Netherlands Enterprise Agency

Borssele Wind Farm Zone

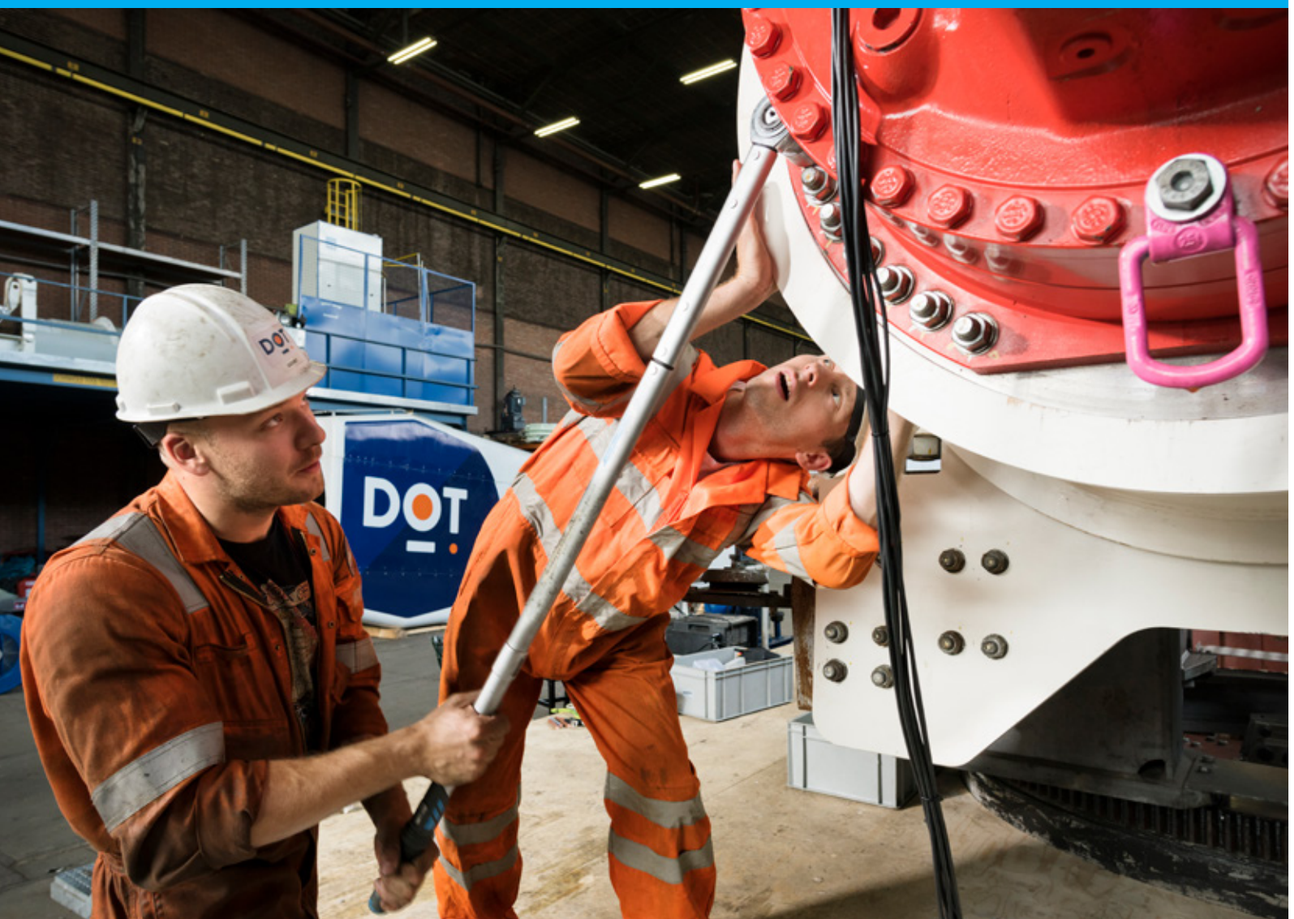
Wind Farm Site V, Innovation Site

Project and Site Description

Version September 2017

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

Contents



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Foreword

The Netherlands Energy Agreement plan for 4,500 MW of cumulative offshore wind capacity in Dutch waters by 2024 is firmly underway. In line with our offshore wind roadmap, two tender rounds for a combined capacity of 1,380 MW have already been held. Both were for projects in the Borssele Wind Farm Zone (BWFZ) and both resulted in record low prices for offshore wind development at the time. With three additional 700 MW tenders planned by end 2019 - two in the Hollandse Kust (zuid) WFZ (HKZWFZ) in 2017 and 2018 and one in the Hollandse Kust (noord) WFZ (HKNWFZ) in 2019 - we are optimistic we will continue to see quality low-cost competitive bids from the industry. Indeed, in light of recent history in the sector, we could see zero-subsidy offshore wind development occur in our waters sooner than expected. Nonetheless, zero-subsidy development is not necessarily the same as long-term cost-effective sustainable power production and supply.

With our 20 MW innovation site tender at Borssele Wind Farm Site V (BWFS V), our goal is to help the industry reduce costs further and reach a stage of true competitiveness with fossil-fueled power stations in terms of levelised cost of electricity. In doing so, we are working to provide the Dutch nation with a secure, sustainable and cost-effective source of clean electricity in line with our national aim to have a totally carbon-free energy supply by 2050.

With all our main tenders, the Government has assumed a leading proactive role in a bid to minimise risk and cost for developers. We have done this, for example, by firmly committing to a five-year offshore wind roll-out plan as well as looking towards the longer term 2050 horizon. This gives industry the policy stability investors require. Moreover, we have assumed responsibility and costs for the site studies developers need to optimise their project designs. The state transmission system operator, TenneT, is also assuming responsibility and costs for building and operating the grid network and transmission infrastructure required. Combined, this proactive stance has contributed significantly in driving overall project costs down substantially.

With the innovation tender for BWFS V, the Government is again being proactive, providing all the necessary site studies via the Netherlands Enterprise Agency (RVO.nl) and grid connection infrastructure via TenneT.
This time, however, our goal is to help bring research and development (R&D) innovations currently at Technology Readiness Level 7 (ready for a system prototype demonstration in an operational environment) up to Technology Readiness Level 9 (proven in an operational environment) and thus fully to commercial reality.

We recognise that while taking technology through this stage is tough for any innovation, the costs and practicality of doing so for new large-scale offshore technology can be hugely prohibitive. In allocating space for a 20 MW innovation site within the borders of BWFS III, the major obstacles traditionally faced are immediately eliminated.

Firstly, it means the innovations will be installed and operated in a true real-conditions environment, enabling them to fulfil the requirements to reach TRL 9 stage. Secondly, the costs of doing so are dramatically reduced: the required grid-connection and electricity transmission infrastructure is already planned for BWFS III and can easily incorporate the needs of the demonstration projects in BWFS V. This therefore negates the need for completely independent infrastructure (cables, transformer platforms etc.) that would otherwise be required and avoids the huge cost that would arise from having to implement such infrastructure for just one or two turbines at sea.

By capitalising on economies of scale, we are able to transition the innovative technologies from TRL 7 through to TRL 9 in the most cost-effective way as well as in the most accurate way possible. So for BWFS V, we are seeking applications from consortia to install, operate and maintain, one or two innovative turbines. Each turbine must have a minimum nominal capacity of 6 MW. There is no maximum capacity per turbine, but the maximum for the site as a whole is 20 MW, thus offering maximum flexibility. Eligible innovations are not just limited to the turbine itself but can relate to any aspect of an offshore wind system, incorporating foundation design, installation methods, operations and maintenance, or decommissioning.

Importantly, cost will not be the overriding factor when it comes to judging bids. Rather, the one that contributes most to the Government's overall offshore wind innovation objectives, including cost reduction, will win. Hence, a number of qualitative ranking criteria have been formulated in the new Ministerial Order for Innovative Offshore Wind Energy. Another key difference from others tenders is that, in addition to the project permit and SDE+ operating subsidy, an investment subsidy is also available, allowing for financing to be provided before the operating phase.

This Project and Site Description outlines all the tender rules, policy details and site study results required to help consortia prepare successful bids that could see their innovations brought to life in a real operating environment at BWFS V. It also provides links to further information and key contacts which could be of help.

It should be stressed, the 20 MW planned is not just for show. The one or two turbines planned will be expected to contribute their full share of electricity supply to the Dutch national grid network in the same way the larger projects in the BWFZ, HKZWFZ and HKNWFZ will. In doing so, they play their part in helping achieve the goals laid out in the offshore wind roadmap and in the process will become commercially viable proven technology that financing markets will be confident to support. We have every confidence the offshore wind industry will meet this challenge admirably.

Manon Janssen
(Top Sector Energy)

Sandor Gaastra
(Director-General Energy, Telecommunications and Competition, Ministry of Economic Affairs)

1. Objectives and Reading Guide

1.1 Objectives

This Project and Site Description (PSD) is designed to help any party with an interest in participating in the planned grant and permit tender for Borssele Wind Farm Site V (BWFS V) in the Borssele Wind Farm Zone (BWFZ) in the Netherlands.

BWFS V has been designated as an innovation site. The 20 MW site was originally included as part of Borssele Wind Farm Site III (BWFS III). Site investigations conducted prior to the separation of the sites included BWFS V and therefore information gathered for site BWFS III is used for this PSD.

This document summarises:

- A description of the site, surroundings and characteristics of BWFS V.
- All data collected by the Netherlands Enterprise Agency (RVO.nl) regarding the physical environment of the Borssele area.
- A selection of constraints, technical requirements and grant related issues that are deemed to be most relevant for development of BWFS V.
- The process for the SDE+ and investment grant, permit and the legal framework. This document has been produced for information purposes only and is not intended to replace any legal or formally communicated rules, regulation 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***.

