk assessment and coordination of UXO clearance activities. Moreover, the company has performed the UXO desk study for the Borssele Wind Farm Zone, the previous tender location of the Dutch offshore wind rollout.

4.2.3 Results

The HKZWFZ and surrounding areas were the scene of many war-related activities during World War I and World War II. Additional historical research has shown that intense mining operations took place in and near the HKZWFZ in World War I and in World War II, but the mines were only partially recovered after the war. In addition, the HKZWFZ is located slightly north of the main flight path of allied bomber raids - many bombs were dropped and a large number of aircraft have crashed in the North Sea. As a result many bombs, wrecks and crashed aircraft are likely to be found in the HKZWFZ. A few types of mines that may be present in the HKZWFZ, according to the consulted historical sources, are German moored mines, German LMB ground mines, British Mark XIX contact mines and British Mark XVII moored mines.

Figure 4d *An overview of all known wreck locations and cleared ammunition in the vicinity of HKZWFZ*



It must be taken into account that this overview is based on the minefields actually present in (the vicinity of) the area of investigation. Since the war, some ordnances are likely to have moved as a result of fishing, wave and current loads and seabed dynamics. The entire wind farm zone is considered a UXO risk area. This conclusion is supported by the fact that since 2005 fishermen have found eight UXOs within the HKZWFZ. However the types of mines mentioned in the additional research are considered the most plausible types of mines to be present. An overview of all known wreck locations and cleared ammunition in the vicinity of HKZWFZ can be found in figure 4d. Note that locations of crashed aircraft are only indicative.

A UXO can be sensitive to hard jolts, change in water pressure and accelerations with an amplitude >1m/s². Detonation can lead to serious damage to equipment and injuries to crew members. The possible presence of UXOs in the area, however, is no constraint for offshore wind farm related activities. With proper UXO risk management strategies, risks can be reduced to a level that is as low as reasonably practicable (ALARP).

A main challenge in UXO risk management at HKZWFZ is the dynamic character of the seabed (see section 4.8, morphodynamical desk study). This may cause UXOs that were buried during preliminary scanning to resurface and become subject to migration. Also sand dune migration may have led to burial of UXOs. Furthermore, migration of UXOs may occur as a result of waves and currents or fishing activities. The possibility of UXO migration and burial needs to be considered in all development phases and closely integrated into the UXO risk management strategy.

The report provides a number of recommendations to manage UXO risks in each development phase:

1. Preparation phase
   a. A geophysical survey should be conducted to assess geomorphology and identify objects, consisting of at least a high-resolution multibeam and side scan sonar. This has now been completed, with the results now superseding those of this UXO desk study - see section 4.4.
   b. In case of any soil intrusive operations (e.g. anchoring, CPTs or boreholes), a UXO search of the area of planned activity should be conducted and any discovered UXOs should be cleared or avoided. The clearance operation should be conducted by a certified UXO clearance company (see 4.2.5).
2. Execution Phase
   a. A UXO-related risk assessment should be prepared based on the first draft of the wind farm design and optimisation of the design may be performed based on the outcomes.
   b. A UXO risk mitigation strategy should be prepared, which includes a search for and safe removal of UXOs within the areas of planned activity. Because the validity of the collected data is time-limited, it is recommended that the period between the survey and installation work is minimised.
3. Operational phase
   a. After completion of construction activities, it is still important for developers to remain vigilant and remember that UXOs can migrate as a result of loads from tidal currents and waves, mobility of sand waves and seabed usage
   b. Produce a UXO maintenance and monitoring plan.

4.2.4 Conclusion and recommendations

UXOs from both world wars are likely to be present at the site, which is therefore considered a UXO risk area. Due to the types and sizes of UXO likely to be present there is no 'silver bullet solution' for the UXO geophysical survey. Especially the possible presence of non-ferrous ground mines (LMB) might necessitate a combination of geophysical survey methodologies to mitigate UXO related risks to a level that is considered ALARP. The provisional thresholds in the geophysical survey needed to mitigate the risk to a level that is considered ALARP are set.

Due to the highly dynamic soil morphology and possible associated migration and burial of UXOs, it is recommended companies conduct UXO search (and removal) operations immediately prior to construction activities at the intended construction locations. The limited temporal validity of the collected survey data should be taken into account when planning survey and construction operations. Due to the time-limited nature of findings and the required survey demands (dense grid spacing), a dense magnetometer survey to detect UXOs was not part of the geophysical survey performed by RVO.nl. However, the survey does include a magnetometer survey on a grid spacing of 100 m.

4.2.5 UXO removal procedure

If a wind farm developer identifies a UXO at a location where activities are planned, it needs to be removed. This should be reported to the Dutch Coastguard. The Royal Netherlands Navy will dispose of the UXO. No disposal costs will be charged to the wind farm developer.

4.3 Geological desk study

This study was the starting point for several other studies. However, more in-depth geophysical and geotechnical site investigations have since been conducted hence the desk study is not described further in this PSD.

4.4 Geophysical survey

4.4.1 Overview - aims, objectives and approach

Following up on the findings of the geological desk study and the archaeological desk studies (discussed earlier in this chapter), the objective of the geophysical survey is to provide more detailed, accurate soil information for developers planning to submit tenders for HKZWFS III and IV.

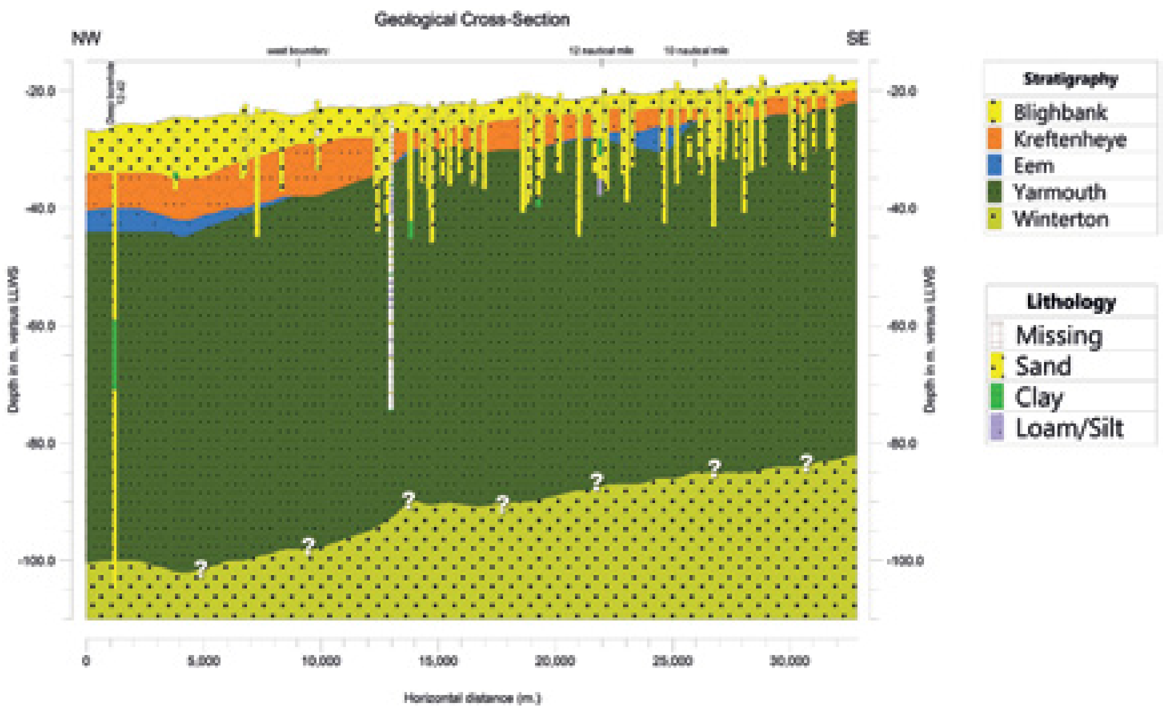
The geophysical survey is designed to improve the bathymetrical, morphological and geological understanding of HKZWFS III and IV. Furthermore, the geophysical results were used for the planning of the geotechnical campaign, which was integrated with the geophysical data to create a ground model. The ground model will serve as the base for the design and installation of support structures and cables.

Specifically, the aim of the geophysical survey was to:

1. Obtain an accurate bathymetric chart of the development areas HKZWFS III and IV;
2. Identify or confirm the position of wrecks, pipelines, possible electrical cables, and natural objects;
3. Produce isopach charts showing the thickness of the main geological formations including any mobile sediments and any other significant reflector levels which might impact on the engineering design;
4. Locate and identify any structural complexities or geo-hazards within the shallow geological succession such as faulting, accumulations of shallow gas, buried cables, etc;
5. Provide detailed geological interpretation showing facies variations and structural feature changes via appropriate maps and sections;
6. List the exact position of existing (active & inactive) cables and pipelines;
7. Provide proposed positions for a geotechnical sampling and testing programme following the completion of the geophysical survey;
8. Prepare a comprehensive interpretative report on the survey results in order to assist design of the offshore foundations/structures and cable burial and assist in the preparation of the geotechnical investigation (discussed in section 4.6).

The survey itself was carried out from 7 March to 18 April 2016, using the survey vessels MV Fugro Pioneer and MV Victor Hensen with Scheveningen used as the main reference port. The equipment used in this campaign was state-of-the-art and included sidescan sonar (SSS), single beam echo sounder (SBES), multibeam echo sounder (MBES), pinger (SBP), ultra high resolution (UHR) multi-channel and single channel seismic (SCS) and magnetometer (MAG). The approach towards the geophysical survey for the HKZWFZ was therefore similar to the one adopted for the Borssele Wind Farm Zone. An important distinction, however, is the application of UHR MCS with a mix of two seismic sources: this improves the resolution in the shallow subsurface.

Figure 4e *Geological Cross Section of the HKZWFZ*



4.4.2 Supplier

Fugro Survey B.V. was contracted by RVO.nl to conduct the geophysical survey for HKZWFZ. Fugro is an integrator of geotechnical, survey, subsea and geosciences services.

Services are designed to support engineering design and large structure building projects. The company has previously performed investigations for offshore wind farm projects in The Netherlands, Belgium, United Kingdom, Denmark and Germany. The company is familiar with the local conditions and technical requirements for a geophysical survey of the HKZWFZ. DNV GL was contracted to review the study results and provide a Verification Report.

4.4.3 Results

4.4.3a Bathymetry and seabed features

The bathymetry data from the geophysical survey shows water depth ranging from 18.6 m to 25.3 m bLAT across HKZWFS III and 15.6 m to 24.5 m bLAT across HKZWFS IV, whilst the seabed for both sites is characterised by very large sand dunes. These dunes were observed throughout both areas with NW to SE trending crests with wavelengths ranging from 300 - 1000 m for HKZWFS III and 300 - 1100 m for HKZWFS IV, and height ranging from 2 - 6 m for HKZWFS III and 2 - 4 m for HKZWFS IV. At both sites, medium sized dunes are superimposed on the very large dunes and have the same crest orientations. They have 4 - 20 m wavelengths and are typically 0.1 - 0.4 m in height. The very large sand dunes are expected to migrate at a rate of 2 - 4 m/year in a north-easterly direction.

The shallow sub-surface geological conditions within the survey areas for HKZWFS III and IV were interpreted based on single channel and multichannel UHR sparker data and information from BGS standard geological maps. The limit of interpretation of the UHR data to achieve satisfactory results was set at a depth of 100 m below seabed. Four lithological units were identified in each area with generally similar results identified across the two sites: sediments found within the two top units/layers at both HKZWFS III and IV mostly consist of medium to coarse sand with shells and shell fragments, silt, clay and gravel. These were all also found in the lower two units although generally they tend to be of a finer consistency (material) here. Thin layers of peat were also detected in these lower level units at both sites.

4.4.3b Wrecks, cables and pipelines

In order to confirm and/or identify the presence of wrecks, cables and pipelines at HKZWFS III and IV, Fugro was provided with a database listing those believed to be in the vicinity. Fugro was also provided with the desk studies previously mentioned in this chapter. Key results of its geophysical survey were:

- One wreck was found at HKZWFS III, while no wrecks were found at three wreck database positions.
- Four wrecks were found at HKZWFS IV, while no wrecks were found at three wreck database positions.

One pipeline was known and confirmed present at HKZWFS III (ENGIE Q13a-A to P15-C 8 inch oil pipeline). No pipelines are present at HKZWFS IV. Two inactive telecom cables were also confirmed in the HKZWFS III area, along with five active and three inactive telecom cables in the HKZWFS IV area. These had been listed in the database provided.

The survey reports for both sites note the reason why the known wrecks were not detected may be due to the strong currents and sediment movements (i.e. sand dune migration) in the area that can bury or relocate possible objects on the seabed. Moreover, wreck locations are seldom reliable as often their final positions are 'last known' or 'mayday' positions instead of the actual sinking location. These positions are also often derived from less accurate positioning systems.

The geophysical survey identified several seabed and sub-seabed geohazards at both sites. For example, at both sites, high seabed gradients up to 20° are found on the leeside of the very large dunes. Meantime, in the HKZWFS III survey area 96 SSS contacts and 585 magnetometer contacts were detected. Similarly, in the HKZWFS IV area 234 SSS contacts and 860 magnetometer contacts were found. At HKZWFS III, the SSS contacts were observed scattered across the survey areas and were interpreted as debris items except for 38 high backscatter patches that might have originated from local reworking of sediments and four boulders. At HKZWFS IV, 111 of the SSS contacts were high backscatter patches and 19 boulders were identified. The remaining contacts were assessed to be debris.

Meantime, in terms of the magnetometer contacts, at HKZWFS III the magnetic anomalies ranged from 1 to 4,018 nT, whilst at HKZWFS IV they ranged from 2 to 11,235 nT. Most of the strongest anomalies are associated with the buried cables or pipelines, the survey report says. It adds that unknown, high amplitude magnetic anomalies were observed across both sites.

At sub seabed level, when assessing Palaeochannel infills, numerous buried channels were also detected in seismic Unit B (Kreftenheye Fm - Upper Pleistocene) at both wind farm sites. In this regard, the survey notes that fluvio-glacial /delta front channel infills are expected to be highly heterogeneous and can pose an engineering hazard due to lateral changes in mechanical resistance. Coarser sediments or gravel layers were also identified within seismic Unit C (Brown Bank Member/ Eem Fm - Upper Pleistocene) in both HKZWFS III and IV survey areas, showing high amplitude reflections. In Unit C of HKZWFS IV some localised, high amplitude, reversed polarity reflectors were observed, possibly related to the presence of shallow gas and/or peat layers.

No features suggesting the presence of shallow gas or peat layers were observed in HKZWFS III. As mentioned earlier in this section, the geophysical results were used for planning a geotechnical campaign (see section 4.6). The geological interpretation from the geophysical survey was integrated with the results of the geotechnical assessment of the geophysical survey results campaign to produce a ground model for the wind farm site. The presence of gravel layers and their thickness were confirmed by the geotechnical campaign. Meanwhile, an archaeological assessment of the geophysical data reported in the geophysical survey has been performed (section 4.5).

4.5 Archaeological assessment of geophysical survey results

4.5.1 Overview - aims, objectives and approach

Periplus Archeomare was asked to conduct an archaeological assessment (phase II) of the geophysical results to further investigate the presence of archaeological remains in the HKZWFZ.

The goals set for this assessment were:

1. To determine the historical or archaeological value of contacts found in the geophysical survey;
2. To validate the locations of known wrecks; and
3. Assess the prehistoric landscape based on the seismic data.

4.5.2 Supplier

Periplus Archeomare was contracted by Fugro Survey B.V., on behalf of RVO.nl, to conduct an archaeological assessment of the geophysical survey.