1.2 Reading guide

The PSD for BWFS V presents an overview of all relevant information for parties interested in preparing a bid for an SDE+ and investment grant and permit to build and operate wind turbines at the sites. This PSD covers the following aspects in the different chapters:

- Chapter 1: Objectives and reading guide.
- Chapter 2: Background - a general introduction to the concept of an innovation site as part of the Dutch offshore wind energy programme, new tender, new rules, new opportunities, eligible innovations and target audience.
- Chapter 3: Borssele Wind Farm Site V - site description - general information on the BWFZ, the location, surroundings, its bathymetry (submarine topography), existing cable and pipeline infrastructure, and TenneT grid connection system.
- Chapter 4: Site data - a summary of all the studies and measuring campaigns performed on the BWFZ, covering the following:
  - Morphodynamic characteristics
  - UXO risk assessment
  - Geophysical survey
  - Archaeological assessment
  - Geotechnical survey
  - Metocean characteristics
  - Metocean measurement campaign
  - Wind resource assessment
- Chapter 5: Legal framework - an overview of the legal framework that is and will be implemented to facilitate the development of BWFS V for innovation.
- Chapter 6: Specific requirements - an overview of the most relevant design parameters, coordinates, permit requirements found in the various acts, decrees, ministerial orders and Wind Farm Site Decision, described in chapters 3 and 5. It also provides an overview of the status of the SDE+ framework. This overview is not complete and does not replace any legal documents, but it aims to provide information that is relevant to prepare a tender bid submission for BWFS V.
- Chapter 7: Next steps - an overview of the process for granting a subsidy and permit, including useful links and key dates.
- Chapter 8: Innovation offshore wind power - an overview of the sector and relevant parties, Dutch innovations and the role of TKI Wind op Zee, knowledge institutions and universities.
- Chapter 9: Applicable documents.

This PSD contains three appendices, which can be found as separate documents;

- Appendix A: Applicable Law
- Appendix B: Summary of Environmental Impact Assessment
- Appendix C: Boundaries and coordinates Borssele Wind Farm Zone.

2. Background

2.1 Why an innovation site?

The Dutch Government is fully committed to supporting the roll out of cost-effective offshore wind energy for the long-term, in line with the ambitions set out in the Netherlands' Energy Agreement. The Agreement calls for 4,500 MW of cumulative installed offshore wind power and a 40% drop in offshore wind costs by end 2023. In addition, it also sets a national goal for a fully zero-carbon energy supply by 2050. Offshore wind is expected to play a significant role in achieving this 2050 goal.

Both nationally and internationally, more and more experience is being gained with offshore wind. This is helping to drive down costs and increase efficiency. But both the Dutch Government and the offshore industry agree that further cost reductions are possible. This requires innovations to be put to work in almost every sphere of the sector, including wind turbine technology, foundation design, installation procedures, operations and maintenance, and decommissioning.

The industry and R&D institutions are already working on such innovations. Transitioning those innovations fully out of the laboratory environment into commercial reality is, however, a difficult and sometimes prohibitively costly exercise for suppliers. An innovation will not become commercially viable until it has gone through experimental phases and validation at Technology Readiness Level (TRL) 7-9. TRL 7 is when an innovation reaches the stage for a system prototype demonstration in an operational environment, while TRL 9 is when the actual system is proven in an operational environment. Offshore demonstration projects can be very costly and complex.

For these reasons, in consultation with the offshore wind industry, the Government decided to reserve a 20 MW innovation Wind Farm Site in the Borssele Wind Farm Zone (BWFZ). This means the 20 MW can connect to the transmission network (TenneT's platform beta) already planned for the offshore wind farms being built at BWFS III and IV. In this way, substantial cost is saved compared to a standalone solution. In being deployed at the innovation site, commercial feasibility and bankability of the winning innovations will be substantially improved.

2.2 Roadmap towards 4,500 MW offshore wind

The innovation site is designated as BWFS V. Located within the original boundary of BWFS III (see Chapter 3), the 20 MW is included within the Government's 4,500 MW by 2023 grid-connected offshore target. In September 2014, the Minister of Economic Affairs presented an Offshore Wind Roadmap to parliament, outlining how the Government plans to achieve its goal. The roadmap outlines a schedule of tenders offering 700 MW of development each year in the period 2015 – 2019 (see Figure 1), with development split across three Wind Farm Zones: 1,400 MW each for Borssele and Hollandse Kust (zuid) and 700 MW for Hollandse Kust (noord). In effect, the capacity for BWFS III was reduced from the 700 MW originally envisaged to 680 MW. Importantly, the 20 MW at BWFS V is still expected to contribute its share of green electricity to the Dutch national grid network to ensure the roadmap goals are achieved.

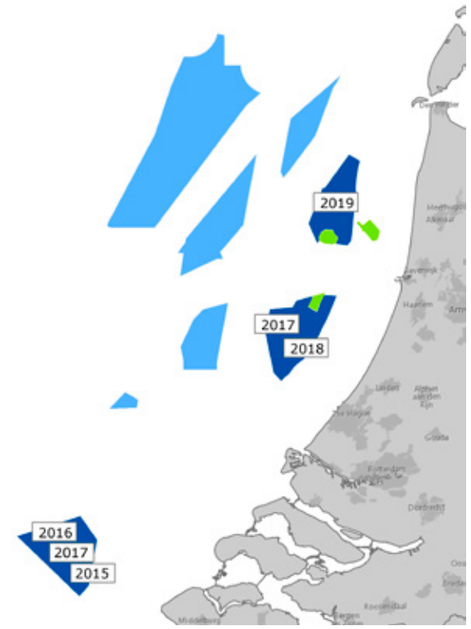


Figure 1 Tender timetable for the Dutch offshore wind rollout. Wind Farm Zones to be tendered are shown with year of tender date. Existing wind farms are green and future Wind Farm Zones are light blue

The Government recognises that as well as allocating space for the innovation site and access to the electricity transmission network planned in the BWFZ, extra financial support for innovators is also required. The possibility was created in 2009, in the Decision for the Production of Electricity Using Offshore Wind Energy, to provide a subsidy for "the extraordinary and high-risk application of innovative wind turbines". This will therefore be used for the innovation site, with companies and organisations being invited to submit bids for the projects.

2.3 New tender, new rules, new opportunities

The Ministry of Economic Affairs, via Netherlands Enterprise Agency, is responsible for organising the innovation site tender. This includes gathering all the site data (see Chapter 4) required for participants to prepare a successful bid as well as overseeing the actual tender process itself.

The design of the innovation site will mirror as much as possible how the regular Borssele tenders are operated, deviating from this where necessary. The innovation tender will thus seek applications to install, operate and maintain, one or two innovative turbines at BWFS V. Each turbine must be a minimum of 6 MW, allowing for a maximum capacity of 20 MW.

The subsidy rules for the innovation tender are different to the rules governing the large-scale offshore wind projects already planned for the BWFZ, where the lowest cost was the defining criteria and the subsidy awarded was an operating subsidy. For the innovation site, the winning application will be the one that contributes most to the Government's overall offshore wind innovation objectives, as follows:

- Create an opportunity for companies established in the Netherlands to test or demonstrate highly-developed technology before actual market introduction (showcase). This mainly relates to innovations in the final pre-commercial stage, in line with the TRL 7-9 focus, that lend themselves less well to experimentation at the regular Wind Farm Sites;
- Contribute to reducing the cost of offshore wind energy;
- Contribute to the Dutch economy through expansion of the market and (export) potential for Dutch companies;
- Contribute to building knowledge in the Netherlands by involving Dutch SMEs and Dutch knowledge institutions.

A number of qualitative ranking criteria have therefore been formulated in the new Ministerial Order for Innovative Offshore Wind Energy for this purpose. See paragraph 5.3.6.

Significantly, as well as receiving an operating subsidy, winners can also receive an investment subsidy, whereby finance can be provided before the operation phase, independent of the amount of energy eventually produced. The present Decision for the Production of Electricity Using Offshore Wind Energy provides also a framework for the investment subsidy specific for Innovative Offshore Wind Energy to facilitate this form of subsidisation, based on the new wind farm site system in the Offshore Wind Energy Act. In view of the experience that still needs to be gained with this system, the present Decision is provided with broader delegation provisions than is the case for a regular operation subsidy.

Finally, the operation phase will commence as soon as the installation enters into operation.

2.4 Eligible innovations and target audience

Eligible innovations are not just limited to the turbine system itself, but bids can include innovations relating to:

- Wind turbines and wind turbine components
- Foundations;
- Installation methods and equipment;
- Operation & maintenance related methods and equipment;
- Decommissioning methods and equipment; and
- Any associated offshore wind system technology innovation.

Applications are welcome from consortia of various types. For example:

- Turbine and/or foundation supplier(s);
- Utility/project developers; or
- A mix of the above, complemented with other parties which want to demonstrate an innovation.

Participants are free to participate in more than one consortium. However be aware that the equity capital of a participant in a collaborative venture or the equity capital of the parent company of the participant can be included for just two applicants. See for more details Appendix A.

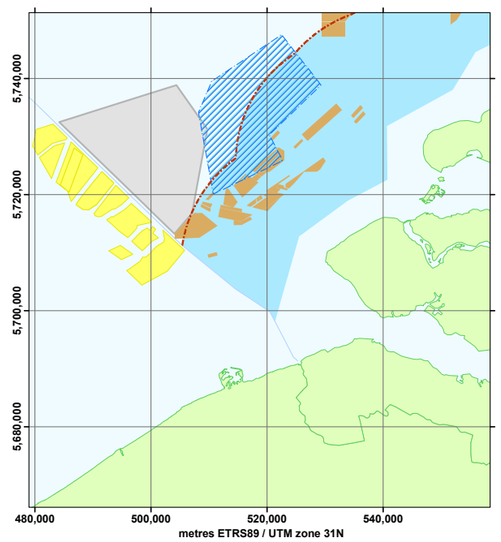
Please refer to Chapter 5 (Legal Framework) and Chapter 6 (Specific Requirements) for full details on the tender rules and legislative guidelines.

3. BWFS V - site description

3.1 General description of the Borssele Wind Farm Zone

The BWFZ, shown in Figure 2, is located at the southern border of the Netherlands Exclusive Economic Zone (EEZ); 0.5 km from the Belgium EEZ. The zone borders a sand extraction area in the southeast and a piloting area in the east. Anchoring areas and a shipping lane are located at the north side of the zone. The Belgian dedicated offshore wind farm zone is located directly to the southwest.

Figure 2 The Borssele Wind Farm Zone and surrounding areas



3.2 Layout and coordinates of BWFS V: Route to V

BWFS V is 0,59 km² in size. The surface areas referred to exclude the locations of export cables and TenneT's grid connection system including its safety and maintenance zones.

Figure 3 shows the Borssele Wind Farm Zone. The coordinates of the boundaries, maintenance zones, infield cable corridor and safety zones are given in Appendix C. The cable entry zone to the platforms alpha and beta are shown in § 3.7 of this document. All coordinates are published in Appendix C; Boundaries and coordinates Borssele Wind Farm Zone. The rotor blades of installed wind turbines are only allowed within the border coordinates of the specific zone. No turbines or rotor blades are allowed within the maintenance zones. Mooring systems for floating foundations must be deployed within the contours of the site. Subsea infield cables must follow a route through a specified corridor toward the TenneT platform beta.

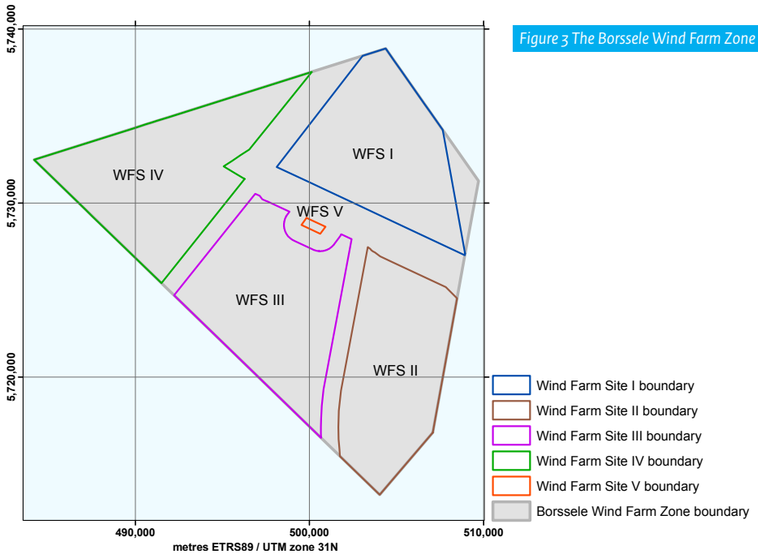


Figure 3 The Borssele Wind Farm Zone

The basic bathymetry of BWFS V is shown in Figure 4. More detailed bathymetry, morphodynamical and metocean information relating to the zone is provided in following chapters.

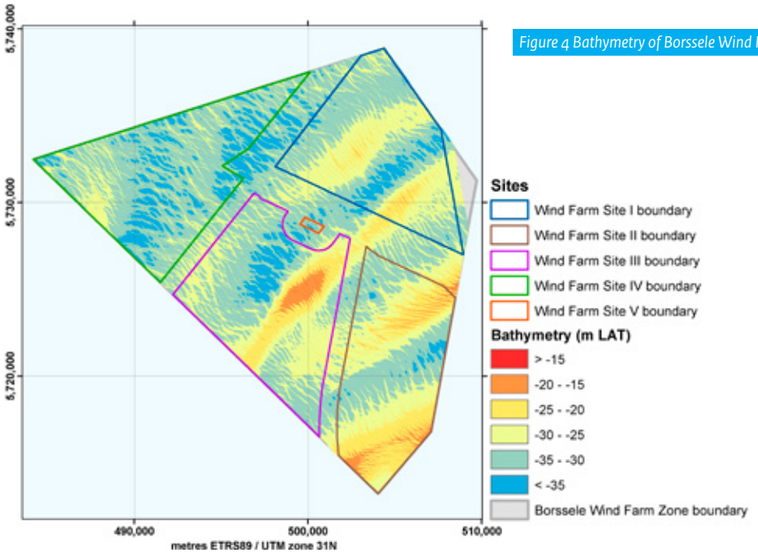


Figure 4 Bathymetry of Borssele Wind Farm Zone

3.3 Existing infrastructure

Several operational cables and pipelines cross the BWFZ, as shown in Figure 5, but none cross BWFS V.

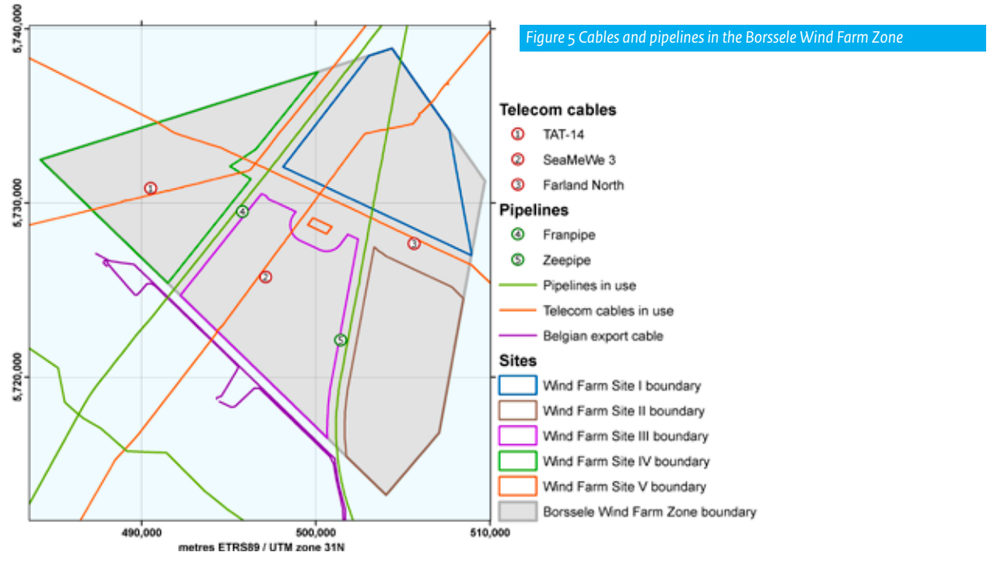


Figure 5 Cables and pipelines in the Borssele Wind Farm Zone

A description of the different cables and pipelines can be found in table 1.

Table 1: Description of pipelines and cables in the Borssele Wind Farm Zone.

Name	Description
TAT-14	Transatlantic telecommunications cable
Franpipe	Natural gas pipeline from a Norwegian gas field to France
SeaMeWe 3	Segmented telecommunications cable between Western Europe and South East Asia
Farland North	Telecommunications cable between the UK and the Netherlands
Zeepipe	Natural gas pipeline from a Norwegian gas field to Zeebrugge (Belgium)

Several abandoned cables and/or pipelines also run through the Borssele area. An overview of these can be found at: ***offshorewind.rvo.nl***.

3.4 Nearby Belgian wind farms

The Dutch Belgian border is located immediately south of the BWFZ. The Belgian dedicated offshore wind farm zone is directly opposite this border - this is where several Belgian wind farms are operational or under development (Table 2). This information is subject to change, with the latest information available from the Belgian authorities.

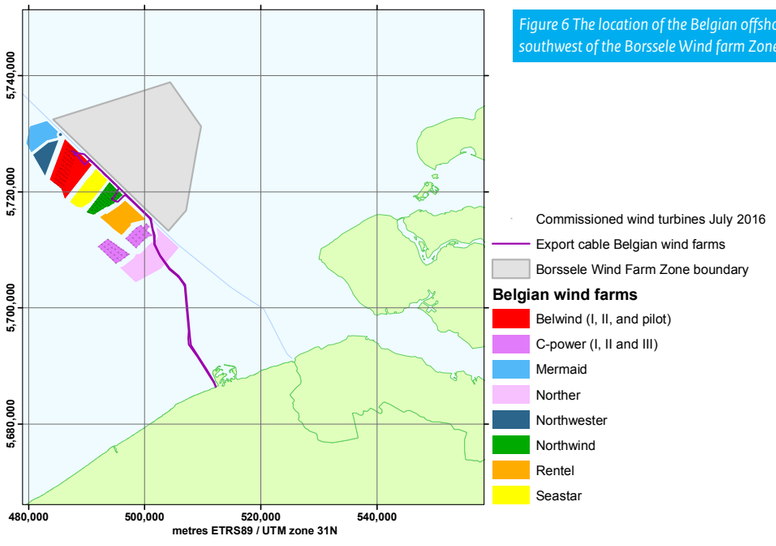


Figure 6 The location of the Belgian offshore wind farms directly southwest of the Borssele Wind farm Zone

Table 2: Characteristics of the Belgian wind farms July 2017.

Name	Hub-height / rotor diameter [m]	Turbine type	Individual turbine rating [MW]	No. of turbines	Total capacity [MW]	Status
Belwind I	76/90	Vestas 90	3	55	165	Fully commissioned
Belwind II	72/112	Vestas 112	3.3	50	165	Under development
Belwind-Pilot	100/150	Haliade	6	1	6	Fully commissioned
Northwind	84/112	Vestas 112	3	72	216	Fully commissioned
C-Power I	94/126	Senvion 5M	5	6	30	Fully commissioned
C-Power II	95/126	Senvion 6.2M	6.15	24	147,6	Fully commissioned
C-Power III	95/126	Senvion 6.2M	6.15	24	147,6	Fully commissioned
Rentel	106/154	Siemens SWT-7.0-154	7	42	294	Under Development
Seastar	?/?	ND	4-10	41-62	246	Consent received
Norther	98/164	Vestas VV 164	8	44	350	Under development
Mermaid	?/?	ND	3.3-10	24-80	266	Consent received
Northwester 2	?/?	ND	3-10	22-70	224	Early planning

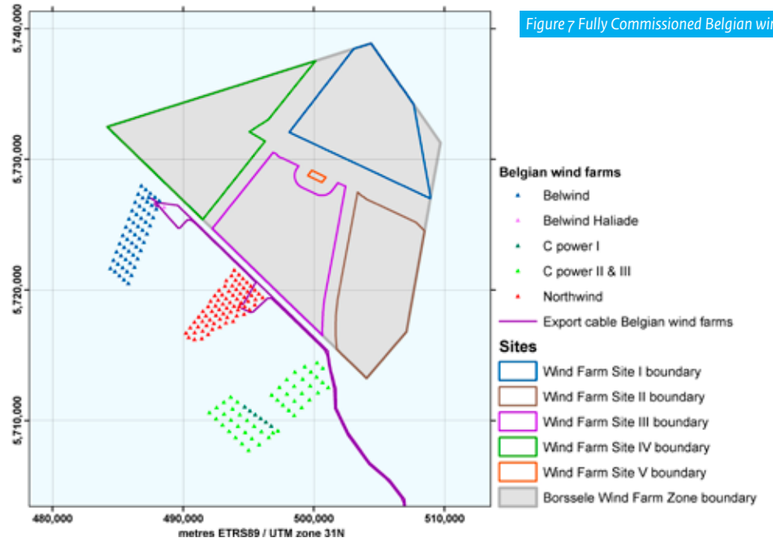


Figure 7 Fully Commissioned Belgian wind farms

3.5 Exclusion Zones

Between the Belgian Wind Farm Zone and BWFZ, a safety zone of 500 m is in place on both sides of the border. Full coordinates and boundary details are published in Appendix C; Boundaries and coordinates Borssele Wind Farm Zone. Pipelines and cables, plus their maintenance zones (500 m on both sides of the pipes/cables), are excluded from the different parcels. Turbine blades are not allowed outside the BWFS boundaries. As shown in Figure 8, a shipping corridor also runs through BWFZ from east to west. Under the National Water Plan 2, vessels up to 24 m are allowed to cross the entire BWFZ. TenneT awarded the contract for Borssele beta platform 01 September 2017.