4.5.3 Results

Periplus Archeomare's analysis of the geophysical survey concluded that no objects of potential archaeological interest were found at HKZWFS III. Six objects known from reference databases were expected in the area of HKZWFS III. None of these known objects has been detected with SSS or MAG. Alike HKZWFS III six objects known from reference databases were expected in the area of HKZWFS IV. Five of these known objects have been found; one was not found. In addition to those five known objects one, until now unknown cluster of exposed objects was found with SSS and one buried object was found with MAG. Periplus Archeomare suggests these could simply be covered with sediments however.

The Periplus report advises a buffer zone of 100 m should be applied around the few objects found which have yet to be determined to have no archaeological value. This also applies to cable trenching and anchorages of work vessels. The buffer zone may be reduced if it can be substantiated that the applied activity and disturbance has no effect on the archaeological object. For example, when no anchoring is used during cable lay operations the buffer zone can be decreased. Reduction of the distance may be obtained after consultation with Rijkswaterstaat on behalf of the Ministry of EZK and their advisor the Cultural Heritage Agency.

A number of magnetic anomalies have also been observed in phase II that cannot conclusively be related to known pipelines and cables, or visible objects at the seabed surface. They are related to unknown ferrous objects buried in the seabed, covered by sediments, and some have an amplitude of 50 nT or more. Whilst installing wind turbines and the various inner field and export cables, the report advises developers to avoid areas where these buried ferrous objects have been identified, again by implementing a 100 m buffer zone.

If it is not feasible to avoid the reported magnetometer locations with such a buffer zone, additional research should be conducted to determine the actual archaeological value of the reported locations, the report says. It also suggests that any UXO research conducted within 100 m of those magnetometer anomalies with an amplitude of 50 nT or more are carried out under on-board archaeological supervision. Depending on the outcome of the UXO research, it can be decided if additional research (for instance by means of ROV or dive investigations) is needed. If the UXO research indicates the object has no UXO risk, the location can be omitted.

Pre-historic remains

The report confirms that in situ remains of prehistoric settlements are expected to be located, or found, in the HKZWFS IV. In the course of the site investigations, borehole samples are being taken. It was advised to look at these samples from an archaeological perspective. This is being executed - see Chapter 4.7, 'Archaeological assessment of borehole data'.

Finally, the report notes that during the installation of the wind turbines and cable lay operations, archaeological objects may be discovered which were completely buried or not recognised as an archaeological object during the geophysical survey. Periplus Archeomare recommends passive archaeological supervision based on an approved Program of Requirements. Passive archaeological supervision means that an archaeologist is not present during the execution of the work but always available on call. Following this recommendation would prevent delays during the work when unexpected archaeological remains are found. In accordance with the law on cultural heritage (Erfgoedwet), those findings must be reported to the competent authority. This notification must also be included in the scope of work.

4.6 Geotechnical survey

4.6.1 Overview - aims, objectives and approach

The primary aim of the geotechnical campaign is to validate the geological model resulting from the geophysical investigation and to confirm the soil engineering properties at HKZWFS III and IV required by developers to progress with their geotechnical foundation designs and other general design and installation requirements for the wind farm, as well as those relating to cable installation.

As with the Borssele wind farm sites, the geotechnical survey for HKZWFS III and IV used intrusive techniques to gain an insight into the characteristics of the subsoil. Two general types of measurements were performed: cone penetration tests (CPT) and boreholes.
The field investigations and laboratory tests have been completed. The results of the survey will be used to:
- Further develop and confirm the geological and geophysical model for HKZWFS III and IV;
- Determine the vertical and lateral variation in seabed conditions;
- Provide the relevant geotechnical data for design of the wind farms, including (but not limited to) foundations and cable installation; and
- Update the geological desk study and provide a geological model.

4.6.2 Key changes to improve data quality

There are some key differences in the approach taken to defining the site investigation for Hollandse Kust (zuid) when compared to the procedures adopted for Borssele. This follows feedback from developers after the tenders for the Borssele Wind Farm Zone projects. The aim is to provide more detailed, higher-quality, information, cut risks further, and save time by limiting the need for the developers who win contracts to conduct too many further geotechnical site investigations in the post-tender phase

For example, the amount and type of boreholes were selected with the specific aim of avoiding the need for additional boreholes in the post-tender phase when the company awarded with the contract and subsidy for the project is in the detailed design stage. For Borssele, developers indicated that in the post-tender phase (after winning the tender) additional geotechnical investigations for detailed design purposes were on the critical path towards reaching financial close of the project.

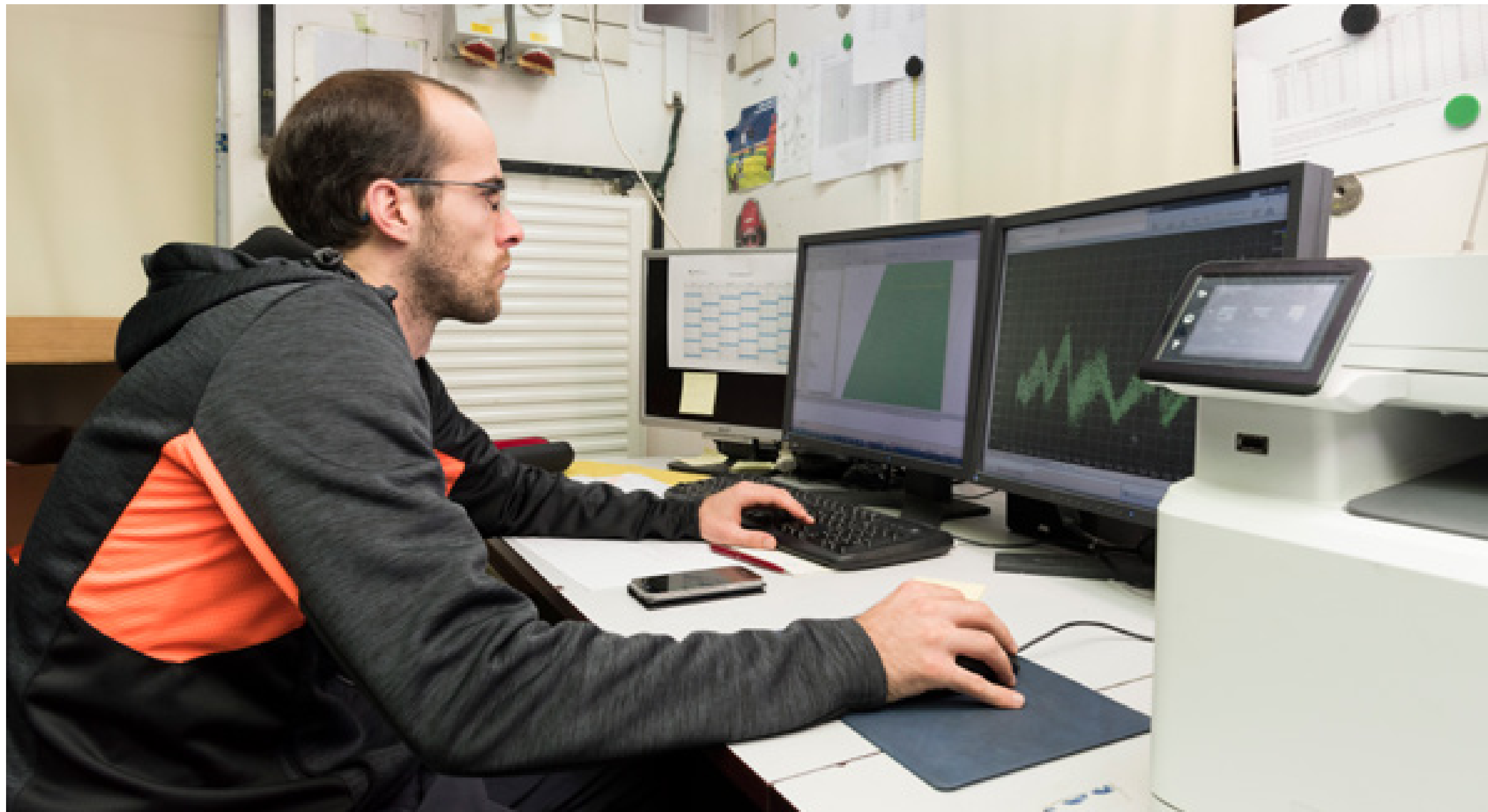
Following this feedback, for the HKZWFZ geotechnical survey, RVO.nl has increased the number of boreholes required and optimised their locations. This means that in the post-tender detailed design stage, likely, only CPTs will need to be performed at the turbine locations. Eliminating the need for sample boreholes and advanced laboratory testing at this stage will save developers significant time and costs and gives them the best opportunity to truly optimise their planning.

A three-step procedure was adopted as follows to define measurement locations:
1. The preliminary CPT and borehole locations were initially defined based on the results of the geophysical study.
2. Those locations were then reviewed by geotechnical experts and designers hired by RVO.nl and Fugro to make sure the right information would be obtained for the design.
3. Finally, contrary to Borssele, the CPTs were performed prior to the boreholes, which gave the opportunity to further optimise the borehole locations based on the preliminary CPT data.

In taking this approach the selection of the borehole locations was significantly improved when compared to Borssele. In the meantime, the laboratory test programme was reviewed and adapted to provide a better basis for advanced design methods. Tests added were:
- Microbial Influenced Corrosion (MIC) tests (assess presence of microorganisms that could play a role in corrosion processes);
- Age dating (for a better understanding of the geology);
- Thermal conductivity (needed to calculate heat transmission in soil for cable design); and
- Resonant column tests (assessment of soil damping characteristics).

The cyclic test programme was also extended to include drained cyclic triaxial tests. After the laboratory testing programme, all remaining samples will be stored and handed over to the winner(s) of the grant and permit tender. Please note the MIC tests performed for HKZWFS III and IV were issued as a separate report.

The total number of measurement locations for HKZWFS III and IV were as follows:
- Twenty-eight (28) (HKZWFS III) and 31 (HKZWFS IV) seafloor CPTs;
- Thirteen (13) (HKZWFS III) and 11 (HKZWFS IV) boreholes including continuous sampling (and downhole CPTs in selected boreholes);
- Four (4) (HKZWFS III) and 4 (HKZWFS IV) boreholes including downhole seismic CPTs.



An overview of the basic laboratory test programme can be found in Table 4a.

Table 4a *Overview Basic Laboratory Test Programme*

Index tests	HKZWFS III	HKZWFS IV	Total
Density of Solid Particles (Small Pycnometer)	64	72	136
Particle Size Analysis (Sieving and Pipette)	142	194	336
Minimum and Maximum Index Dry Unit Weight	48	59	107
Atterberg Limits	53	69	122
Carbonate Content	108	116	224
Organic Content (dichromate oxidation)	61	80	141
Organic Content (loss on ignition)	7	11	18
Triaxial tests			
Unconsolidated Undrained Triaxial compression -Undisturbed (UU)	37	36	73
Unconsolidated Undrained Triaxial compression - Remoulded (UUr)	39	40	79
Isotropically Consolidated Undrained Triaxial in compression (CIUc)	5	10	15
Isotropically Consolidated Undrained Triaxial in compression (CIUc) with bender element testing	6	11	17
Isotropically Consolidated Drained Triaxial in compression (CIDc)	21	21	42
Isotropically Consolidated Drained Triaxial in compression (CIDc) with bender element testing	20	24	44
bender element testing			
Ring Shear (Soil-Steel Interface)	10	9	19
Ring Shear (Soil-Steel Interface)	21	29	50
Compressibility Tests			
Incremental Loading (IL) Oedometer	8	13	21
Constant Rate of Strain (CRS)	9	17	26
Other Tests			
Thermal Conductivity	9	12	21
Microscopic Photography	27	27	54
Permeability Tests	8	12	20

Note water content, unit weight, torvane and pocket penetrometer tests were also performed as part of other test types, e.g. a CIUc triaxial tests includes determination of unit weight and water content, but are not presented in Table 4a

Table 4b shows the types of tests that were part of the advanced laboratory test programme performed across the different formations.

Table 4b *Overview Advanced Laboratory Test Programme per Formation*

Unit	Formation	Test type(s)
A	Southern Bight (-)	Geotechnical index, sample micro photography, (cyclic) strength, and dynamic
B1	Kreftenheye (sand member)	Geotechnical index, sample micro photography, (cyclic) strength, and dynamic
B2	Kreftenheye (clay member)	(Cyclic) strength and dynamic
C1	Eem (Brown Bank)	(Cyclic) strength and dynamic
C2	Isotropically Consolidated Undrained Triaxial in compression (CIUc) with bender element testing	Geotechnical index, sample micro photography, (cyclic) strength, and dynamic
D	Yarmouth Roads (-)	Geotechnical index, sample micro photography, (cyclic) strength, and dynamic

In addition, the geological age dating programme included 116 samples at HKZWFS III and IV taken from 4 boreholes. The results are presented in the geological ground model report.

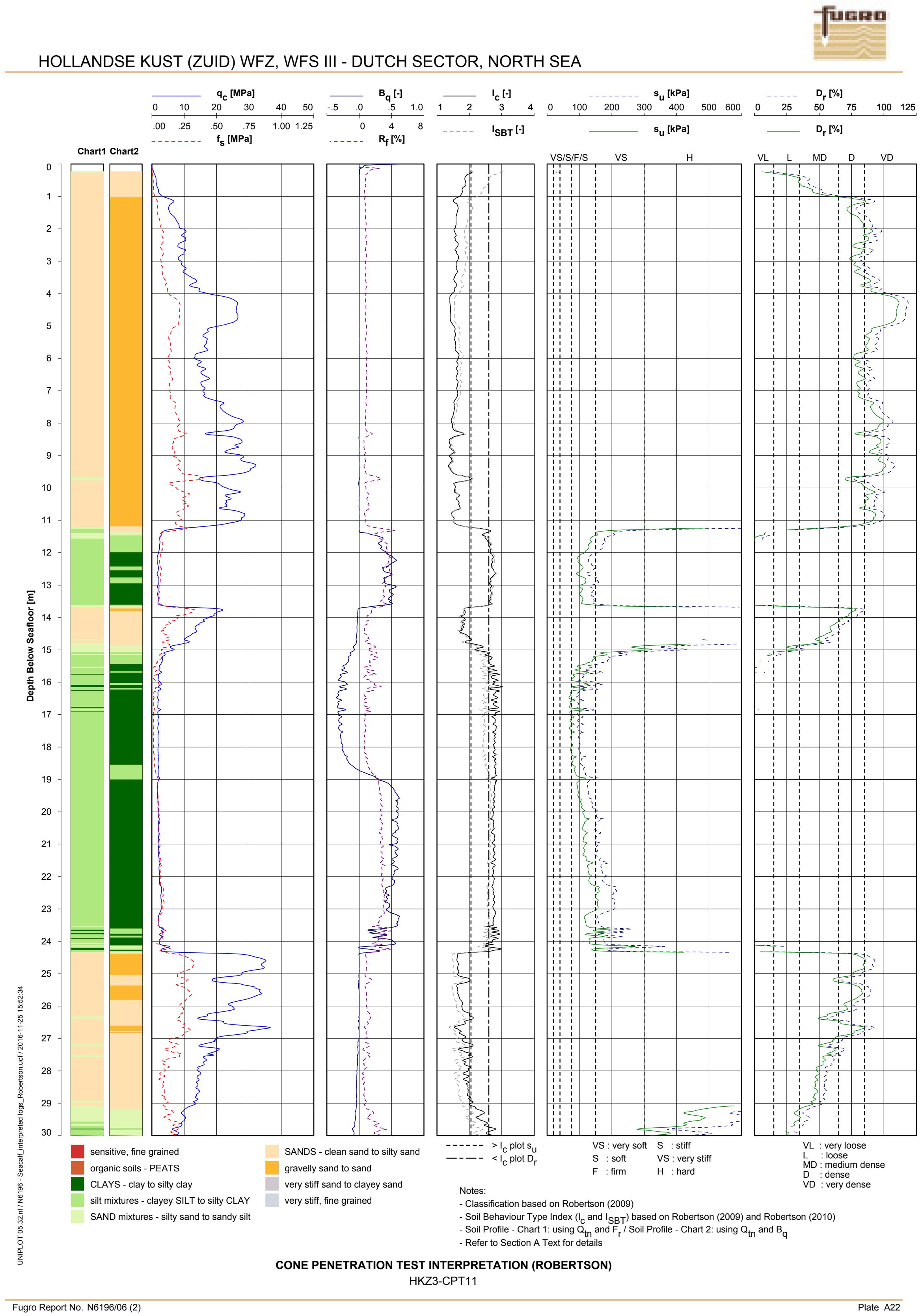
As Table 4c shows, the advanced laboratory test programme included the following tests.

Table 4c *Overview Advanced Laboratory Test Programme for HKZWFS III and IV*

Geotechnical Index	Total
Particle Size Analysis (Sieving and Pipette)	5
Sample Micro Photography	49
Strength (Static)	
Direct Simple Shear (DSS)	10
Isotropically Consolidated Undrained Triaxial compression (CIUc)	4
Anisotropically Consolidated Undrained Triaxial compression (CAUc)	3
Isotropically Consolidated Drained Triaxial compression (CIDc)	2
Strength (Cyclic)	
Strain-controlled Cyclic Simple Shear (CSS)	12
Stress-controlled Isotropically Consolidated Undrained Cyclic Triaxial (CTX)	8
Stress-controlled Anisotropically Consolidated Undrained Cyclic Triaxial (CTX)	10
Stress-controlled Isotropically Consolidated Drained Cyclic Triaxial (CTX)	8
Dynamic	
Bender Element (BE)	10
Resonant Column (RC)	7

Please note that only total quantities for HKZWFS III and HKZWFS IV combined are given, as tests on granular soils have been carried out on batch samples which are composed of material from both sites, and hence no logical split in test quantities per site can be made.

Figure 4f *Example of CPT data interpretation*



4.6.3 Supplier

Fugro Marine Services B.V. was contracted to perform this survey. The survey has been performed according to ISO 19901-8 (2014) Marine Soil Investigations.

The investigation was conducted in four campaigns with geotechnical drilling vessels Bucentaur and Gargano, between 26 June and 9 September 2016.
A 20-ton double block-drive unit was used for the seafloor in situ testing in combination with piezo-cone penetrometers. The geotechnical boreholes were performed with rotary drilling with direct circulation and use of a seabed frame.

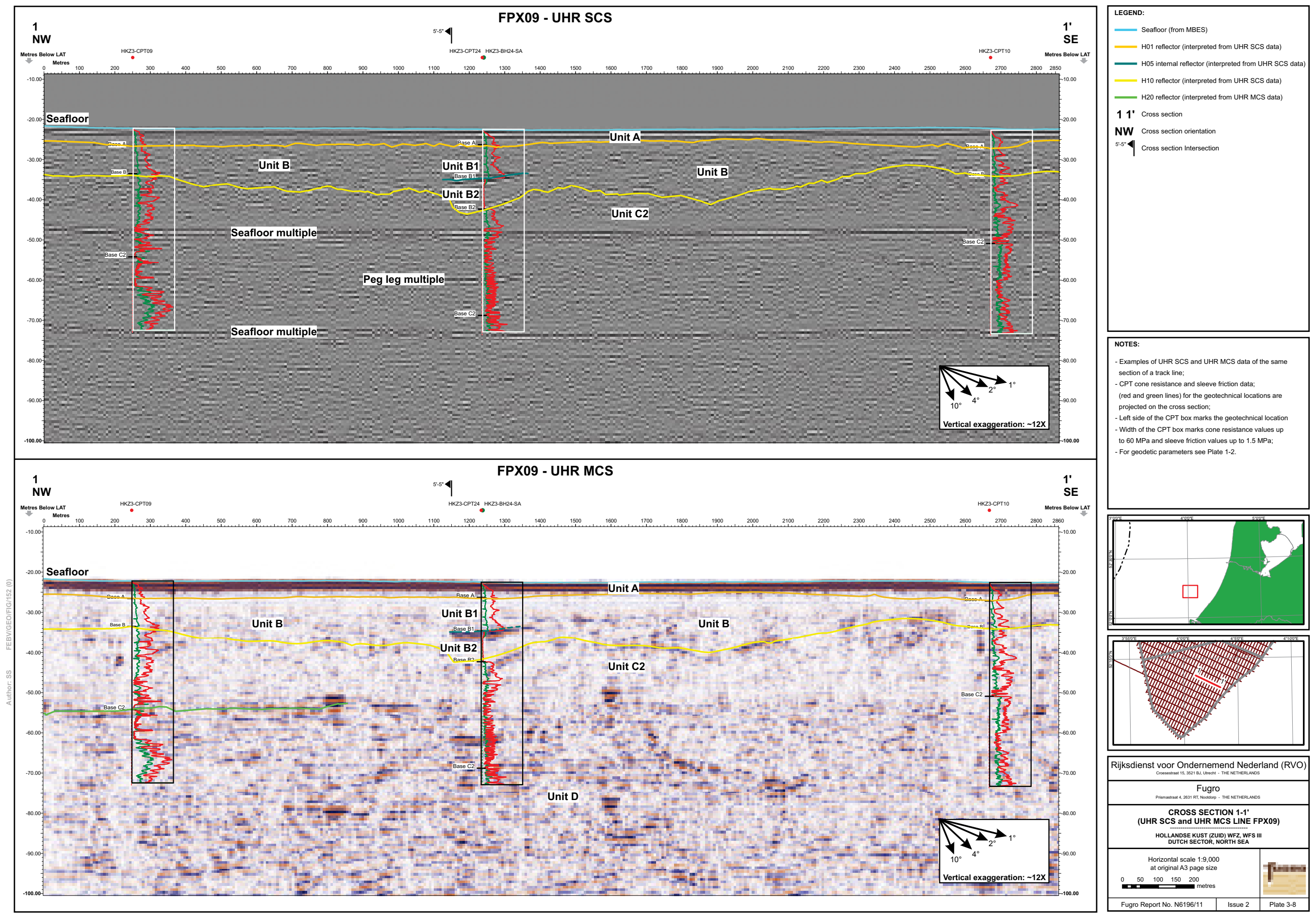
4.6.4 Results

The results of the geotechnical investigation and the basic laboratory test programme can be found in three reports for each individual site:

1. A geotechnical report containing interpreted CPT logs and results from in situ testing, including:
   - Interpretation of soil profile, strata description and CPT-derived relative density and undrained shear strength;
   - Cone resistance (net/total), sleeve friction, pore pressure, friction ratio and pore pressure ratio;
   - Results of pore pressure dissipation tests, i.e. cone resistance and pore pressure versus time.

2. A geotechnical report containing geotechnical logs and results from in situ testing and laboratory testing, including:
   - Interpretation of soil profile, strata description and CPT-derived relative density and undrained shear strength;
   - Cone resistance (net/total), sleeve friction, pore pressure, friction ratio and pore pressure ratio.
   - Recorded shear waves (X and Y) and derived shear wave velocity;
   - Selected results of laboratory tests.

Figure 4g *Seismic UHR MCS cross section with CPT cone resistance data projected in red*



3. A geological ground model report containing a geological ground model, including:
   - Geological setting, stratigraphy, lateral variability;
   - Isopachs, depth to top of unit maps and contours and thickness of unit maps and contours;
   - Geotechnical parameter values per borehole location and unit;
   - Geohazards and assessment of suitability of selected types of structures;
   - Age dating results.

In addition, the results of the advanced static and cyclic laboratory programme for HKZWFS III and IV are issued in a further report combining the results from both sites as follows:
- Results of static and cyclic direct simple shear and triaxial tests;
- Results of dynamic tests;
- S-N degradation curves with results of and cyclic tests;
- Drammen Clay Model graphs with results of cyclic tests.

In addition to the geotechnical reports, the following deliverables have also been issued:

A. Digital Data Packages – Geological Ground Model (IHS Kingdom® format) – HKZWFZ.

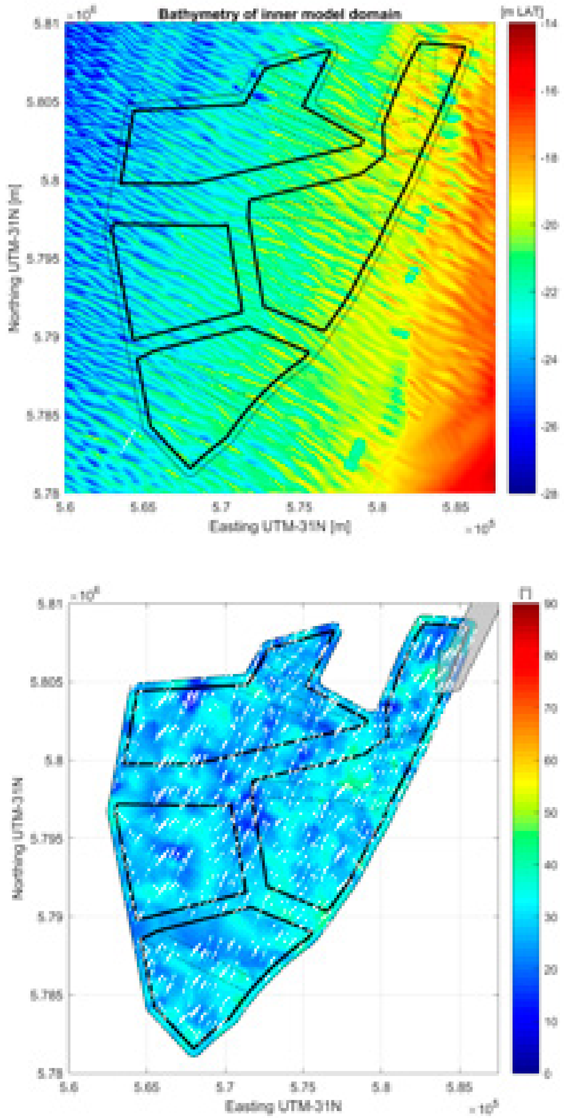
In April 2018, a Digital Data Package was released which consisted of interpreted horizons used for the Geological Ground Model from sub-bottom profiler and multi-channel seismic data together. Data is presented in the IHS Kingdom® format. The provided digital data packages contain information for HKZWFS III and IV.

B. Technical Note – MIC; Technical Note Laboratory Test Data Microbial Influenced Corrosion (MIC) at HKZWFS III and IV.

Selected tests were performed to provide information to assess the presence of micro-organisms that could play a role in corrosion processes.

An example of CPT data interpretation provided in the reports is shown in Figure 4f. An example of a seismic line at HKZWFS III with a projected seafloor CPT is shown in Figure 4g.

Figure 4h *Map view of the bathymetry (top) and estimated sand wave migration directions (bottom)*



4.6.5 Conclusion

Significant effort was taken to maximise the data quality and suitability of the geotechnical data for HKZWFS III and IV. The reports were certified by DNVGL. The data was used to ground truth the geological ground model resulting from the geophysical campaign. The results are anticipated to form a solid basis for geotechnical designs at HKZWFS III and IV.

It is anticipated that, thanks to the enhanced programme followed, additional sampling boreholes may not be needed in further stages of the development, if a reliable correlation between CPT data and laboratory test data can be made. However, this remains the final responsibility of the developers. The samples remaining after the laboratory testing phase will be available to the winning developers, e.g. to perform additional testing.

4.6.6. Webinar

The results of the investigation for HKZWFS I and II were presented and discussed at a webinar in January 2017. A webinar about the result of the investigation for HKZWFS III and IV was organised in June 2018. Please see the webinar for HKZWFS I and II at ***offshorewind.rvo.nl/presentationshk.***

4.7 Archaeological assessment of borehole data

4.7.1 Overview - aims, objectives and approach

The archaeological assessment of borehole data is phase III in the chain of archaeological studies carried out in the course of the HKZWFZ development. Prior to this assessment, an archaeological desk study (phase I - see Chapter 4.1) and analysis of geophysical data (phase II - Chapter 4.5) had been carried out. Phase II included an archaeological assessment of geological units identified in seismic data. It was concluded that intact Middle Paleolithic remains could be present in HKZWFS IV. This conclusion was based on the occurrence and distribution of Pleistocene deposits of the Bligh Bank Member. The geotechnical programme comprised the execution of cone penetration tests and the collection of borehole samples. The resulting data were used to build a geological model and to determine the physical properties of the stacked sedimentary layers. A selection of those samples has been used for archaeological research.

The goals set for the assessment were:
1. To acquire information on the prehistoric landscape evolving in time; and
2. Assess the opportunities this landscape could have offered for human occupation.

4.7.2 Supplier

Periplus Archeomare was contracted by RVO.nl to conduct the archaeological assessment of borehole samples.

4.7.3 Results

The borehole samples from the HKZWFZ have proved to provide a unique dataset for reconstructing the evolution of Pleistocene landscapes. During the warm Eemian interglacial period, sea level rose rapidly to reach a highstand some 120,000 years ago. In those days, the sea level equalled values faced today. After this warm period, climate grew colder on the onset to the Weichselian ice age. The sea level dropped and a major part of the North Sea, including the HKZWFZ, fell dry. Apart from extremely cold periods, the Weichselian ice age is charactersied by cool and moderately warm periods. Flora and fauna adapted to the fluctuations in temperature and precipitation. At times the evolving landscape offered favorable circumstances for humans to occupy this part of the North Sea area.

A partially intact sedimentary record of Eemian and Weichselian deposits, including those of the warm Brørup and Odderade interstadials, has been found. Middle and Late Paleolithic campsites and lost hunting gear are expected to be contained within this sedimentary sequence. The campsites, characterised by the presence of bone and flint artifacts, charcoal and burned seeds, are often small and very hard to trace. Even onshore, where on plowed fields the traceability of finds is high, prospecting for Middle and Late Paleolithic sites has proven to be difficult.

The valuable information which has come to light from this investigation opens up the possibility of using the geochronological information to broaden knowledge on the successive Pleistocene landscapes in the North Sea area and correlate this information with the stratigraphic sequences found in basins onshore. The collected data and analysis provide useful results, not only from an archaeological point of view, but also for palaeo-climatic research. Moving forward with geo-archaeological research is considered to be outside the framework of the development of the HKZWFZ.

The primary goal to gain an optimal amount of information on the evolving landscape over a prehistoric period, which thus far has been little studied in the North Sea area, has been achieved. As the impact of the planned activities on potential archaeological levels is limited, and with the traceability of covered Paleolithic sites being almost impossible, no further archaeological research has been recommended. The final Wind Farm Site Decisions HKZWFS III and IV have incorporated the findings of the phase III archaeological assessment.

4.8 Morphodynamical desk study

4.8.1 Overview - aims, objectives and approach

The morphodynamical study assesses the seabed dynamics at the HKZWFZ. It is based on existing historical bathymetrical data and the survey results obtained in the geophysical campaign.

The aim of the study is to:

1. Characterise the seabed features at the HKZWFZ;
2. Assess the morphodynamics at the HKZWFZ;
3. Predict the change in seabed levels at the HKZWFZ over the lifetime of a wind farm to support the design, installation and maintenance of wind turbines, inter array cables, platforms and their support structures;
4. As for Borssele, the study determines minimum and maximum seabed levels at the site for a total duration of 40 years, but for the HKZWFZ, it also provides a minimum, maximum and best-estimate seabed levels at five-year intervals over a 40-year period. The best-estimate seabed levels are useful to define the monitoring or maintenance requirements for the infield cables and the scour protections.

Overall, the information gathered in this desk study should provide detailed information to help developers with the design, installation and maintenance of wind turbines, inter array cables, substations and their support structures e.g. by choosing smart locations for the wind farm infrastructure. The results of this study were also used for UXO burial/migration assessments and the metocean study.