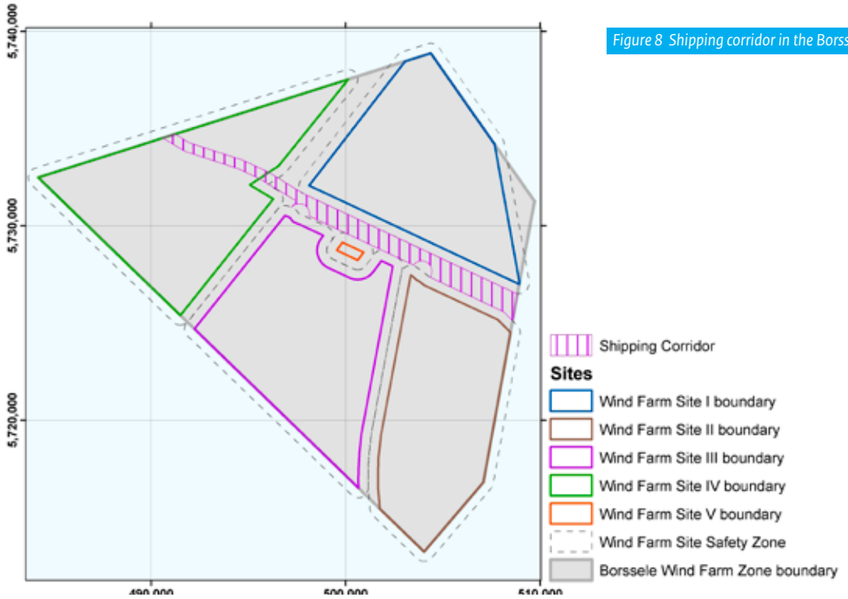


Figure 8 Shipping corridor in the Borssele Wind Farm Zone

3.6 TenneT offshore grid connection system

The planned Borssele alpha and beta platforms are shown in Figure 9. Platform alpha, beta, its 220 kV export cables and the 66 kV link between platform alpha and beta are part of the offshore grid Borssele. Infield cables from the wind farms will connect directly to these platforms. BWFS V will connect with one 66 kV inter array cable directly to platform beta. Platform beta will transform the power of BWFS III, IV and V from 66 kV to 220 kV and transport the electricity to shore. Appendix C (Boundaries and coordinates Borssele Wind Farm Zone) shows the border coordinates of the infield cable corridor. The position points of platform beta are shown in table 3. Permits and licenses for the Borssele offshore grid became irrevocable as of March 2017.

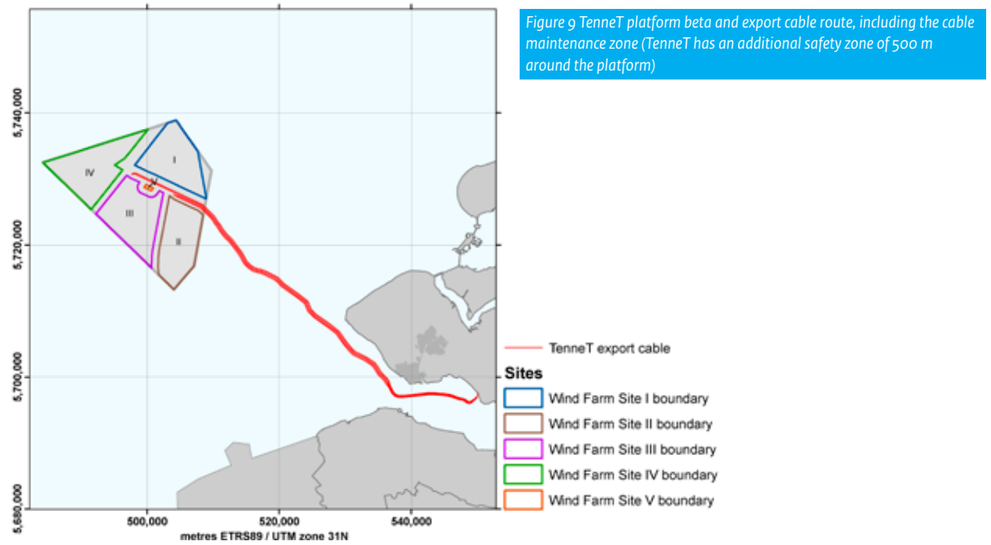


Figure 9 TenneT platform beta and export cable route, including the cable maintenance zone (TenneT has an additional safety zone of 500 m around the platform)

Table 3: Position points TenneT platform beta.

UTM coordinates (ETRS89, zone 31)		
Platfotm	**Easting**	**Northing**
Beta	497620.7	5730622.0

More information regarding the current status can be found via the websites:

1. ***http://www.rvo.nl/subsidies-regelingen/transmissiesysteem-op-zee-borssele*** (draft decisions and MER net op zee)
2. ***http://netopzee.eu/borssele*** (offshore grid Borssele)
3. ***http://www.tennet.eu/netopzee*** (more information regarding the Dutch offshore grid)

3.7 Cable Entry Zone

The cable entry zone from BWFS III and V towards TenneT offshore substation beta is shown in Figure 10.

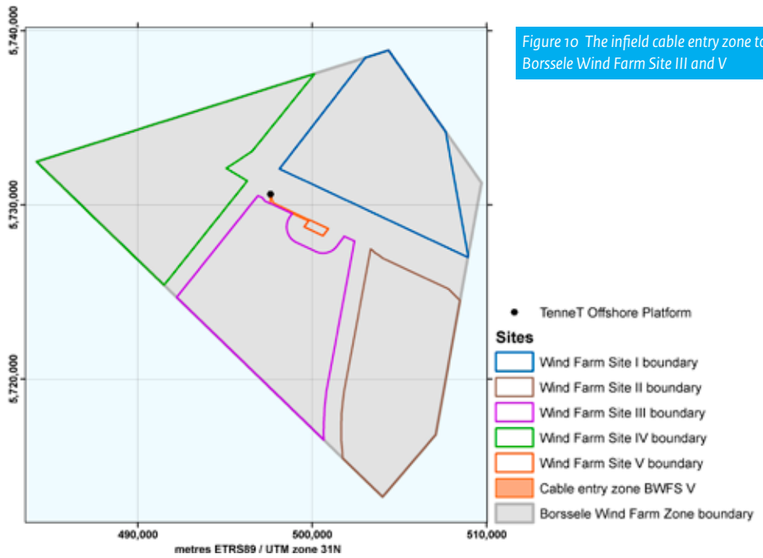
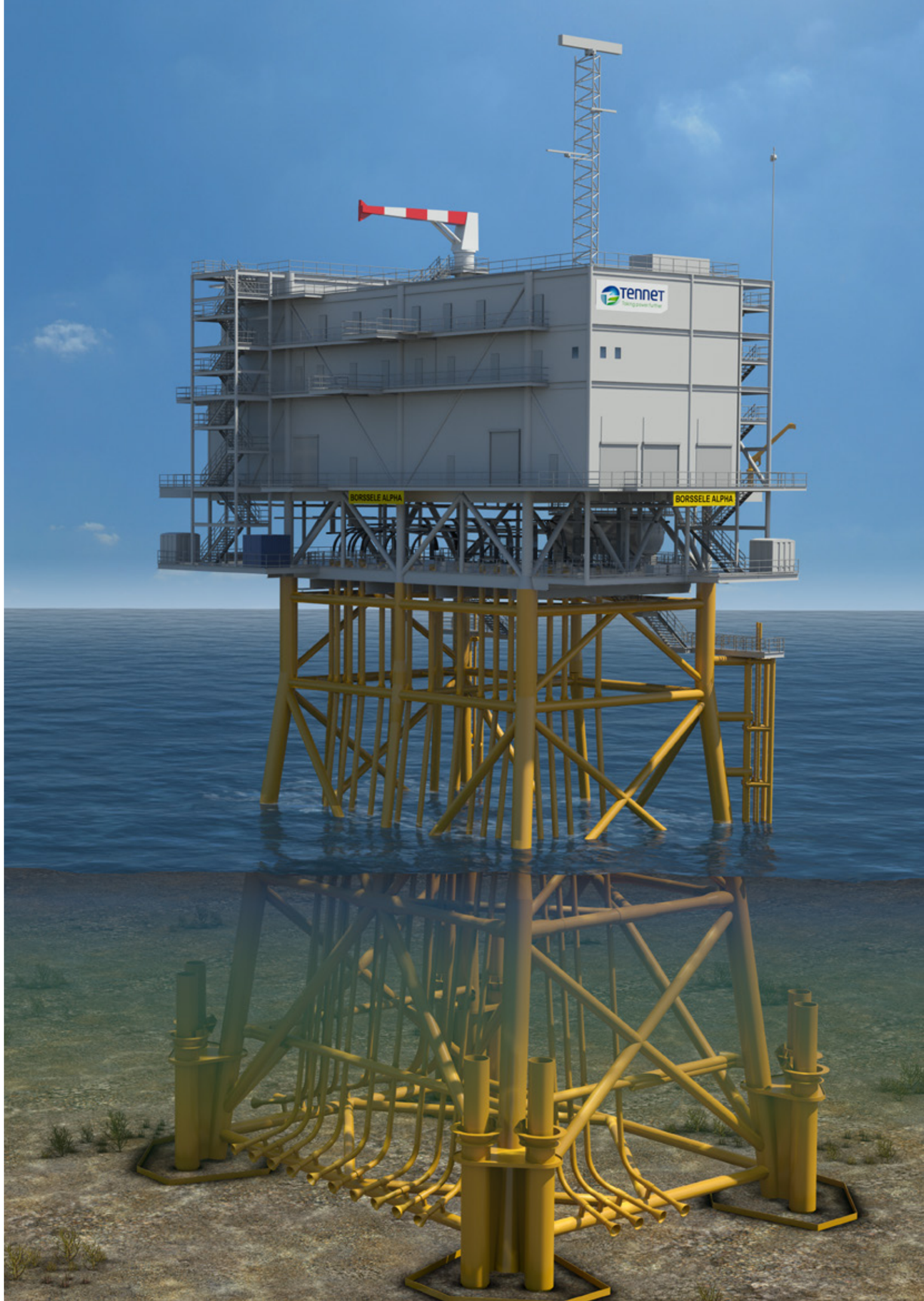