Compared to Borssele, the morphodynamic study of the HKZWFZ was extended with a geological analysis of the top layers, hydrodynamic modelling to assess and validate the migration directions of the bed features, an analysis of the morphodynamic changes during a storm, and best-estimate seabed levels.

In addition, a separate note has been produced into the scour conditions at the side. The purpose of this note is:

1. To describe the scour conditions to be expected at Hollandse Kust (zuid) for typical structure types; and
2. To provide a state-of-the-art overview of scour mitigation measures and their applicability at HKZ at these structures. The results of this scour note are presented in Chapter 4.9.

4.8.2 Supplier

Research institute Deltares was awarded the contract to conduct the morphodynamical desk study and the scour note for HKZWFZ. Deltares has previously conducted similar studies for other offshore wind farms, including Borssele, Prinses Amalia, Luchterduinen, Nordergründe, Vesterhav Nord and Syd and Belwind.

The approach followed by Deltares was to start with a literature study, followed by an analysis of available seabed surveys and the shallow geology and supported by numerical modelling, to assess the morphodynamics and predict the future seabed levels at the site. The data analysis included available historical seabed surveys and the survey performed during the geophysical campaign.

4.8.3 Results

The morphology is classified as dynamic with significant sand wave migration in the top layer. The sand waves are in general oriented perpendicular to the shore and are migrating to the north-northeast (see Figure 4h). The underlying bathymetry is considered static over the lifetime of the wind farm.

A review of available geological and geophysical data indicates that non-erodible layers exist, but that they are located too deep to influence the sand wave migration. A numerical analysis of the hydrodynamics and sediment transport in the area indicates the net sediment transport is aligned with the residual tidal flow and towards the north-northeast.

A Fourier frequency analysis was carried out to determine the spatial characteristics of the sand waves. Wavelengths between 200 m and 1,000 m and wave heights between 1.1 m and 4.0 m are observed. Sand waves are higher and shorter in the western part of the wind farm zone, which is characterised by a deeper water depth.

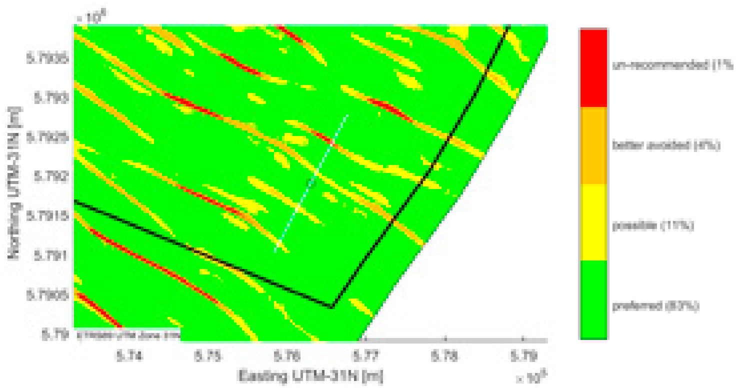


Figure 4i *Overview map of classification zones including classification for both highest and lowest seabed levels*

A detailed analysis of the sand wave field is presented for the entire HKZWFZ, as well as for the individual wind farm sites. In total, 3,904 transects distributed over the wind farm zone were analysed. The sand wave migration speeds were determined by a 1D cross-correlation technique and average migration speeds of 0.7 m/year to 3.0 m/year were observed. In general, sand waves in the northern part migrate faster than in the southern part and, locally, migration speeds as high as 5.2 m/year are observed.

Based on the morphodynamic analysis, a best estimate bathymetry (BEB), a lowest seabed level (LSBL) and a highest seabed level (HSBL) were determined. The LSBL and HSBL indicate the lowest and highest seabed levels expected during the lifetime of the wind farm (2016-2051). Locally, the maximum seabed lowering that was found for the entire area is -3.6 m. The maximum seabed rising is 7.2 m (the 99% non-exceedance values for lowering and rising are -1.5 m and +4.1 m respectively). Furthermore, the LSBL is compared against both the base of the Holocene formation and identified non-erodible layers.

The predicted seabed level changes presented in this study follow from the applied morphological analysis techniques, describing the physics and the natural variability of the analysed morphological system. No additional safety margins for design purposes have been applied. Finally, classification zones were provided to assist developers in determining the locations of their cables and foundations (see Figure 4i).

4.8.4 Deliverables

The results of the morphodynamic analysis are summarised in a desk study report. This report includes:

- General background information regarding sand waves;
- Geological and geophysical characterisation of the site and other offshore morphodynamic seabed features present in the HKZWFZ;
- Summary of performed numerical modelling for tides and sediment transport;
- Analysis regarding bed form migration speed and direction, including storm effects;
- Predicted future seabed levels (LSBL, HSBL, BEB);
- Classification zones and considerations for cables and foundations.

The resulting minimum, maximum and best-estimate seabed levels are provided as GIS files. The results of the scour note are presented in Chapter 4.9 and published on ***offshorewind.rvo.nl/soilzh.***

4.8.5 Webinar

The study was presented and discussed at a webinar in January 2017. The webinar can be found on ***offshorewind.rvo.nl/presentationshk.***

4.9 Technical note on scour and scour mitigation

4.9.1 Overview - aims, objectives and approach

The technical note on scour and scour mitigation provides general considerations on how to deal with scour development and scour mitigation in the HKZWFZ, taking into account the morphodynamic character of the area (the presence of migrating sand waves) and a range of potential types of foundations. Also general considerations for cable routing in a morphodynamic environment are provided.

The aim of the technical note is to:

1. Describe scour conditions to be expected at HKZWFZ for typical wind farm-related structures;
2. Provide a state-of-the-art overview of scour mitigation measures and their applicability for structures within the HKZWFZ;
3. Provide guidance on how the morphodynamics should be taken into account for the selection of locations for structures and cables as well as for a scour mitigation strategy.

4.9.2 Supplier

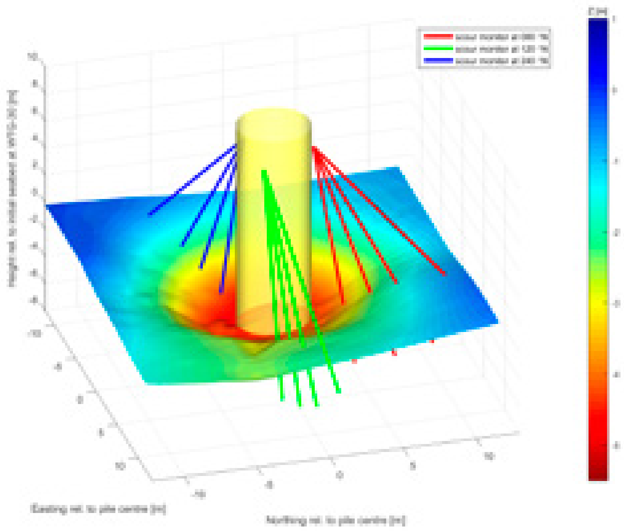
Research institute Deltares provided the technical note. Deltares has previously conducted many scour assessments, designed scour mitigation strategies and physical model testing for other offshore wind farms, including Borssele, Egmond aan Zee, GEMINI, Luchterduinen, Nordergründe, Butendiek, DanTysk and Norther offshore wind farms.

4.9.3 Results

Offshore structures can either be protected against scour or be designed such that scour development can be allowed. To decide which strategy can best be adopted for a certain foundation type and specific location, information was presented on how to predict the scour depth (when not protected) and how to protect against scour, both taking into account the morphodynamic scenarios of stable, lowering and rising seabeds.

It can be concluded that for monopiles, an easy-applicable, well-proven solution is to place the monopiles just north-east of the sand wave crests in the HKZWFZ or even on top of the sand wave crests and to apply a scour protection to maintain a more or less fixed seabed level around the foundation. In the first case a slightly longer pile is needed, while in the second case, a longer extent of the scour protection is recommended to cater for the lowering seabed. Gravity-Based-Structures (GBS) will typically need a scour protection due to too severe scour development in the mobile seabeds in the HKZWFZ and the low tolerance for scour due to undermining risks; locations with a significantly lowering seabed are best to be avoided for GBS. Jacket structures are expected to experience significant scour development as well. However, as long as they are not located in areas with lowering seabeds and cable free spanning risks are mitigated by proper cable protection measures, they can be designed for free scour development. This does not hold for Suction Bucket Jackets: due to the limited penetration depth of the suction cans, scour protection is, in most cases, recommended in the HKZWFZ. Self-installable systems look promising here.

Figure 4j *Measurement setup at an unprotected monopile in Luchterduinen used for field validation of Scour Prediction Model [source: flow-offshore.nl]*



Besides foundations, this technical note also discusses general considerations for cable routing in a morphodynamic area such as HKZWFZ. It is expected that cables can be buried sufficiently deep to avoid cable exposure, when smart cable routing techniques are adopted, which avoids the areas with largest morphodynamic seabed lowering or other 'expensive' areas.

4.9.4 Deliverables

The results are summarised in a technical note on scour and scour mitigation. The note includes:

- Recommendations regarding possible scour mitigation strategies for the HKZWFZ;
- Scour predictions for selected foundations, e.g. monopiles, jacket structures and Gravity Based Structures;
- Scour predictions for selected jack-up platforms (for installation purposes);
- Implications of edge scour around scour protections;
- Design requirements for a scour protection;
- Description of scour protection methods, e.g. rocks, mattresses, gabions, artificial vegetation, filter units etc.;
- Description of how to deal with cable routing in morphodynamic environments.

4.10 Wind Resource Assessment

4.10.1 Overview - aims, objectives and approach

The goal of this study is to provide a wind resource assessment (WRA) for the HKZWFZ.

The information can be used to feed into wind farm modelling, yield assessments and business case calculations for the offshore wind farms to be developed at HKZWFS III and IV. The analysis is based on the best possible data and state-of-the-art methods and models and is designed to be in accordance with applicable offshore standards.
The study consists of two parts:

- One is an overview of the assessment issued in March 2017 based on off-site data, the WRA1.
- The second is a new assessment performed based on on-site metocean measurement campaign data, the WRA2.

The study concludes with a discussion and the combined findings from both elements for a final wind climate assessment.

WRA1

Since there were no on-site measurements available at the time of this study, i.e. the measurement campaign had just started, Ecofys performed the study based on nearby offshore wind measurements and scale based on a validated mesoscale model. The analysis was performed for the entire HKZWFZ with the following approach:

- The data of five nearby wind measurement locations was subjected to a detailed analysis. The station with the highest quality was selected for the analysis;
- Several mesoscale models were compared and the one with best performance (lowest uncertainty) was selected for the analysis;
- The wind climate was calculated based on a combination of the best available data source and mesoscale model. The analysis included variations with height, time and distance, as well as a comprehensive uncertainty assessment;
- The resulting wind climate was compared with various other studies and wind atlases and aligned with the metocean study.

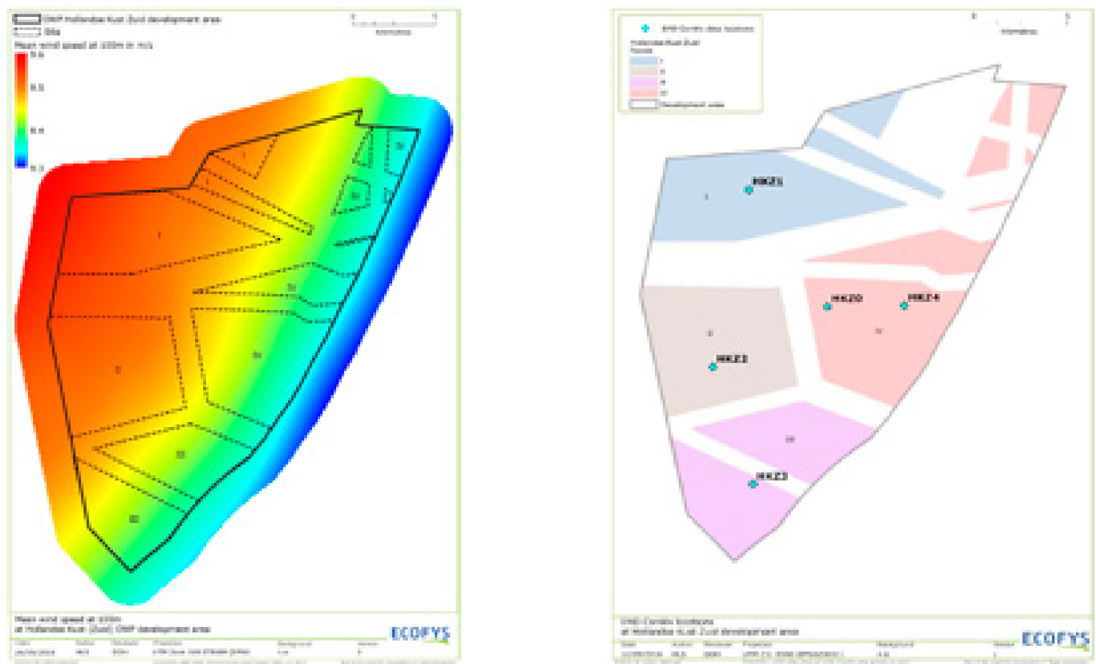
The Offshore Windpark Egmond aan Zee (OWEZ) 70 m met mast data formed the basis of the wind resource assessment, based on the proximity to the site and the overall low uncertainty of the wind measurements. The extrapolation was based on the EMD-ConWx mesoscale model, which was selected based on a validation using multiple offshore measured wind datasets. Detailed analyses of the calculated wind climate were carried out across the modelled heights, showing good comparisons of the analysed trends with measurements at other offshore sites in the Dutch North Sea.

WRA2

Wind measurement data from the metocean measurement campaign has become available and this data has been used as a second wind resource assessment study (WRA2). The contractors have made metocean measurement campaign data available, from June 2016 to May 2017, for two Fugro SeaWatch buoys (HKZA and HKZB), which both had a Zephir Z300 wind LiDAR installed. The wind speed measurements of the HKZB buoy (with some gaps filled based on the co-located HKZA buoy) were the primary source for this assessment.

Wind measurements from the Lichteiland Goeree platform were selected as the long-term reference, based on a validation using multiple offshore measured wind datasets. Based on this reference, a translation to the long-term wind speed was performed, using the so-called MCP-method. Detailed analyses of the calculated wind climate were carried out across the modelled heights, showing good comparisons of the analysed trends with measurements at other offshore sites in the Dutch North Sea.

Figure 4k *Long-term mean wind speed (WRA2) at a hub height of 100 m MSL at the Hollandse Kust (zuid) Wind Farm Zone (left) and output locations of the WRA1 and WRA2 (right)*



WRA and metocean desk study

Both WRA1 and WRA2 were carried out in parallel with the metocean desk study (section 4.12). Both the WRAs and the metocean desk study analyse the ambient wind climate at the HKZWFZ. However they do so for different reasons and with different outcomes in mind - the metocean desk study is to be used for wind farm design purposes whilst the WRAs are used to calculate energy yield. Thus the reporting criteria and calculation methods used can differ between these studies, which in turn can sometimes result in different results when compared.

RVO.nl and the contractors responsible for the WRAs and metocean desk study have ensured that the basic boundary conditions (e.g. wind speeds and directions, vertical/horizontal bins and assumed vertical wind profiles) were compared and aligned as much as possible in order to achieve consistency or a motivated deviation between both studies.

4.10.2 Supplier

Ecofys WTTS was contracted by RVO.nl to conduct the wind resource assessment. The company has ample experience in offshore wind resource assessments, having prepared bankable reports on multiple large offshore wind farms, often at sites where wind measurements were not available previously. Moreover, the company is skilled in the validation and application of mesoscale model data, including detailed uncertainty assessments.