Figure 10 The infield cable entry zone to the TenneT platform beta from Borssele Wind Farm Site III and V

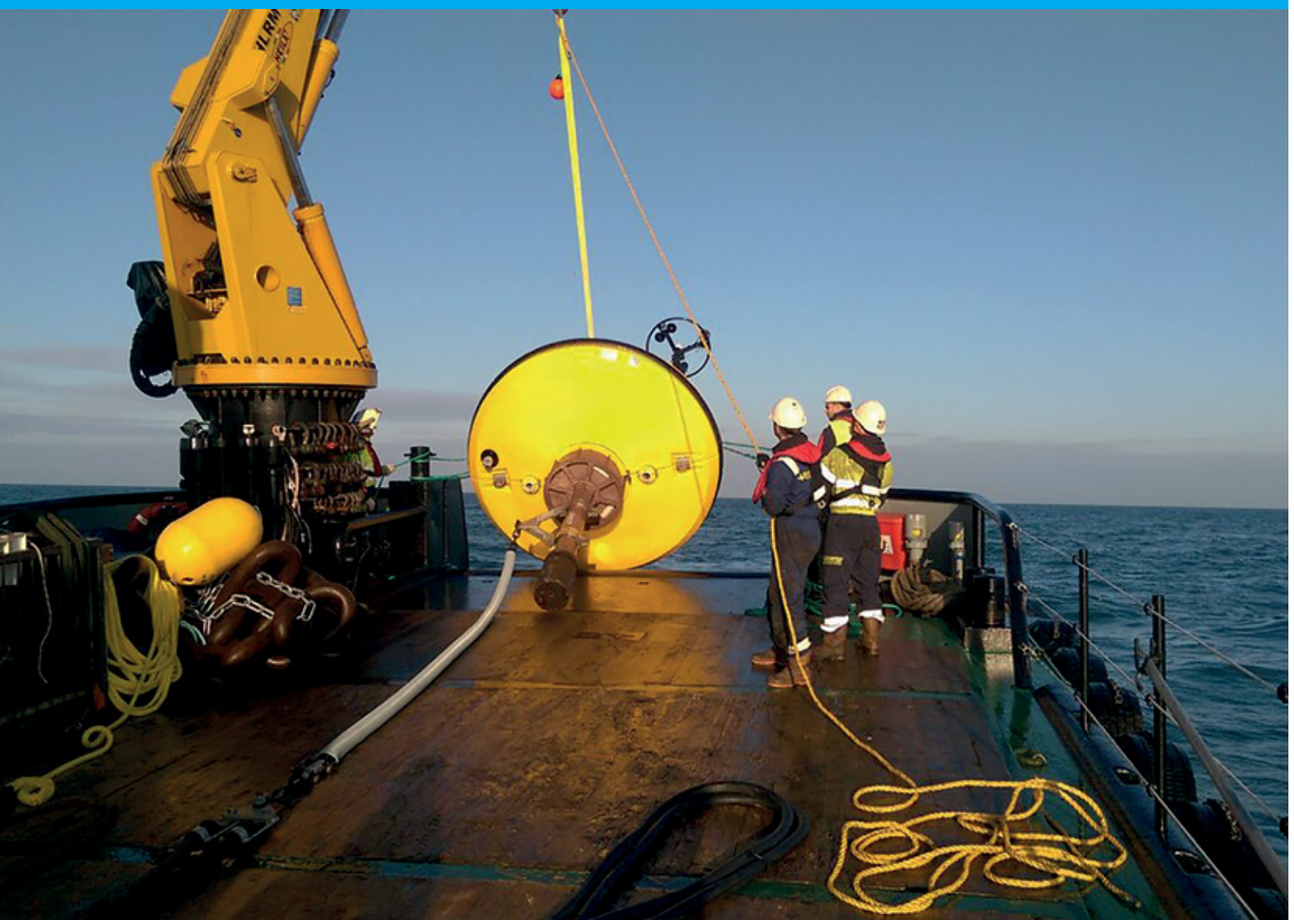
In table 4 the coordinates of the infield cable entry BWFS V is shown.

Table 4: Coordinates infield cable entry BWFS V.

BWFS V Cable entry zone	UTM coordinates (ETRS89, zone 31)	
Point No.	Easting	Northing
T_2	497,620.7	5,730,622.2
T_14	497,615.4	5,730,568.7
P_88	497,769.0	5,730,118.6
P_86	499,836.2	5,729,146.6
P_87	499,774.9	5,729,064.9
P_54	497,575.3	5,730,099.1
T_22	497,603.4	5,730,569.9
T_21	497,609.5	5,730,630.6



4. Site data



4.1 Introduction

The Netherlands Enterprise Agency is responsible for collecting site information that companies require to prepare bids for the SDE+ subsidy and permit tenders for the entire BWFZ. The site information package should be of sufficient detail and quality to be used as input for, as an example, front-end engineering design studies. A detailed overview of the approach, procurement of the studies and quality assurance can be found in § 4.2.

For studies relevant for foundation, infield cables and wind turbine design, a certifying authority (DNV GL) reviewed the reports and provided a Verification Letter (metocean, morphodynamics, geophysical survey, and geotechnical survey) to assure the results were acquired in compliance with the DNV-OSJ101 and/or other applicable industry standards. Where applicable, Verification Letters and/or statements of conformity are added to the report.

BWFS V was originally part of BWFS III. As such, the site studies originally conducted for BWFS III also apply for BWFS V and are used throughout this PSD, although new graphs pertaining to Site V have been produced specifically for this PSD. Parties interested in submitting bids for BWFS V are minded to note that they will have to refer carefully to data in the BWFS III site studies in preparing their tenders. The most up-to-date information on site data, including the results can be found at ***offshorewind.rvo.nl***. The site also contains maps, minutes of workshops, and a Q&A and revision log.

Figure 11 shows how the various studies and investigations relate to each other as well to which element of the wind farm design they feed into.

In the following paragraphs the scope and results of the relevant studies and investigations are summarised as follows:

4.2 Geological desk study
4.3 Archaeological desk study
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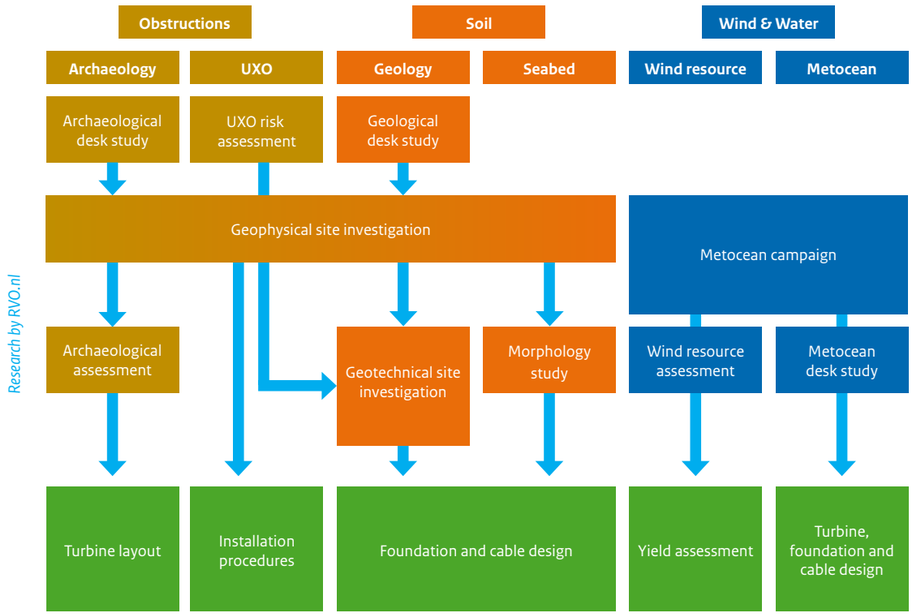
4.7 Geotechnical survey
4.8 Morphodynamical desk study
4.9 Meteorological and oceanographic (Metocean) desk study
4.10 Meteorological and oceanographic (Metocean) measurement campaign
4.11 Wind resource assessment
4.12 Site investigation QA-QC procedures

Figure 11 Site Studies and investigations for the Borssele Wind Farm Zone



4.2 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 and so the desk study is not described further in this PSD. Results of this study can be found on ***offshorewind.rvo.nl***.

4.3 Archaeological desk study

4.3.1 Introduction

The purpose of the archaeological desk study is to provide insight into any archaeological aspects that impact the development of the BWFZ. The main objectives of the study are:

1. Assess whether there are (indications of) areas of specific archaeological interest (wrecks and prehistoric life) at the BWFZ;
2. If present, specify expected locations, size and dating of the areas;
3. Determine possible effects of offshore wind farm installation on the areas of specific archaeological interest;
4. Assess options to mitigate disturbance on areas of specific archaeological interest;
5. Identify whether further archaeological risk assessments should be carried out and make a recommendation regarding the scope of future investigations;
6. Specify obligations and requirements for any activity carried out in the wind farm zone (including site investigations and/or monitoring, installation, and operational activities) that could have an effect on archaeological aspects.