4.10.3 Results

The results of the two wind resource assessments differ only slightly, with a 0.5% difference in the mean wind speeds at 100 m MSL. Also, the uncertainty of both assessments is comparable. Since the calculations are largely independent, the two results may be combined based on inverse-variance weighting, to result in long-term mean wind speed at 100 m MSL at the centre of the HKZWFZ of 9.44 ± 0.38 m/s (± standard deviation). The spatial variation from the zone's centre is about ±0.1m/s, as seen Figure 4k. The wind speeds found within the wind resource assessment are comparable with the wind speeds found within the metocean desk study.

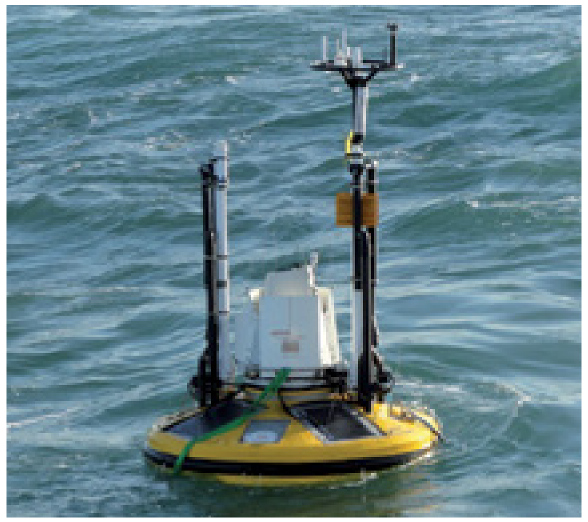
Please note this final WRA is for reference only. Companies participating in the tenders for the permit relating to HKZWFS III and/or IV are required to submit their own wind report (produced by an independent company) with net P50 value of the yield. This WRA may be used as input for the required report.

4.10.4 Deliverables

The results of the WRA are summarised in a desk study report. The report includes the following results:

- Annual mean wind speeds at elevations of 10 to 200 m;
- Annual mean wind speeds at various probability levels (P10 – P90);
- Wind roses (mean wind speed vs. direction) and wind shear (vertical distribution);
- Omni and directional mean wind speed distributions including Weibull parameters;
- Diurnal (daily), monthly, seasonal and year-to-year variations of mean wind speed;
- Anticipated wake losses due to the existing wind farms;
- A comprehensive uncertainty assessment.

Figure 4l *Location (squares) of Fugro Seawatch Wind Lidar buoys (left) and picture of Seawatch Wind Lidar buoy (right)*



In addition, the spatial distribution of the mean wind speed from both WRAs is provided as a GIS file. Time series are provided at the five output locations of the current site (2000-2016). For information regarding wind turbulence, refer to the metocean report. Turbulence is considered applicable for design and was not considered as part of the wind resource assessment.

4.10.5 Webinar

The study was presented and discussed at a webinar in January (WRA1) and November 2017 (combined WRA). The webinars can be found on ***offshorewind.rvo.nl/presentationshk***.

4.11 Metocean measurement campaign

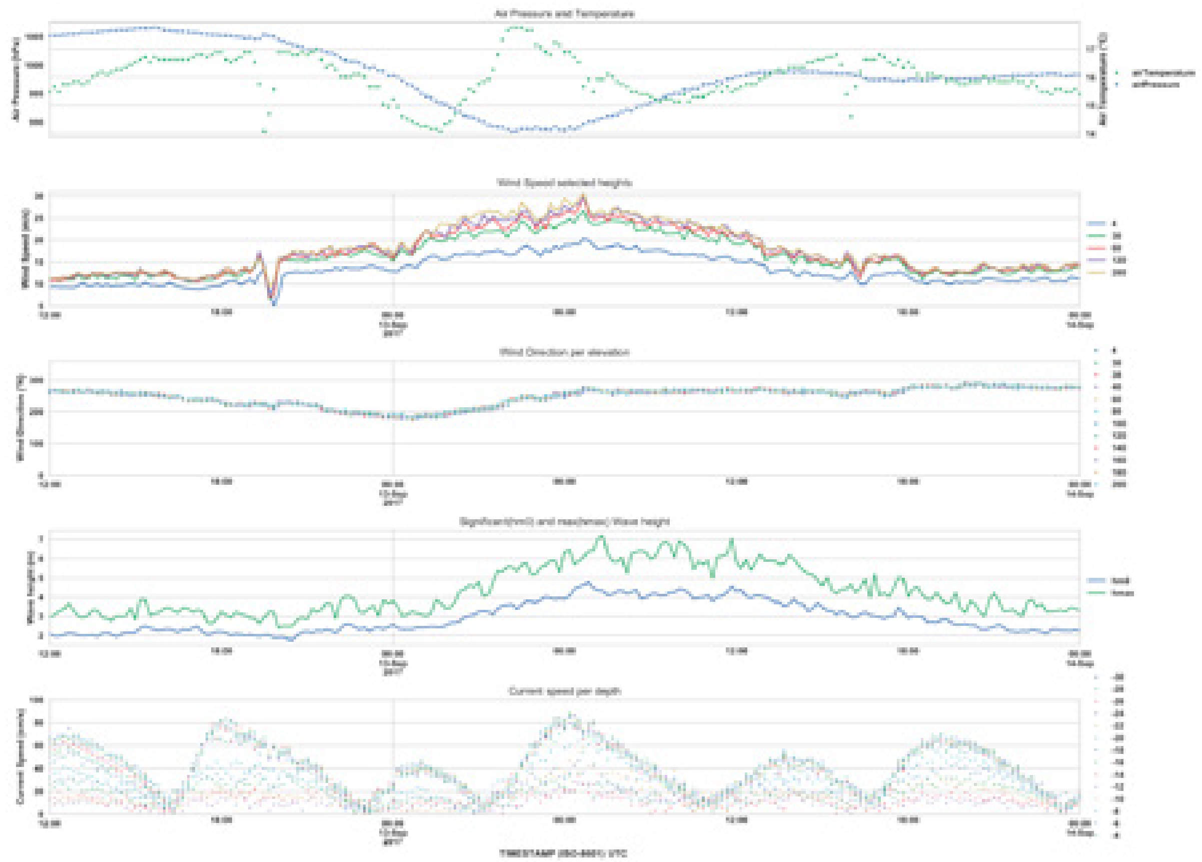
4.11.1 Overview - aims, objectives and approach

In the belief that more accurate metocean data will lead to a lower risk surplus and therefore lower cost of capital (strengthening the business case) for an offshore wind farm, DNV GL and Ecofys were asked to perform an assessment of the different options for a metocean measurement campaign. The aim of the study was to investigate the possibility of improving the accuracy of wind resource data at the HKZWFZ.

Based on their recommendation, in June 2016 two onsite Seawatch Wind LiDAR Buoys to measure wind properties and dedicated instrumentation to measure wave and current properties were deployed by Fugro Norway AS (OCEANOR) to provide on-site metocean data for the HKZWFZ. The buoys were positioned centrally in the site and far enough from the existing Luchterduinen wind farm to avoid wake effects and ensure they measure a representative wind climate (see Figure 4l and 4m).

The Seawatch Wind Lidar buoys are equipped with an integrated system comprising instruments to measure wind, waves, currents, water levels, air pressure and air temperature simultaneously. The wave sensor and the Wavescan platform is validated for use by clients requiring high quality wave measurements. Raw data from all sensors are transmitted to shore in real time and triggers are present to notify in case

Figure 4m *2017 September storm with maximum wind speeds of 31 m/s at the 200m measurement elevation and 20 m/s at the 4m measurement elevation at September 13, 06:40 UTC*



the buoy leaves its position or in case instruments fail. The buoys are located close to each other (max. 2 km distance) to create a redundant system, i.e. to make a second set of measurements available if any of the instruments fail. This was a key learning point after the measurement campaign at Borssele.

The objective of the measurement campaign is to reduce the uncertainty of the metocean data at the HKZWFZ. The aim has been to have at least 12 months of validated data measured at the HKZWFZ available prior to permit tenders, which has been achieved. To reduce the uncertainty of data further, the campaign has been extended to 24 months, until June 2018.
The dataset means the metocean models available for wind farm design can be calibrated and/or validated, enabling developers to carry out more accurate calculations of annual energy yield. Also the second Wind Resource Assessment (WRA2) is based upon the data of this metocean measurement campaign.
The meteorological data (or variables derived from it) include the following parameters, measured at 10-minute frequencies:

- Wind speed and direction in the range of 30 - 200 m above mean sea level (MSL), in steps of 20 m (Please note that Mean Sea Level (MSL) at Hollandse Kust (zuid) is equal to Lowest Astronomical Tide (LAT) + 0.95m)
- Wind shear and wind veer
- Turbulence intensity
- Inflow angle
- Air temperature LiDAR level
- Air pressure LiDAR level

Similarly, the oceanographic data will also be provided and include at least the following:

- Significant wave height
- Peak wave period
- Mean wave period
- Mean wave direction
- Wave spectra
- Current speed at ≥ 10 evenly spread positions over the water depth
- Current direction at ≥ 10 evenly spread positions over the water depth
- Water level
- Sea water temperature

Compared to Borssele, the main differences are that the present metocean campaign started in an earlier phase and that the performed validation is more extensive and includes all measured parameters including water levels, currents and waves.

4.11.2 Supplier
The metocean measurement campaign is being conducted jointly by Fugro Norway AS (OCEANOR) and Fugro Survey B.V, subsidaries of Fugro B.V. With more than 30 years experience, Fugro Norway is a global leader in design, manufacturing, installation and support services for environmental monitoring, metocean observation and forecasting systems.

4.11.3 Results
Monthly results from June 2016 to June 2018 are available on ***offshorewind.rvo.nl***. Available data is validated by Deltares. This validation includes a comparison of the measured wind and waves between both buoys and with several surrounding measurement stations (Meetmast IJmuiden, Licht Eiland Goeree, Euro platform and K13 platform). The measured currents and water levels are checked by comparing them with operational numerical model results of Rijkswaterstaat (DCSM). Each month, after completing the data validation, a data package is issued to RVO.nl, containing the raw data, a data report and a data validation report. This data package is subsequently reviewed and quality approved by ECN on behalf of RVO.nl, before finally being made available on the RVO.nl website. This strict quality assurance procedure assures that the results serve as a high-quality reference for wind climate and metocean studies.

The monthly reports demonstrate the required parameters are being measured with a high availability and accuracy. The winters of 2016/2017 and 2017/2018 included some storms for which the data has been successfully recorded. Offshore operations are being performed to service the buoys and instruments at regular intervals. To date 24 months of metocean site data (from June 2016 - June 2018) has been collected. A final report comprising the full 24 months of data is being compiled and will be issued shortly.

4.11.4 Deliverables
The results of the metocean campaign are published on a monthly basis on ***offshorewind.rvo.nl/windwaterzh***. The data package includes raw data, a data report and a data validation report. The packages become available about two months after completion of a month of measurements.

4.11.5 Webinar
The setup of the metocean measurement campaign was presented and discussed at a webinar in January 2017. The webinar can be found on ***offshorewind.rvo.nl/presentationshk***.

4.12 Metocean desk study

4.12.1 Overview - aims, objectives and approach
The metocean desk study provides information on the meteorological and oceanographic (metocean) conditions in the HKZWFZ . This information will serve as input for the design, installation and maintenance of wind turbines, inter array cables, substations and their support structures for companies submitting bids to develop projects at HKZWFS III and IV. The study also provides information relevant for the site in Hollandse Kust (noord), but this will not be discussed in any detail in this PSD.

The metocean desk study includes the following:

1. A general characterisation of the metocean climate at the sites (e.g. operational conditions, dominant tides, storm severity, spatial uniformity of conditions);
2. Analysis of normal and extreme metocean conditions for winds, waves, currents, water levels and their joint probability;
3. A combined report for Hollandse Kust (zuid) and (noord) for efficiency reasons;
4. A digital metocean database that will enable users (e.g. project developers) to obtain output (time series, tables and graphs for both normal and extreme conditions) at any requested location within the site boundaries of the HKZWFZ as well as the surrounding areas. The metocean conditions vary across the zone, mainly due to variations of the local bathymetry and tide. With the metocean database, developers will be able to optimise their designs - i.e. for wind turbines, inter array cables, substations and their support structures - based on the conditions at their actual location, rather than using a single conservatively chosen reference point in each zone. The database has been made available through ***offshorewind.rvo.nl***, using an application that can be downloaded.

The development of the digital metocean database is one of the main improvements compared to the metocean desk study performed for Borssele Wind Farm Zone. This database will allow developers to further optimise their preliminary design when preparing the tender bid. The results can also be used for detailed design of the offshore wind farms.

4.12.2 Supplier
RVO.nl assigned DHI to perform the metocean study. DHI is a renowned hydraulic institute with significant experience with the provision of metocean conditions and databases. DHI has contributed to most of the existing offshore wind farms in Europe.

Figure 4n *Scatter comparison plot of significant wave heights between the model and measurements at location Euro platform*