4.3.2 Supplier

Vestigia Coastal and River Archaeology, a subsidiary of Vestigia, was selected to perform the archaeological desk study. This subsidiary combines the offshore archaeology expertise of Vestigia and its cooperating partners. Vestigia has a track record in maritime archaeological preparatory research, including Nuon's offshore wind prospects, Maasvlakte 2 and the COBRA cable between the Netherlands and Denmark.

4.3.3 Results

The desk study was performed prior to the geophysical and geotechnical investigations. The report assesses the presence of early prehistoric sites from an era when the North Sea was still land, as well as historic shipwrecks, lost cargo and crashed airplanes.

Prehistoric sites:

1. No early prehistoric sites have been identified within the BWFZ itself, the nearest being nine miles southeast of the zone.
2. Where present, prehistoric remains are located at a depth of 30-40 m below sea level. This means the site has been submerged by the expanding North Sea around 7000 BC and therefore possible settlements will most likely be older. However, population density in North-western Europe during these early stages of prehistory was very low. Therefore, the density of archaeological traces of those people is also low while the chance of any traces being well preserved is even lower. In conclusion, the chances of encountering prehistoric archaeology within the BWFZ are small (low sensitivity).

Historic shipwrecks:

1. Three shipwrecks have previously been identified within the BWFZ, one of which is located in area covering site III, IV and V. There are also a number of unidentified obstructions, four of which are located in site III, IV and V area. These could either be wrecks, part of wrecks, anchors, cargo or garbage. They may also be the remains of aircraft lost in the World War II. The recorded shipwrecks and objects may or may not be of archaeological significance. As it is impossible to determine the archaeological significance of these obstructions, these locations are best avoided during development.
2. Vestigia found no record of systematic surveys using side-scan sonar or other geophysical techniques within the BWFZ, mainly because the area has not been of commercial interest until now. The reported discoveries are considered random ones. The low number is, however, in no way a reflection of the actual density of historic archaeological sites. More undiscovered shipwrecks and other historical objects are likely to be present within the zone. Therefore, the chance of encountering further historic archaeology (shipwrecks, airplanes, etc.) within the BWFZ is considered to be average (medium sensitivity).

4.3.4 Conclusions and recommendations

No early prehistoric sites have been identified within the BWFZ itself and the likelihood of encountering prehistoric archaeology within the zone is small. Therefore, further archaeological surveys are not recommended.

Historic shipwrecks have been identified in the area while other shipwrecks of high archaeological significance have also been found in the vicinity, leading to an average chance of encountering historic archaeology.

The recommendations of Vestigia were taken into account during the geophysical survey (chapter 4.5) and the archaeological assessment (chapter 4.6).

4.4 Unexploded ordnance (UXO) assessment

4.4.1 Introduction

The UXO desk study looks at areas in the BWFZ with an increased risk of encountering unexploded ordnances (UXOs). The main objectives of this study are:

1. Identify constraints for activities relating to offshore wind farm development in the BWFZ due to the presence of UXOs;
2. Identify areas within the BWFZ where wind farm or cable installation should be avoided;
3. Identify requirements (from an UXO perspective) that should be taken into account for:
   - Determining the different concession zones in the Wind Farm Zone;
   - Carrying out safe geophysical and geotechnical investigations;
   - Safe installation of wind turbine foundations;
   - Safe installation of inter array cables.

4.4.2 Supplier

REASEuro performed the UXO desk study. The company specialises in offshore UXO studies, serving clients involved in dredging, wreck recovery and offshore wind construction. Since 2012, REASEuro has been involved with several offshore projects in the Persian Gulf, performing data analysis, project risk assessment and coordination of demining activities. The project team members for this assessment have specific North Sea experience from their previous employment at Van Oord Dredging and the demining department of the Royal Netherlands Navy.

4.4.3 Results

The BWFZ and surrounding areas were the focus of many war-related activities during World War I and World War II. In both wars a large number of naval mines were deployed in the North Sea, but they were only partially removed after the war. The BWFZ is also located along the main flight path of Allied bomber raids - many bombs were dropped and a large number of aircrafts have crashed in the North Sea (see Figure 14).

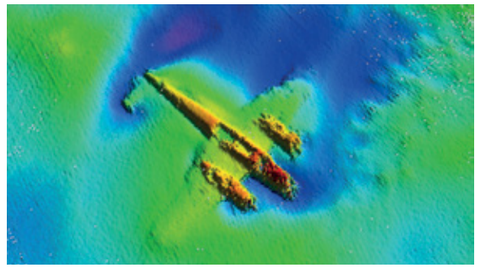


Figure 12 A scan of the sea bed in the English Channel shows the Dornier-17 German bomber, buried under the sand since World War II

Since World War II some ordnances are likely to have moved as a result of fishing, tidal streams and seabed migration. Overall, the whole of the BWFZ is considered an UXO risk area. This has been validated by the fact that since 2005 over 20 UXOs have been found by fishermen.

A UXO can be sensitive to hard jolts, change in water pressure and acceleration with an amplitude >1m/s². A detonation can lead to serious damage to equipment and injuries to crewmembers. The possible presence of UXOs in the area, however, is not considered a constraint for offshore wind farm related activities. By using proper UXO Risk Management strategies, risks can be minimised as low as reasonably practicable (ALARP).

A challenge in UXO Risk Management at BWFZ is movement of the UXO over the seabed. This can lead to resurfacing UXOs that were buried during preliminary scanning and introduction of new UXOs by sea currents or fishing activities. Therefore, monitoring needs to be a crucial aspect of all development phases, closely integrated into the UXO Risk Management plan.

The report provides a number of recommendations for each phase in the development:

1. Preparation phase
   a. A geophysical (bathymetric) survey should be conducted to assess geomorphology and identify objects - Netherlands Enterprise Agency has already conducted this survey (See chapter 4.5)
   b. In case of any soil intrusive operations, an UXO search of the area affected should be conducted and any discovered UXOs should be cleared. The clearance operation should be conducted by a certified EOD company.
2. Execution Phase
   a. UXO-related risk assessment based on the first draft of the wind farm design and optimisation of the design based on the outcomes.

b. UXO risk mitigation strategy, which includes a search for and safe removal of UXOs. 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 wind power companies to remain vigilant and remember that UXOs can move as a result of tidal streams, mobility of sand waves and seabed usage.
   b. Maintenance and Monitoring Plan.

4.4.4 Conclusion and recommendations

UXOs from both world wars are likely to be present at the site, which is therefore considered an UXO risk area. However, with proper UXO Risk Management, the risks can be minimised. Due to the highly dynamic soil morphology, it is recommended companies conduct UXO search and removal operations immediately prior to construction activities at specific locations. The validity of the collected magnetometer survey data in regards to tidal streams, mobility of sand waves and seabed usage should be taken into account when planning survey and construction operations. The time lapse between project phases should be limited. Due to the time-limited nature of findings, a dense magnetometer survey to detect UXOs was not part of the geophysical survey objectives. Chapter 4.6 (archeological assessment) advises to have active archaeological supervision on board during the UXO research.

4.4.5 UXO removal procedure

If a wind farm developer identifies an UXO on a location where a foundation of a wind turbine is planned, it should be reported to the Dutch Coast guard. A developer is not allowed to undertake UXO removal with a qualified contractor. The Royal Netherlands Navy is responsible for the removal and disposal of all UXO encountered. Dutch authorities will cover costs of this removal. Rijkswaterstaat Zee en Delta, part of the Ministry of Infrastructure and the Environment, is the competent authority regarding the public security. It is advisable to consult the competent authorities in regards to management measures that can be taken to prevent stagnation in the execution phase. A possible measure is to safely move the UXO outside the work area awaiting destruction.

4.5 Geophysical survey

4.5.1 Introduction

The objective of the geophysical survey is to:

1. Obtain an accurate bathymetric chart of the development areas BWFS III, IV and V;
2. Identify/confirm the positions of known 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 geohazards within the shallow geological succession such as faulting, accumulations of shallow gas, buried channels, 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.

4.5.2 Supplier

Netherlands Enterprise Agency (RVO.nl) contracted Fugro Survey B.V. (FSBV) to conduct geophysical surveys in BWFS III (encompassing site V) and IV. Fugro is an integrator of geotechnical, survey, subsea and geosciences services. Services are designed to support engineering design and large structure building projects. Fugro has previously performed investigations for offshore wind farm projects in The Netherlands, Belgium, UK, Denmark and Germany. The company is familiar with the local conditions and technical requirements for a geophysical survey of the BWFZ. DNV GL provided a Verification letter for the results of the study.

4.5.3 Results

The geophysical survey was carried out using the survey vessel MV Fugro Pioneer in May and June 2015. Fugro performed the geophysical and bathymetric survey using:

- Side-scan sonar (SSS), magnetometer (MAG), multi- and single beam echo sounder (MBES/SBES), sub-bottom profiler (SBP) with a line spacing of 100 m;
- ultra-high resolution seismic survey (UHR) with a line spacing of 400 m.

The cross lines were planned with 2,000 m line spacing, During the survey 151 km of cross lines were added, to better understand the geology of the survey area.

Bathymetry and seabed features

The bathymetric data shows water depth ranging between from -15 m to -37 m aLAT for BWFS III and V. The seabed is characterised by a complex pattern of shore-parallel sandbanks, with superimposed dunes of different orders.

The major dunes have a general NW to SE and W to E direction, with an average wavelength between 80 m and 550 m with heights ranging from 2.5 m to 11 m. Superimposed on these major sand dunes, other minor dunes with 10 - 20 m average wavelength and heights ranging from 0.25 m to 0.75 m are present. Sediments found within BWFS III and V mostly consist of dense to very dense sands and loose sands. Generally, denser material can be found on the top of the sand dunes, while finer material is found between the sand dune troughs.

Wrecks, cables and pipelines

A number of cables and pipelines have been discovered, some with an offset of several hundred metres in relation to their theoretical charted position (TAT14 J, UK-NL8). All cables were detected by magnetometer (except the UK-NL3 cable, which crosses only a small part of BWFS IV). Three magnetic lineations, which might be related to unknown or uncharted cables, have been found in BWFS III and V.

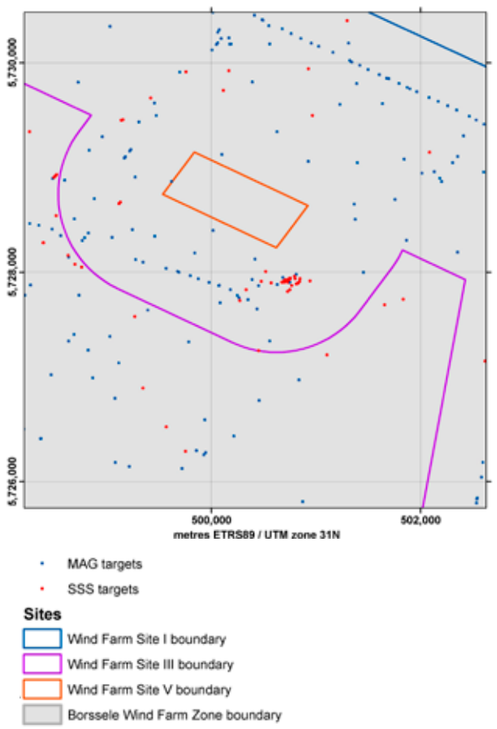
One known wreck and four obstructions are present in the BWFZ. The known wreck was detected with an offset of 75 m from the currently known location. Based on a magnetic anomaly, one of the obstructions might have been detected. No other unknown wreck locations were identified from interpretation of the SSS and magnetometer data.

Unknown objects

The SSS and magnetometer surveys indicated the presence of several objects as shown in the contact chart (Figure 13). All SSS targets observed and spread throughout the entire survey area were concluded to be only debris patches.

No boulders were expected in a palaeo-environmental context and none were identified. It must be noted that the magnetometer survey results provide an indication of the presence of ferromagnetic objects. However, given the line spacing of the survey and the high mobility of the seabed within the BWFZ, these results are not suitable for an UXO analysis.

Figure 13 Contact chart of magnetometer and side-scan sonar survey of BWFS III and V



Geology

The shallow sub-surface geological conditions within the survey area have been interpreted based on pinger and UHR sparker data and information from standard geological charts. Penetration of the pinger SBP was restricted to 20 m below seabed. The limit of interpretation of the UHR data to achieve satisfactory results was set at a depth of 80-100 m. A total of six lithological units were identified in in BWFS IV, only four of which were present in BWFS III and V, as shown in Table 5.

4.5.4 Conclusion

Based on the sub-bottom profiling datasets, Fugro has developed a proposed borehole location plan. This plan includes 6 boreholes and 19 CPT for BWFS III and V. Netherlands Enterprise Agency has developed this into a more extensive Borehole and Seabed PCPT Plan, which has been applied to the geotechnical survey (See chapter 4.7).

Table 5: Geology of BWFZ based on SBP and UHR data.

Unit	Depth of base	Description
UNIT A	1 to 13 m bsb	Holocene in age and expected to comprise loose to dense SAND and is correlated to the Southern Bight Formation.
UNIT B	-30 m to -72 m aLAT	Pleistocene in age and expected to comprise dense to very dense SAND (sometimes stiff to very stiff CLAY), correlated to the Kreftenheye and Eem Formations, deposited respectively in fluvial and shallow marine environment. The base of this unit is a palaeochannel/erosional surface that cuts the Quaternary (Unit C) and Tertiary formations (Unit D and E).
UNIT C	-42 m to -60 m aLAT	Pleistocene in age and characterized by graded lateral lithological variations from stiff to hard sandy CLAY to very dense SAND. This unit is seen in the north-east corner of BWFS IV only. Unit C is expected to comprise stiff to hard sandy CLAY to very dense SAND correlated to the Westkapelle Formation, deposited in a marine pro-delta and delta-front environment.
UNIT D	from -42 m to -74 m aLAT	Tertiary in age and seen in the north-east corner of BWFS IV only. Unit D consist predominantly of very stiff to hard Clay, with at top locally some dense sand beds. It has been correlated to the middle part of the Rupel Formation which corresponds to the Rupel Clay member.
UNIT E	-45 m to -145 m aLAT	Tertiary in age and expected to comprise dense to very dense SAND. It has been correlated to the Tongeren Formation.
	-20 m to -150m aLAT	Tertiary in age and expected to be comprised very stiff to hard CLAY and dense clayey SAND member toward the base. This Unit has been correlated to the Dongen Formation.

4.6 Archaeological assessment

4.6.1 Introduction

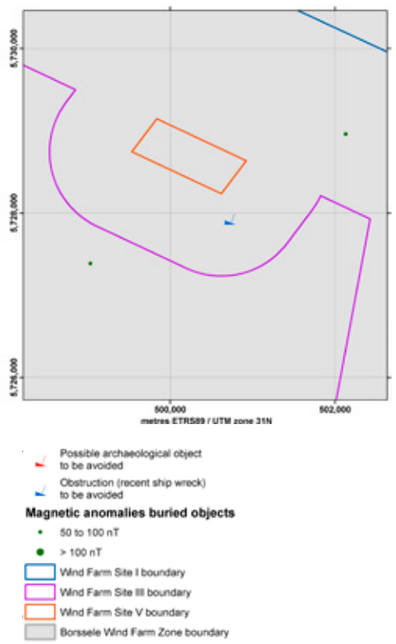
Commissioned by Netherlands Enterprise Agency, Periplus Archeomare executed a pilot archaeological assessment in March 2016. This assessed whether the geophysical study for BWFS III, IV and V proved a good case justifying further archaeological analysis. Due to promising results of the pilot, Netherlands Enterprise Agency then commissioned Periplus Archeomare to execute a more detailed archaeological assessment of the BWFZ based on the geophysical data.

4.6.2 Results

The investigation comprised an assessment of geophysical data and a comparison with known objects in the area in order to identify potential archaeological objects. A large quantity of survey data (side scan sonar, magnetometer and multibeam echosounder) was analysed in order to conduct an archaeological assessment.

No anomalies with a possible archaeological value were found. See Figure 14.

Figure 14 Summary of findings archaeological assessment



Side-scan sonar contacts

Periplus Archeomare analysed 234 side-scan sonar contacts in BWFS III and V. No contacts in BWFS III and V proved to be of possible archaeological value. This includes the wreck of the Belgian cutter 'Alca Torda' (ref. NCN1684/SR12173), that sunk in 1973. This was idenfitied outside the BWFS V boundaries, but within the (future) safety zone. It should be noted that the Hydrographic service database, used for the desk study and by Fugro, placed this wreck at the incorrect location. Nonetheless, the wreck is not considered to be of archaeological value and therefore its presence will not - from an archaeological point of view - jeopardise the development of BWFS V.

Concerning visible structures at the seabed surface, as long as the archaeological value of the remains is not determined, it is advised not to conduct disturbing activities on the locations including a buffer zone of 100 m around. This also applies to cable trenching and anchorages of work vessels.

Magnetometer contacts

In terms of magnetic anomalies, 685 were analysed in BWFS III and V. Of these, 26 were considered a possible archaeological object.

Concerning the buried ferrous structures, companies are advised to avoid such areas whilst installing wind turbines and constructing a trench for the cables. It should be stressed that the origin of the magnetic anomalies is unknown and, in addition to possible archaeological remains, any type of man-made objects could be encountered, including unexploded ammunition, anchors, pieces of chains and cables, debris, etcetera.

If it is not feasible to avoid the reported magnetometer locations, additional research is required in order to determine the actual archaeological value of the reported locations. It is advised that the UXO research within 100 m of the magnetometer anomalies is carried out under on-board archaeological supervision. Depending on the outcome of the UXO research, it may be decided that additional research (for instance by means of ROV or dive investigations) is needed. If the UXO research indicates the object has no archaeological value, the location can be omitted.

The cumulative surface area occupied by side-scan sonar and magnetometer buffer zones is 0.68% for the magnetometer contacts and nil for the side-scan sonar contacts in BWFS III and V.

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 programme of requirements. Passive archaeological supervision means that an archaeologist is not present during the execution of the work but always available on call. Implementing this recommendation would prevent delays during the work when unexpectedly archaeological remains are found. In accordance with the Monuments Act 1988 (Revised 2007), those finding must be reported to the competent authority. This notification must also be included in the scope of work.

4.7 Geotechnical survey

4.7.1 Introduction

The objective of the geotechnical soil investigation is to improve the geological and geotechnical understanding of the wind farm sites and to obtain geotechnical information which is suitable for progressing the design and installation requirements of offshore wind farms, including (but not limited to) foundations and cables.

The geotechnical survey uses intrusive techniques, such as boreholes and Piezo Cone Penetration Testing (PCPT), to gain an insight into the characteristics of the subsoil. The results of the geotechnical survey have been used to:

- Confirm the geological and geophysical model;
- Determine the vertical and lateral variation in seabed conditions;
- Provide the relevant geotechnical data for design of the wind farm, including foundations and cables;
- Update the geological desk study and provide a geological model.

4.7.2 Supplier

Fugro Engineers B.V., a member of the Fugro global group of companies and responsible for offshore geotechnical surveys, performed the survey. Fugro is an integrator of geotechnical, survey, subsea and geosciences services. Services are designed to support engineering design and large structure building projects. Fugro has previously performed investigations for many other offshore wind farm projects in the Netherlands, Belgium, UK, Denmark and Germany. Therefore, the company is familiar with the local conditions and technical requirements for geotechnical survey of the BWFZ.

The in situ testing was conducted from the geotechnical vessel Fugro Scout, between October 2015 and November 2015. The geotechnical borehole drilling was conducted from the geotechnical drilling vessel Gargano between September 2015 and October 2015. The survey has been performed according to ISO 19901-8 (2014) Marine Soil Investigations. DNV GL has provided a Verification letter for the results of the study.