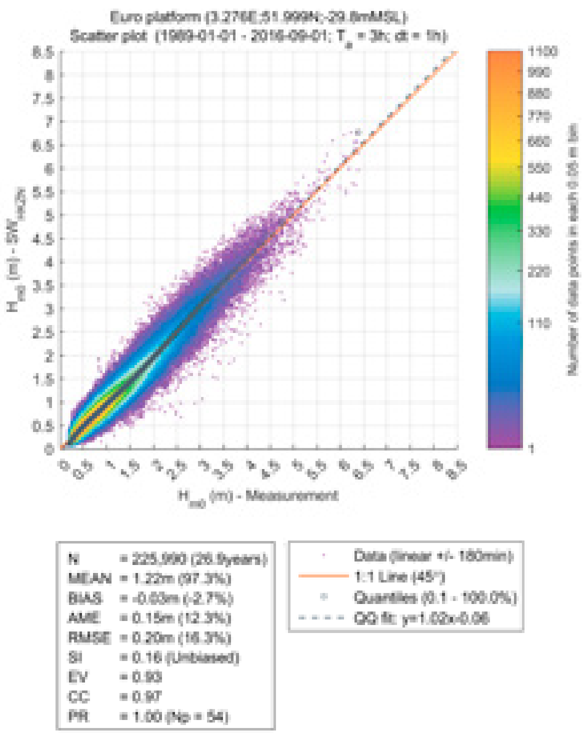


Figure 4o *Wave rose comparison between the model and measurements at HKZA*

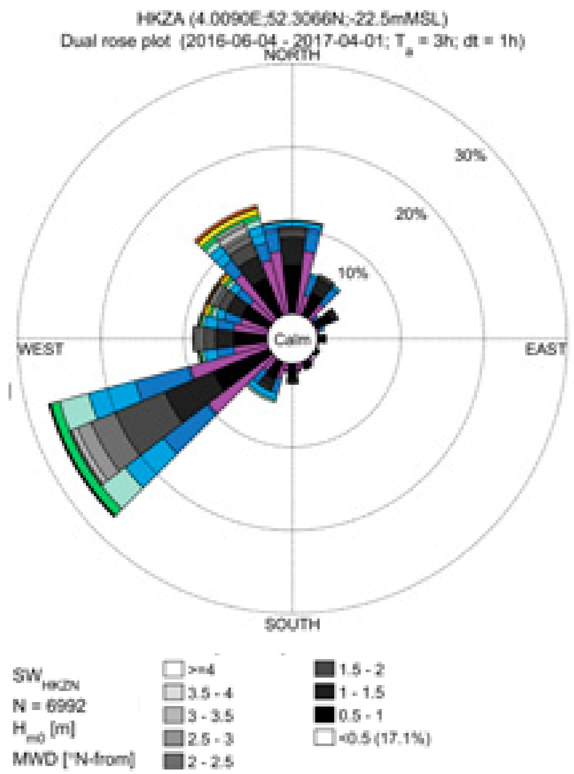
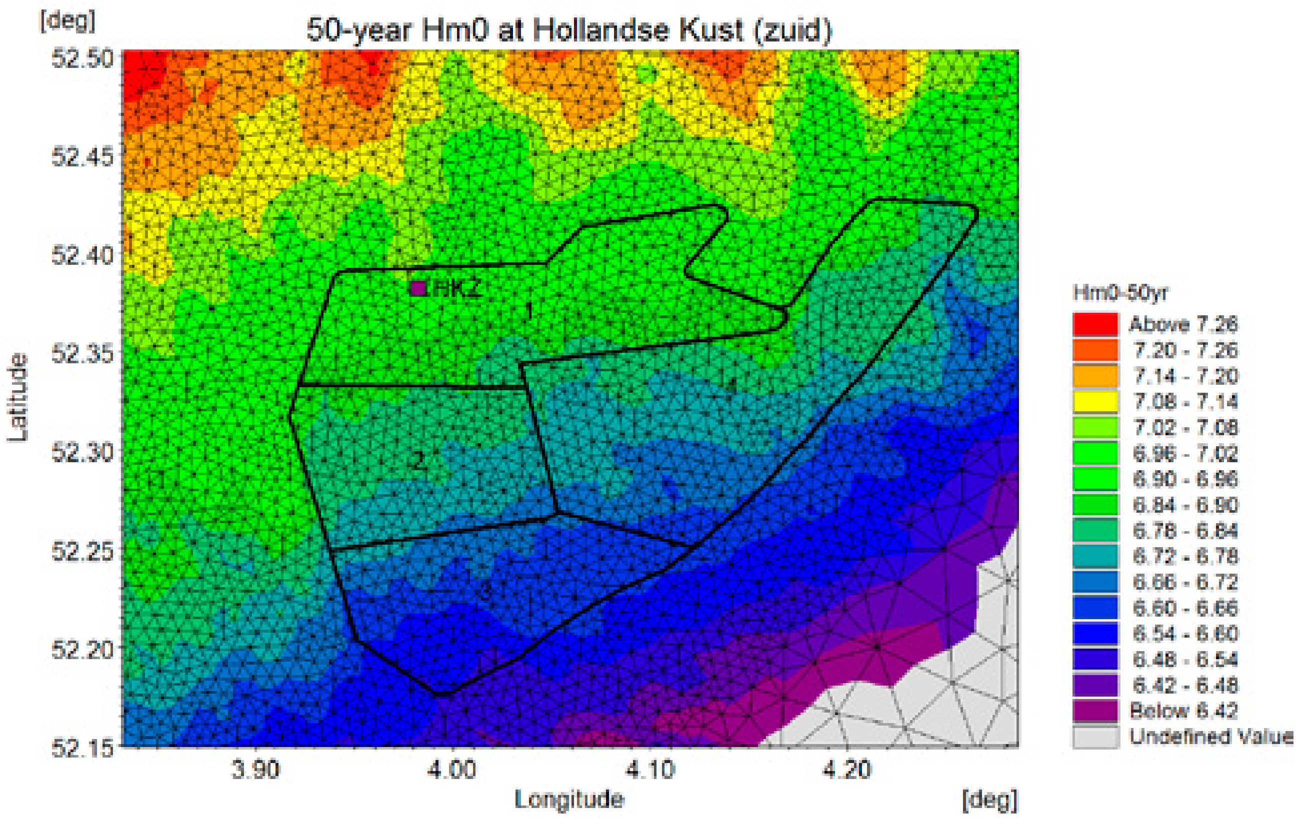


Figure 4p *Significant wave height with a 50-year return period at the Hollandse Kust (zuid) including the output location*



4.12.3 Results

Work started on the metocean desk study in August 2016. The metocean conditions were established using a dedicated high-resolution model covering the period from 1979 to 2016 (37 years). The modelling procedure comprised a wave model to simulate wave generation and propagation and a hydrodynamic model to simulate currents and water levels. Both featured an unstructured grid with respective grid resolutions of about 600 m and 200 m at the wind farm site. The atmospheric forcing for both wave and hydrodynamic model was taken from the wind and pressure field data from the Climate Forecast System Reanalysis (CFSR) dataset provided by the National Centers for Environmental Prediction (NCEP). The local hydrodynamic model was forced by a regional DHI model covering the North-Atlantic and optimised with data assimilation techniques. The local wave model was forced by DHI's regional North Sea wave model. An extensive validation of the modelling results was conducted using available satellite and local measurements.

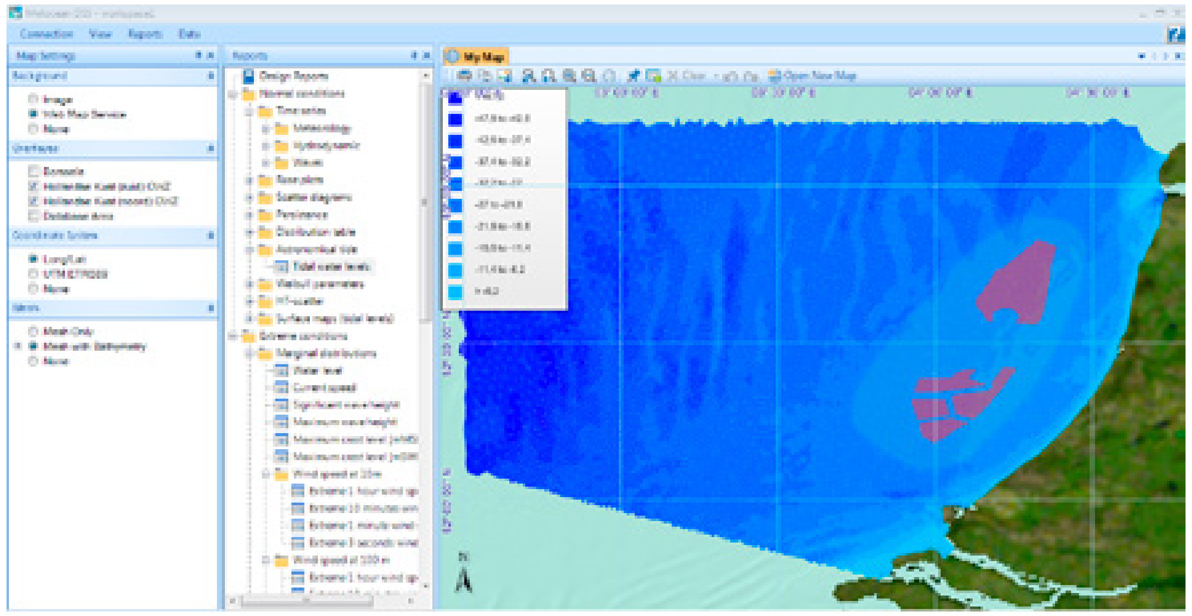
The local measurements included met masts at IJmuiden and Egmond aan Zee, measurements at platforms K13, K14, Euro platform, Lichteiland Goeree and measurements performed by RVO.nl at Borssele and HKZWFZ. The (south) eastern CSFR wind speeds in the metocean study were increased to match the wind speeds of the wind resource assessment.

All models were extended to cover until 2017-04-01 in order to validate the models against the latest HKZWFZ metocean campaign measurements. The resulting validation showed very good model performance and demonstrated accurate and high-quality metocean conditions at the wind farm areas (see e.g. Figure 4n and Figure 4o).

The metocean analysis covered winds, waves, currents and water levels, both under normal (ambient) conditions and extreme storm conditions. The analysis included persistence tables, scatter tables, rose plots, spatial variations, spectral analyses, joint occurrence tables, occurrence of individual wave heights and periods and misalignment of wind and waves.

Particular attention was brought to the extreme value analyses, since the resulting values are critical for design. Extreme conditions were established for winds, currents and water levels for return periods up to 100 years and for waves (significant wave height, maximum individual wave height and maximum crest heights) for return periods up to 10,000 years. Extreme conditions were provided on a directional and monthly basis. In addition, the joint probability of various parameters and the likelihood of breaking waves were assessed.

Figure 4q *Example of graphical user interface of metocean database*



The report includes results of metocean analysis at one output location for Hollandse Kust (zuid) and one output location for Hollandse Kust (noord). These output locations were selected at locations with maximum extreme significant wave height for a 100-year return period. The output location of HKZ was located in the north-western part of HKZWFS I (see Figure 4p).

Typical design values with a 50-year return period at the output location of HKZ include an hourly wind speed (at 100 m elevation relative to MSL) of 40.4 m/s, a significant wave height of 7.0 m, an associated peak wave period of 12.1s (to the 50-year significant wave height) and a depth-averaged total current velocity of 1.0m/s at a water depth of about 31 m MSL (this includes storm surge). The extreme sea states show spatial variability, e.g. at HKZWFS II the 50-year significant wave height is a few decimetres smaller. Values at other locations can be accessed through the metocean database, which enables users to access the modelling data and the analysis results through a user-friendly interface.

4.12.4 Deliverables

The results of the metocean desk study are summarised in a desk study report. The report includes the following results:

- Wind: wind velocity roses, joint occurrence tables, Weibull parameters, persistence of wind speed, extreme wind speeds, wind profiles, wind energy spectra, wind turbulence intensity and spatial variations;
- Wave: roses of significant wave height and peak wave period, joint occurrence tables, persistence of wave height, extreme wave conditions, partitioning wind sea and swell, assessment of sea level rise on the extreme sea states, mean storm durations, spatial variations, breaking wave effects, and normal sea states, according to DNV-GL-0437;
- Currents: current roses, velocity profiles, occurrence tables of current velocity and direction, extreme currents, separation tides and residual currents and spatial variations;
- Water levels: astronomical tide levels, extreme water levels, assessment of sea level rise and spatial variations of water levels;
- Joint probabilities: joint occurrence tables of wind and waves, current and waves, water levels and currents;
- Other metocean parameters: snow and ice accretion, seismicity, salinity, air and sea temperature, atmospheric and seawater density, marine growth, lightening and visibility.

The metocean database is a software application that can be downloaded from the RVO.nl website. It includes the following functionality:

- A graphical user interface with a map (see Figure 4q) allowing to select locations by clicking on a map, or by loading own coordinates;
- Access to modelling results (winds, waves, currents, water levels) at about 17,000 grid points within a large area covering both Hollandse Kust (zuid) and (noord) for the period from 1979 to 2016 (37 years) at high resolution;
- Functionality to perform analyses: plot time series, rose plots, scatter diagrams, persistence tables, distribution tables, fatigue tables, tide level tables, tables with extreme conditions and surface maps, all with user-defined settings;

- Functionality to export time series, data and plots at selected location(s), including an option to create various tables in one go, which can be customised;
- Functionality to download full directional-frequency spectrum on a 1 km grid within the wind farm zones.

The following options are available regarding support for using the database: user manual and a webinar. DHI will maintain the database for bug fixes for a period of five years. The metocean report and database are available on the website ***offshorewind.rvo.nl***

4.12.5 Webinar and database support
The study was presented and discussed at a webinar in January 2017. The approach towards the metocean study and the performed analyses were presented in the first part of the webinar. In the second part of the webinar, the metocean database was demonstrated. The webinar can be found on ***offshorewind.rvo.nl***

4.13 Site investigations quality and certification

4.13.1 Procedure
The Netherlands Enterprise Agency (RVO.nl), assisted by BLIX Consultancy, managed the process of site investigations for HKZWFS I, II, III and IV. RVO.nl maintained a quality assurance procedure to provide accurate practical high quality studies.

First, the scope of the different studies was determined using the following steps:
1. RVO.nl and BLIX determined the preliminary scope of the different studies. Lessons learned from the site investigations at the Borssele Wind Farm Zone were taken into account;
2. Where applicable, input was provided on these scope descriptions by internal experts, other governmental departments, agencies, external experts and the industry (Netherlands Wind Energy Association);
3. At market consultation sessions, the scope descriptions were discussed with market parties with input on completeness provided by the attendees at these workshops;
4. The study deliverables were reviewed by internal experts from other governmental departments, and external experts;
5. For studies with results becoming part of the design basis for the developer, the accredited certifying body DNV GL was contracted to confirm the completeness of the scope.

4.13.2 Procurement
The procurement of the different studies was carried out in compliance with the applicable procurement procedures within RVO.nl. The desk studies have been procured through a limited tender where, for each study, at least two expert parties were invited to submit their proposal.
The site investigations were procured through a public European tender. All proposals have been assessed by internal experts, other governmental departments, agencies, and external experts. Contractors were selected on the basis of determining the most economic advantageous offer, with safety, quality and track record as the primary award criteria.

4.13.3 Quality assurance
After procurement, whilst work was being conducted by the specific contractor, quality assurance was performed as follows:
1. A project team from RVO.nl and external experts was assigned for each study. The project team monitored the execution of the scope was in compliance with the scope description;
2. Draft reports and other deliverables were reviewed by internal and independent external experts;
3. Where applicable, accredited certifying body DNV GL reviewed reports and other deliverables and provided a Verification Letter to assure the results were acquired in compliance with the DNVGL-SE-0190:2015-12 and other applicable industry standards. Verification Letters are added to the published reports where applicable;

An overall Statement of Compliance was issued for the complete set of site studies, allowing the studies to be used in the design basis of an offshore wind farm. The following scheme was applied: Document No. DNVGL-SE-0190:2015-12 Project certification of wind power plants. By fulfilling the requirements in DNVGL-SE-0190, the Site Assessment Requirements listed in IEC 61400-22:2010-05 Wind turbines – Part 22: Conformity Testing and Certification are also fulfilled.

4.13.4 Experts
Experts that have provided input in the process include:
- BLIX Consultancy (Project management, experts)
- The Cultural Heritage Agency (Archaeological desk study)
- Rijkswaterstaat
- Windsupport Ltd (Geotechnical site investigations)
- Reynolds International Ltd (Geophysical site investigations)
- RPS Energy Ltd (Geophysical and geotechnical site investigations, Metocean campaign HSE)
- Rambøll (Geotechnical Site Investigations)
- ECN (Metocean measurements)
- Ecofys WTTS (Metocean measurements)
- Carbon Trust, Offshore Renewable Energy Catapult (Metocean measurements)
- Primo Marine (Metocean desk study)
- Periplus Group (GIS)
- DNV GL for Verification Letters
- Ministry of Defence (UXO risk assessment)

5. Offshore grid

The Authority for Consumers and Markets, ACM, (regulator) decided to appoint TenneT as the offshore grid operator in July 2016. This was a requirement for the Ministry of Economic Affairs and Climate Policy to formally designate TenneT as offshore grid operator in the Netherlands on September 6, 2016. The Electricity Act 1998 introduced a 'Development framework for the offshore grid', which provides a technical framework and outlines the future development of offshore wind energy in the Netherlands. The Development framework for the offshore grid was published by the Ministry of Economic Affairs and Climate Policy and amended in September 2018.

5.1 TenneT offshore grid connection system

As prescribed in the Development framework and elaborated on in the offshore Quality and Capacity Document published in December 2017, TenneT will build grid connections for the 3,500 MW new offshore wind capacity planned under the current offshore wind road map.

To create economies of scale, TenneT will construct five standardised substation platforms, each with a capacity of 700 MW. These platforms will be connected to the national Extra High Voltage grid with two 220 kV export cables per platform. Two platforms, alpha and beta, within one WFZ will be connected via a 66 kV link.
Output from HKZWFS III and IV will be connected to a single platform (beta). The planned location of platform beta is shown in Figure 5a within the 12 nautical mile zone, while Table 5a shows its coordinates. Infield cables from the wind farm(s) at HKZWFS III and IV will connect directly to this station. Cable entry zones are designated as the area to place infield cables connecting the wind farms at HKZWFS III and IV to platform beta. These zones are confirmed for HKZWFS III and IV in the Wind Farm Site Decisions.

The Hollandse Kust (zuid) platform beta will transform the power of HKZWFS III and IV from 66 kV to 220 kV and transport the electricity to shore through the two 220 kV export cables, which will connect to the planned onshore substation Maasvlakte Noord. Platform beta is planned to be due in 2022 - as published in the Development Framework. The platform contract has been awarded to Petrofac, see ***https://www.tennet.eu/news/detail/tennet-awards-contract-for-offshore-platforms-to-petrofac/***

Following a European tender procedure, TenneT TSO B.V. has selected Petrofac to construct an offshore transformer station (platform) for the Hollandse Kust (zuid) alpha wind farm zone. Petrofac is also the preferred contractor for TenneT's next offshore project, the Hollandse Kust (zuid) beta platform. Petrofac will undertake the engineering, construction, transport, installation, connection and testing of the offshore transformer station.

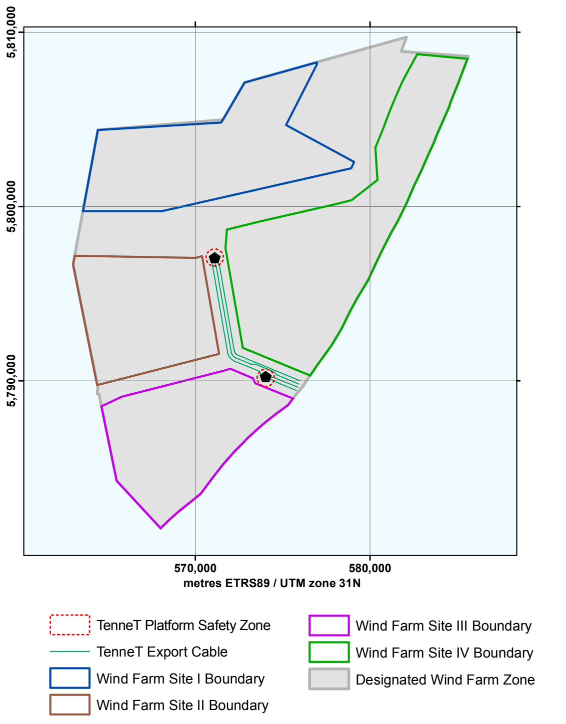
The cable contract was awarded to a consortium consisting of Van Oord Offshore Wind Projects B.V. and Hellenic Cables S.A, and includes the design, manufacture and installation of 220 kV subsea and onshore cables, and connecting these cables to the Maasvlakte high voltage substation. The consortium is also the preferred contractor for the supply and installation of cables for the Hollandse Kust (zuid) beta wind farm zone. The realization of a 66 kV subsea cable between the Hollandse Kust (zuid) alpha and beta offshore platforms has been included as an option in the contract. See ***https://www.tennet.eu/news/detail/tennet-awards-contract-for-hollandse-kust-zuid-offshore-grid-project-to-van-oord-and-hellenic-cabl/***

LMR Drilling GmbH was selected as the winning tenderer for the horizontal directional drilling of four 550-metre-long pipeline sections as part of the same project. A table in Appendix C shows the border coordinates of the export cable corridor.

Table 5a *Coordinates HKZWFZ platform beta by TenneT*
UTM (ETRS89, zone 31)

TenneT platform	Easting	Northing
Beta	574032.2	5790258.7

Figure 5a *The location of HKZWFZ TenneT platform beta*



5.2 Realisation Agreement and Connection and Transmission Agreement

In close consultation with the offshore wind industry, the Ministry of Economic Affairs and Climate Policy, the regulator ACM, and representatives of the Dutch energy market, TenneT has developed an offshore legal framework consisting of so-called model agreements. Consultation sessions of these model agreements were open to all stakeholders of the offshore grid and this consultation was finalised ahead of the first subsidy tender process. The model agreements consist of a Realisation Agreement and a Connection and Transmission Agreement supported by Offshore General Terms and Conditions, in line with onshore practice.

In addition, due to micro-rerouting of the 220 kV export cable within the cable corridor, TenneT foresees that cable crossing and proximity agreements will need to be arranged between the tender winner and TenneT. Prior to the tender, TenneT will publish models for these agreements on its website for information purposes.

All model agreements are available for parties to be connected to the offshore grid (*see www.tennet.eu/netopzee*). The model for these agreements will basically be the same for all winners of the tenders (past, present and future). All agreements will be entered into force according to the model agreements published by TenneT. The agreements will be concluded on an equal basis with the parties concerned in accordance with the model which has been consulted. For the sake of completeness: the content of these agreements is non-negotiable.

The missing data in these agreements will be completed in close consultation with the parties with whom TenneT enters into agreements.

5.3 Applicable codes

The generic technical requirements for offshore wind farm connections are established as technical code requirements, and as such are based on public law. In December 2016, ACM concluded and published the offshore code. Further generic technical requirements by TenneT can be found in the annexes to the model agreements.

5.4 Step-by-step process to connection

RVO.nl will, when requested, organise an introduction for the winner(s) of the tender with RVO.nl, Ministry of Economic Affairs and Climate Policy, Rijkswaterstaat and TenneT. After this introduction, TenneT will invite the winner(s) for bilateral meetings to start the connection process with the necessary steps for connecting a wind farm to the offshore grid:

- The winner(s) of the tender will provide TenneT with the missing data as indicated by TenneT in the Realisation Agreement and the Connection and Transmission Agreement;
- TenneT will process the data received in the agreements and provide fully completed agreements to the winner;
- After the agreements have been signed by both parties, the parties will consult on the joint planning, and further information exchange and coordination will take place in the project working group (as referred to in Article 6 of the Realisation Agreement);
- Timely conclusion of the agreements is vital to effecting the connection to the offshore transmission grid according to the planning;
- RVO.nl will hand over all remaining samples of the geotechnical survey;
- As with the Borssele projects, Rijkswaterstaat will coordinate the Maritime Information Services. Several sensors for public use will be placed on the platform. The opportunity exists for the wind farm developer to add individual systems as desired for its offshore wind farm operation.

6.
Specific requirements and relevant information from the legal framework

This chapter outlines the specific information that is relevant or needs to be adhered to when competing in the call for tender to design and build a wind farm at HKZWFS III and IV. These requirements originate from the legal framework (an unofficial English translation of the legal framework can be found in Appendix A).

6.1 Boundaries and coordinates

The boundaries of the HKZWFZ have been updated and published in the Memo Boundaries and Coordinates, Appendix C.

Appendix C contains the coordinates of:
- The Hollandse Kust (zuid) Wind Farm Zone;
- The Hollandse Kust (zuid) Wind Farm Sites;
- Infrastructure (pipelines, telecom and export cables, and infield cable entry zones);
- The existing wind farms.

6.2 Design and operation requirements

This section contains tables summarising the specific requirements that need to be adhered to when competing in the call for tender relating to the design and construction of a wind farm in HKZWFS III and IV. The requirements are grouped in line with the different wind farm development stages (design, finance, build, operate, and decommissioning).

While Netherlands Enterprise Agency (RVO.nl) has tried its best to provide a complete overview of all relevant requirements, this list may still be incomplete or may be superseded. In any case, the applicable law is leading and the Wind Farm Site Decisions are final but still not irrevocable.

6.2.1 Design bandwidths for the HKZWFZ

In order to be compliant with the permit, the design of a wind farm built in the HKZWFZ shall be compliant with the requirements listed in the Table 6a, which are an abstract of the applicable law (Appendix A).

Besides compliance to the permit, compliance to the Arbo act (decree, regulations) and working hours (decree, regulations) is required. English translations of these laws can be found on ***https://www.arboineuropa.nl/en/legislation/wetgeving-in-het-engels***

A catalogue of labor for wind farms made by NWEA can be found on: ***http://windenergiebedrijven.dearbocatalogus.nl/nl/arbo/offshore/322.***

For offshore wind farms it is extremely important to take safe working conditions into account for the entire supply chain: installation, operation and decommissioning, while designing the wind farm.

Table 6a *Bandwidth of design characteristics for HKZWFS III and IV*

Requirement	Applicable Law
HKZWFS III and IV are each appointed as locations for wind farms with a capacity of 350 MW: total minimum capacity allowed is 342 MW and total maximum capacity is 380 MW.	Wind Farm Site Decision (WFSD) III and IV
The wind farms will be situated within the contours of the coordinates listed in Appendix C.	WFSD III and IV Reg 2.1
The route of the grid connection to the Hollandse Kust (zuid) beta platform is within the coordinates listed in Appendix C.	WFSD III and IV Reg. 2.2

No wind turbines will be installed in maintenance zones. These zones are within the coordinates listed in Appendix C.	WFSD III and IV Reg. 2.3

Requirement	Applicable Law
The rotor blades of the wind turbines must remain completely within the contours cited of HKZWFS III and IV in Appendix C of this PSD and completely outside of the maintenance zones regarding WFS I cited in Appendix C.	WFSD III and IV Reg. 2.4
The maximum number of wind turbines to be installed: 63.	WFSD III and IV Reg. 2.5
The maximum total swept area permitted: 1.461.542 m^2.	WFSD III and IV Reg. 2.6
Only wind turbines of minimal 6 MW capacity per wind turbine are to be installed in the wind farm.	WFSD III and IV Reg. 2.7
The minimum distance between wind turbines must be 4 times the rotor diameter expressed in metres.	WFSD IV and IV Reg. 2.8
The minimum tip lowest level is 25 m above sea level (MSL).	WFSD III and IV Reg. 2.9
The maximum tip highest level is 251 m above sea level (MSL).	WFSD III and IV Reg. 2.10
The cables from the wind turbines must be connected to the Hollandse Kust (zuid) beta platform.	WFSD III and IV Reg. 2.11
The permitted foundations for the wind turbines are: monopile, tripod, jacket, gravity based and suction bucket. If the permit holder wishes to deploy a type of foundation that is not cited in this paragraph, then the environmental impact of that must be determined and submitted to the Minister of Economic Affairs and Climate Policy. The environmental impact must not exceed the limits set out in the Wind Farm Site Decision.	WFSD III and IV Reg. 2.12
If sacrificial anodes are used as cathodic protection for steel structures, then these alloys should consist of aluminium or magnesium. The alloys may contain small quantities (< 5 weight %) of other metals.	WFSD III and IV Reg. 2.13
The permit holder must make demonstrable efforts to design and build the wind farm in such a way that it actively enhances the sea's ecosystem, helping to foster conservation efforts and goals relating to sustainable use of species and habitats that occur naturally in the Netherlands. In this respect the permit holder is required to create an action plan, to be submitted to the Minister of Economic Affairs and Climate Policy no later than eight weeks before the commencement of the construction. Construction work must adhere to this plan.	WFSD III and IV Reg. 2.15
The permit holder must make demonstrable efforts to design, build, and operate the wind farm, while taking into account the prevailing laws, in such a manner that the wind farm actively contributes to strengthening the local and regional economy. For that purpose, the permit holder is required to create an action plan, to be submitted to the Minister of Economic Affairs and Climate Policy at least eight weeks before the commencement of the construction. The work will be performed in accordance with this action plan.	WFSD III and IV Reg. 2.16
The permit as referred to in Section 12 of the Offshore Wind Energy Act will be issued for a period of 30 years.	WFSD III and IV Reg. 3
If it is determined by the Water Decree that a measure must be taken for the protection of the North Sea, then another measure can be taken if Our Minister has decided that at least an equal level of protection of the North Sea will be achieved by means of that measure. The person or entity who intends to take another measure should submit an application to Our Minister for that purpose, containing details from which it can be demonstrated that at least an equal level of protection of the North Sea will be achieved by means of that other measure. Our Minister will make a decision within eight weeks regarding an application to take another measure (to protect the North Sea), determining whether or not it will ensure an equal or improved level of protection. Our Minister may extend this period once by six weeks at most.	Water Decree / Article 6.16b

The operator will report its intention to install and/or change a wind farm to Our Minister at least eight weeks before the start of the construction period and will provide the following data thereby: its location, the type of quality and security provisions. Within three months after installation an operator will provide Our Minister the position of foundations and export cables and related works.	Water Decree / Article 6.16d

6.2.2 Construction

Table 6b *Construction requirement parameters for HKZWFS III and IV*

Requirement	Applicable Law
The operator will report its intention to install and/or change a wind farm to Our Minister at least eight weeks before the start of the construction period and will provide all relevant issues related to safety and environment during the construction and operational phase.	Water Decree/§ 6.16d1
Measures for the prevention of permanent physical harm and/or effects to porpoises and seals and the mortality of fish: a. the permit holder must use one or more acoustic deterrent device(s) tuned to the relevant frequencies during piling work, including half an hour before piling work starts. In its piling plan, the permit holder will outline the type of deterrent it plans to use, including supporting evidence of its proven effectiveness; b. piling work must adopt a soft start, ensuring that porpoises are given the opportunity to swim to a safe location. The piling plan should provide details outlining the duration and power of the soft start along with supporting evidence of effectiveness.	WFSD III and IV Reg. 4.1

Requirement	Applicable Law
Measures to prevent disturbance to porpoises, seals, and fish (noise emission standard): a. The underwater noise level as a result of the construction of the wind farm must not exceed the noise levels cited in WFSD Regulation 4.2; b. the permit holder may exceed the noise emission standard stated by a maximum of 2 dB re 1 μPa2s SEL1 for the first ten foundation pillars; c. during the pile-driving work, the noise level must be continuously measured by or on behalf of the permit holder. The noise measurements for each foundation pillar driven must be sent to the Minister of Economic Affairs and Climate Policy within 48 hours after completion of the pile driving of the foundation pillar concerned; d. when consecutive noise measurements reveal that the underwater noise level during the pile driving of the foundation pillars does not exceed the noise emission standard stated in the Minister of Economic Affairs and Climate Policy can be asked to permit the lowering of the noise measurement frequency. e. the permit holder prepares a piling plan and submits this to the Minister of Economic Affairs and Climate Policy at least eight weeks before the commencement of the construction; f. the work must be performed in accordance with the piling plan as referred to in sub paragraphe of this regulation; g. the permit holder strives to produce as little underwater noise as possible; h. the permit holder strives to produce underwater noise in a continuous period of time as short as possible.	WFSD III and IV Reg. 4.2
Measures to protect archaeology and cultural history: a. If the sites which the Hollandse Kust Zuid phase II archaeological assessment shows might contain archaeologically valuable objects cannot be avoided with a radius of 100 metres, it will be necessary to conduct a further exploratory field study into the possible presence of archaeological monuments for those sites before laying cables or building foundations. This study must be performed in accordance with the Dutch Archaeology Quality Standard Aquatic Soils (version 3.2). b. The result of the study referred to in subparagraph a must be submitted to the Minister of Economic Affairs and Climate Policy no later than three months prior to commencement of the construction of the wind farm. c. Depending on the conclusions of the study referred to in subparagraph a: · the work can proceed without any changes; · a follow-up study will be required; · physical measures must be taken to protect archaeological sites; · sites are to be excluded from interference taking into account a buffer zone; · the work must be supervised archaeologically. d) The permit holder will have the results of its UXO study analysed archaeologically in accordance with the Dutch Archaeology Quality Standard Aquatic Soils (version 3.2); e) If the buried ferrous objects revealed by the Hollandse Kust (zuid) phase II archaeological assessment, and the buried ferrous objects identified on the basis of the permit holder's UXO study (referred to in subparagraph d) cannot be avoided with a radius of 100 metres, the UXO study must be accompanied by on-site archaeological supervision. That supervision must be performed in accordance with the Dutch Archaeology Quality Standard Aquatic Soils (version 3.2).	WFSD III and IV Reg. 4.5

Requirement	Applicable Law
If, during the construction of a wind farm or during other work relating to wind turbines in the Dutch Exclusive Economic Zone, a monument is found, or what is possibly a monument, as defined in the Monuments and Historic Buildings Act 1988, then the first subsection of Sections 53, 56, 58, and 59 of that Act are equally applicable.	Water Decree 6.16f.1
1. A wind turbine and any other installation that forms part of a wind farm must be sufficiently strong to withstand the expected forces resulting from wind forces, waves, sea currents and use of the turbine itself. 2. At least four weeks before putting the wind farm into operation, the operator will provide Our Minister with a statement confirming that the construction/installation of the wind turbines and other balance of plant components forming part of the wind farm comply with the first subsection.	Water Decree 6.16g 1 and 2
1. In order to ensure the safety of air traffic and shipping traffic, a wind farm will be equipped with identification marks and beacons. 2. The identification marks and beacons referred to in the first subsection must comply with the IALA recommendation O-139 (the marking of manmade offshore structures) and with the guideline published by the British Civil Aviation Authority CAP 764 (policy and guidelines on wind turbines).	Water Decree 6.16h 1 and 2

6.2.3 Operation

Table 6c *Operational requirements for HKZWFS III and IV*

Requirement	Applicable Law
Vessels used by or on behalf of the permit holder must take into account during their actions the presence of seals in the shallows and designated resting areas and the presence of bird concentrations. The measures cited in the Voordelta Management Plan, the Delta Water Management Plan, the Management Plan Waddenzee, and the Management Plan Noordzeekustzone must be taken into account hereby.	WFSD III and IV Reg. 2.14
During repairs to and maintenance of telecommunication cables, the number of rotations per minute per wind turbine of those wind turbines that are situated within a radius of 1,000 m from the site of the repairs or maintenance must be reduced to less than 1.	WFSD III and IV Reg. 2.17

Requirement	Applicable Law
Measures to limit collision victims amongst birds at rotor height during mass bird migration: a. At night (between sunset and sunrise), during the period in which mass bird migration effectively takes place, to be specified by the Minister of Economic Affairs and Climate Policy, the number of rotations per minute per wind turbine will be reduced to less than 1; b. The permit holder is obliged to cooperate, without financial compensation, with the installation of a system that observes the actual bird migration at the place or places determined by the Government. The safety regulations applicable to the wind farm will be duly observed; c. The permit holder is obliged to provide access for the management and maintenance of this equipment; d. On 1 August and 1 February each year, the permit holder will produce a report outlining how this Regulation has been implemented in the previous six months and submit it to the Minister of Economic Affairs and Climate Policy.	WFSD III and IV Reg. 4.3

Measures to prevent victims of collision amongst bats at rotor level: a. the cut-in wind speed of turbines will be 5.0 m/s at axis height during the period of 15 August to 30 September between 1 hour after sunset to 2 hours before sunrise; b. in case of a wind speed of less than 5.0 m/s at axis height, during the period referred to in part a, the permit holder will reduce the number of rotations per minute per wind turbine to less than 1; c. within two months after the end of the period referred to in part a, the permit holder will produce a report outlining how and in which way this regulation is implemented and submit it to the Minister of Economic Affairs and Climate Policy.	WFSD III and IV Reg. 4.4
Measures to reduce nuisance from lighting of the wind farm: a. Obstruction lights at the highest fixed point on wind turbines are steady-burning red lights. b. If visibility during the twilight and/or night-lighting period is greater than 5 kilometres the nominal light intensity of these obstruction lights during the twilight and/or night-lighting period will be reduced to 30%, and if visibility during the twilight and/or night-lighting period is greater than 10 kilometres, the intensity during the twilight and/or night-lighting period will be reduced to 10%. c. Contour lighting of the wind farm, where, viewed from a cockpit, the distance on the horizon between the individual lights on the wind turbines must not exceed 900 metres, is a minimum requirement; d. On the instructions of the Minister of Economic Affairs and Climate Policy or the Coast Guard, the wind farm will be lit entirely or in part in the event of a rescue operation in the immediate vicinity of the wind farm; e. The tower, the nacelle and the blades of the wind turbines are light-grey (RAL7035) in colour.	WFSD III and IV Reg. 4.6
Measure to promote maritime safety and enforcement in and around the wind farm: a. The permit holder is obliged to cooperate, without financial compensation, with the installation of a system (radar or other type) that can observe ship movements in and around the wind farm at the location specified by the Government for that purpose. b. The permit holder is obliged to provide access for the management and maintenance of this equipment.	WFSD III and IV Reg. 4.7
1. The Minister of Economic Affairs and Climate policy has an environmental monitoring and evaluation programme.The permit holder will cooperate in the implementation of this programme to a reasonable extent, without financial compensation. In doing so, the safety regulations applicable on the wind farm will be taken into account. 2. The Minister of Economic Affairs and Climate Policy will publish the data generated by the monitoring and evaluation programme. 3. The permit holder will cooperate in the implementation of the monitoring and evaluation programme e.g. as follows: • providing access to the wind farm for vessels conducting monitoring and evaluation work; • providing access to the seabed of the wind farm and taking samples; • enabling the attachment of equipment such as cameras and bat detectors to/on (parts of) the wind turbines; • enabling the attachment of radar equipment to/on (parts of) the wind turbines; • enabling the attachment of measurement equipment (for example measurement buoys, C-PODs, etc.) within the wind farm; • making available bandwidth on the data cable.	WFSD III and IV Reg. 5
The operator is responsible for a good level of maintenance of the wind farm and for this purpose will periodically inspect the wind turbines and other provisions, as well as the security provisions.	Water Decree/Article 6.16i

6.2.4 Decommission of the wind farm

Table 6d *Decommissioning requirements for HKZWFS III and IV*

Requirement	Applicable Law
After the power generation operations have stopped the permit holder will dismantle and remove all elements of the wind farm within two years at the latest, but always within the term of validity of the permit.	WFSD III and IV Reg. 6
1. At the latest, at the moment of given proof of produced electricity by the means of so-called Guarantees of Origin (Garanties van Oorsprong), the permit holder will guarantee the removal of the wind farm by means of a bank guarantee for the State in the amount of €120,000 per MW installed. 2. The permit holder will annually increase the amount referred to under 1 by 2% as a conse-WFSD III and IV Reg. 7quence of indexation during a period of 12 years after the issue of the bank guarantee. 3. After operating for a period of 12 years, operating for a period of 17 years, and 1 year before the date of removal, the permit holder will request the Minister of Economic Affairs and Climate Policy to redetermine the amount referred to under 1 and its indexation. 4. If a permit is applied for in accordance with Section 3.3 of the Offshore Wind Energy Act, the bank guarantee referred to in paragraph 1 for the removal of the wind farm shall be granted at the time when the first foundation of the wind farm is installed.	WFSD III and IV Reg.7
A wind farm that is no longer in use must be removed. This is equally applicable to scrap metal and other materials that are present on site or in the surrounding area as a result of the placement, maintenance, use or decommissioning of the wind farm. Our Minister can set a time limit, within which the obligation for decommissioning must be complied with.	Water Decree 6.16l

6.2.5 Electrical Infrastructure

Table 6e *Electrical infrastructure requirements for HKZWFS III and IV*

Requirement	Applicable Law
A power producer is entitled to compensation from TenneT if the offshore grid commissioning is late or if there has been too much downtime during the year.	COMPS 2.1[1]
A downtime of five days per calendar year is allowed without compensation.	COMPS 2.3
Compensation consists of consequential damages and damages resulting from lost or postponed revenue.	COMPS 3.1,3.2
In case of late commissioning, the compensation is: postponed income from electricity price (E-E/3.87) + consequential damages (EACT/Article 16f.2). The rationale behind this factor is that this income is not lost, it is only postponed by 16-20 years. The factors are a compensation for the time value of money.	COMPS, 4.3
In case of unavailability, the compensation is: Lost income from electricity sale + consequential damages. In formula: (E price) * (kWh missed-kWh transported_ in_5_days) + consequential damages.	COMPS, 4.2
The connection voltage level of the inter-array systems to the TenneT platform will be standardised at 66 kV.	Development framework offshore wind energy 3.3.7
Number of bays. With the 66 kV inter-array cables, six 66 kV bays will be available per PPM (Power Park Module). This results in four bays with "one string – one bay" and two bays with "two strings– one bay" on the platform. The "two strings – one bay" solution will be executed with two separate cable disconnectors.	Development framework offshore wind energy, 3.3.8
Access to platform. Boat landing and walk-to-work (W2W) solutions are the standard access method to the offshore substation. The platform will have a helicopter hoisting facility for emergency response (if allowed by authorities) but no helicopter platform.	Development framework offshore wind energy, 3.3.4
Organisation of metering. TenneT will centralise the organisation of the accountable metering requirements via one certified party, contracted by TenneT, responsible for the installation, commissioning and maintenance of the metering equipment. The metering responsibilities of the operator of the PPMs as the Connection Party will be dealt with in the Connection and Transmission Agreement.	Development framework offshore wind energy, 3.3.9
Overcapacity. TenneT guarantees a transmission capacity of 350 MW per power park module. The power park module (PPM) is allowed to transmit to a maximum of 380 MW, with the requirement for output from the PPM to be curtailed in case the 220 kV export cables reach their maximum allowable temperature limits. Curtailment will be addressed in the Connection and Transmission Agreement.	Development framework offshore wind energy, 3.3.6
Number of J-tubes and bays. Based on 66 kV inter-array cables and 60 - 70 MW per cable - a standard platform shall be equipped with 18 J-tubes for the inter array system: - 2x 8 J-tubes for offshore PPMs; 1 J-tube installed for possible test purposes; 1 J-tube installed for the connection to the neighbouring platform.	Development framework offshore wind energy, 3.3.7
Point of Common Coupling. The connection point (CP) between the offshore power park module (PPM) and TenneT is specified at the cable termination of the inter-array cables and the switchgear installation on the platform.	Development framework offshore wind energy, 3.3.8
TenneT will provide a standardised protection system and will decide post award of bid, in consensus with the selected project developer, on details for this protection system and arrange this in the offshore agreements between TenneT and Connected Party. Customised wishes will be at cost of the Connected Party.	Development framework offshore wind energy, 3.3.8
TenneT is inclined towards: (i) not installing, nor make provisions for, a (diesel engine powered) back-up generator plant on the offshore platform to provide auxiliary power for the PPMs; and installing a wireless communication interface (emergency facility) between the offshore platform and onshore substation, only in case of a firm and significant delay in realisation of such communication through the export cable fibres.	Development framework offshore wind energy, 3.3.5 (i)/ TenneT (ii)
Planning. The indicative date for delivery of Hollandse Kust (zuid) beta is the first quarter of 2022.	Development framework offshore wind energy, 3.4.2

[1] *COMPS = Compensation Scheme for Offshore Grid*

For further technical requirements please see TenneT's model agreements published at: http://www.tennet.eu/our-grid/offshore-projects-netherlands/programme-offshore-grid/

7. Resources for further information

Preparations by the Government for the tender of the Hollandse Kust (zuid) Wind Farm Sites III and IV are being finalised. This Project and Site Description, October 2018, is the final version and contains all available site data and project requirements relevant to prepare for the next tender round in the first quarter of 2019.

In this Chapter, you will find the following information (and web links) to help you with the next steps in preparing your tender bid:

- Useful websites that provide the most up-to-date information, e.g. for all relevant site studies;
- A list of applicable documents.

For information on the legal framework and the tender process, including key dates, please refer to Appendix A.

Meanwhile, prospective bidders will also find the magazine, 'Hollandse Kust: where wind & water works' published November 2017, useful. This magazine includes and expands on information published in the PSDs for HKZWFS I and II. This includes, amongst other things, the following:

- Information and contact details of key stakeholders relating to the Hollandse Kust region;
- A detailed overview of all the major Dutch ports that can service the offshore wind sector, both locally and in a European context;
- An overview of TenneT's work relating to the offshore grid for the Netherlands.

7.1 Useful websites to help keep track

Several websites provide the most up-to-date information and status of all relevant studies, legal framework and the application process for a subsidy and permit. The most important of these are listed below:

- The most up-to-date information on site data, including the results of the HKZWFZ metocean campaign, can be found at ***https://offshorewind.rvo.nl/***. The site also contains maps, minutes of workshops, and a Q&A and revision log;
- Application forms required to participate in the tenders for HKZWFS III and IV will be made available from ***www.mijnrvo.nl***;
- More information on the permit, the Wind Farm Site Decisions and the FAQ can be found at ***https://english.rvo.nl/subsidies-programmes/sde/offshore-wind-energy*** and ***www.rvo.nl/windenergie-op-zee***
- Information from Holland Trade and Invest on opportunities in the Netherlands for offshore wind: ***https:// www.hollandtradeandinvest.com/key-sectors/energy/***;
- "Noordzeeloket" provides information on several spatial topics concerning the North Sea, including offshore wind ***www.windopzee.nl*** and ***https://www.noordzeeloket.nl/functies-gebruik/windenergie/***
- Information by TenneT, related to the offshore grid:
  - General information resulting from TenneT's consultation process with the offshore wind sector (technical, legal, planning and other topics): ***https://www.tennet.eu/our-grid/offshore-projects-netherlands/programme-offshore-grid/***
  - Specific information for HKZ: Model agreements, publications, frequently asked questions: ***http://tennet.eu/Netopzee*** and scroll down to project Hollandse Kust (zuid) ***https://www.tennet.eu/our-grid/offshore-projects-netherlands/net-op-zee-hollandse-kust-zuid/***
  - TenneT project -website for Grid Connection System Hollandse Kust (zuid): ***https://www.netopzee.eu/hollandsekustzuid/***

7.2 Applicable documents

7.2.1 Documents attached with this PSD

Appendix A: Legal Framework Hollandse Kust (zuid) Sites III and IV
- Legal framework and specific requirements of the HKZWFS III and IV permit tender
- Wind Farm Site Decisions III and IV
- Development Framework Offshore Wind Energy
- Offshore Wind Energy Act
- Offshore Grid Compensation Decision
- Regulation compensation scheme for offshore grid
- Policy rule concerning a change in power generation facilities for offshore
- Definitions and Paragraph 6a of the Water Decree.

Appendix B: Summary Environmental Impact Assessment Hollandse Kust (zuid) Sites III and IV
- Environmental Impact Assessments HKZWFS III and IV.

Appendix C: Boundaries and Coordinates
- Boundaries and Coordinates Hollandse Kust (zuid) WFS III and IV, Luchterduinen Wind Farm: Please use provided maps and coordinates.

Studies and Suppliers:
- Archaeological desk study, Periplus
- UXO risk assessment, REASeuro
- Geological desk study, Deltares
- Geophysical site investigation, Fugro
- Geotechnical site investigation, Fugro
- Morphology study, Deltares
- Wind resource assessment, Ecofys
- Metocean study, DHI
- Metocean campaign, Fugro.

All the reports of these studies can be found at
https://offshorewind.rvo.nl/

Hollandse Kust: where wind & water work
- Hollandse Kust: A place for offshore wind, work, rest and play
- Reasons to invest: Pieter van Oord, CEO Van Oord
- Offshore hubs of port perfection: detailed overview of all Dutch ports serving the national and European offshore sector
- Existing port and manufacturing infrastructure base: summary of port facilities
- Finding new winds: emerging opportunities
- The right connection: TenneT brings the power of offshore wind to the people
- Leading on innovation: Dutch R&D initiatives including the tender for innovation projects at Borssele Wind Farm Site V
- Key sources of information and help
- This is Holland
- Industry growth.

7.2.2 Other documents relating to Dutch policy on offshore wind
- Energy Agreement for Sustainable Growth, September 6 2013
- Energy Agenda, December 7 2016
- General Implementing Regulations for Stimulating Renewable Energy Production
- Letter to Parliament rollout of offshore wind, September 26 2014
- Nationaal Water Plan 2016-2021, December 14 2015
- Letter to Parliament Offshore Wind Energy Roadmap, March 27 2018.

Appendices

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