4.7.3 Results

Fugro's geotechnical survey consisted of borehole drilling, downhole sampling, downhole in situ testing and seafloor in situ testing. For BWFS III and V, Fugro executed 12 boreholes which included alternating downhole sampling and/or Piezo Cone Penetration Testing (PCPT). Of these 12 boreholes, one borehole also included pore pressure dissipation testing (PPDT) and two boreholes also included Seismic Cone Penetration Testing (SCPT). Furthermore, 27 seafloor PCPTs, including a limited number of PPDTs, were performed.

The results of the survey can be found in three reports:

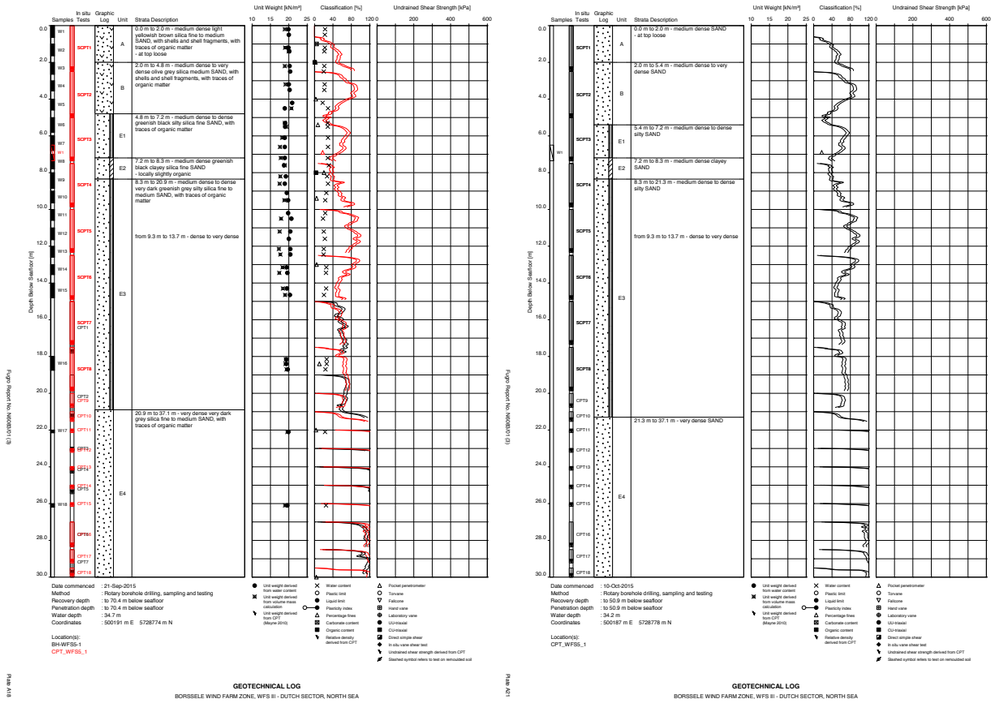
1. A geotechnical report containing geotechnical logs and results from in situ testing (PCPT and SCPT) and laboratory testing on a selection of samples from the borehole locations;
2. A geotechnical report containing geotechnical logs and results from in situ testing (PCPT and PPDT) for the seafloor PCPT locations;
3. A geological ground model report containing a geological ground model, geotechnical parameters per borehole and an assessment of suitability of selected types of structures.

The geotechnical reports include (a selection of) the following:

- Geotechnical logs for borehole locations and seafloor PCPT locations:
  a. Interpretation of soil profile, strata description and PCPT-derived relative density and shear strength;
  b. Selected results of laboratory tests.
- Results of in situ testing consisting of PCPTs, SCPTs and PPDTs:
  a. Cone resistance (net/total), sleeve friction, pore pressure, friction ratio and pore pressure ratio;
  b. Recorded shear waves (X and Y) and derived shear wave velocity;
  c. Results of pore pressure dissipation tests, i.e. cone resistance and pore pressure versus time.

In the centre of BWFS V a semi-continues downhole (s)CPT (CPT-WFS5-1) has been executed as well as a sample bore hole (BH-WFS5-1). Both logs are presented in Figure 15.

Figure 15 CPT data interpretation of testing point (Plate A18 tot A20) (Plate A21 tot A22)



Results of on-site and office laboratory test programmes:

- Geotechnical index testing (sample description, water content, unit weight, particle size distribution, Atterberg limits, particle density, minimum and maximum index unit weight);
- Geochemical index testing (carbonate content and organic content);
- (Index) strength testing (pocket penetrometer, torvane, Unconsolidated Undrained (UU) triaxial compression, Isotropically Consolidated Undrained (CIU) triaxial compression, Isotropically Consolidated Drained (CID) triaxial compression);
- Shear testing (ring shear (soil/soil and soil/steel interface);
- Compressibility testing (incremental loading and constant rate of strain oedometer tests).

Results of an advanced static and cyclic laboratory test programme:

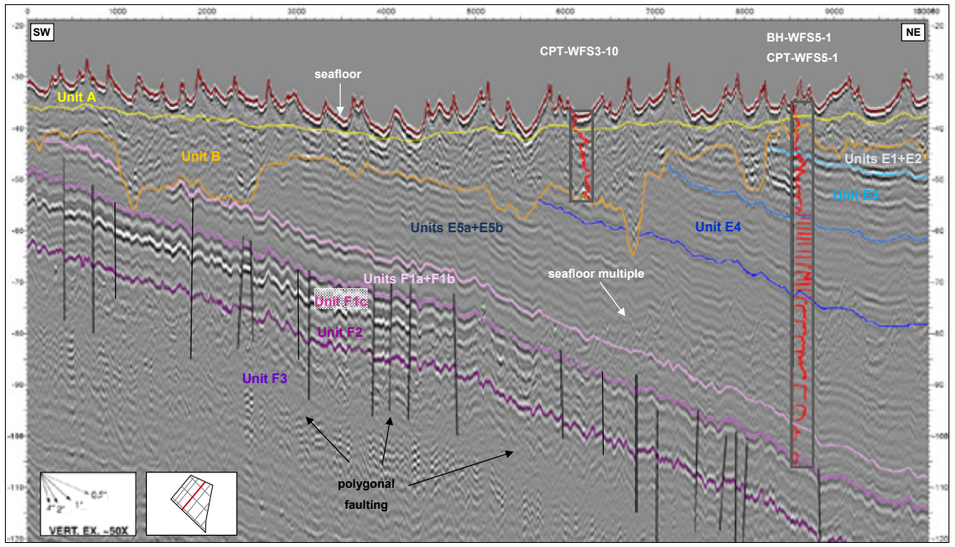
- Coarse-grained soils (CIU triaxial compression, selected tests with Bender Element (BE), Cyclic Undrained Triaxial (CTXL));
- Fine-grained soils (Direct Simple Shear (DSS), Cyclic Simple Shear (CSS), CIU triaxial compression, selected tests with BE, CIU triaxial extension).

The geological ground model reports include:

- Depth to top of unit maps and contours;
- Thickness of unit maps and contours;
- Selection of isopachs;
- Geotechnical parameters per borehole location and per unit;
- Assessment of suitability of selected types of structures.

An example of a cross section of the wind farm site is shown in Figure 16. This shows a bedform zonation classification of the site created using the geotechnical data.

Figure 16 An example of MCS seismic line of BWFS V from southwest (left) to northeast (right) with two seafloor CPTs



NOTE: Example of MCS line. Vertical scale is depth in metres below LAT. Horizontal scale is distance in metres. CPT cone resistance data (red line) for the geotechnical locations are projected on the cross section. Left side of the grey box marks the geotechnical location. The width of the box marks cone resistance values to 50 MPa. Location of the cross section is shown on Plate 3-6.

CROSS SECTION – SECTION LINE A34023
BORSSELE WIND FARM ZONE, WFS III – DUTCH SECTOR, NORTH SEA

The full findings of our reports and site studies, including data, are available via ***offshorewind.rvo.nl*** to anyone interested in participating in the BWFS V tender.

4.7.4 Deliverables following geotechnical data and ground model reports

After issuing the geotechnical reports, the following deliverables have been issued:

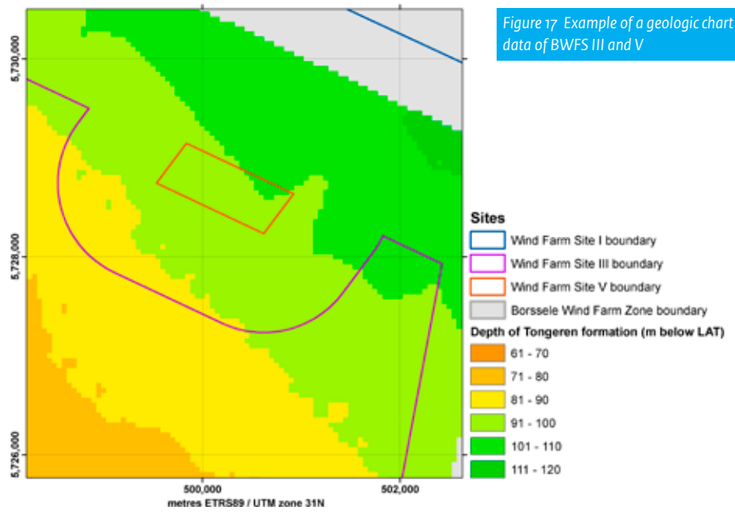
a. Digital Data Packages – Geological Ground Model (IHS Kingdom® format) – BWFS I to BWFS V;
b. Technical Note – Geotechnical guidance for cyclic resistance of sandy soils – BWFZ;
c. Geotechnical Report – Seabed temperature and thermal conductivity – BWFS I to BWFS V;
d. Technical Note – Biostratigraphic analyses – BWFS I to BWFS V;
e. Technical Note – Supporting information for GIS deliverables – BWFS III and V.

Digital Data Packages – Geological Ground Model (IHS Kingdom® format) – BWFS I to BWFS V
In March 2016, Digital Data Packages were 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 BWFS I to BWFS V. The accompanying technical note provides background information on the digital data packages.

Technical Note – Geotechnical guidance for cyclic resistance of sandy soils – BWFZ
In April 2016, Fugro issued a technical note that provides geotechnical guidance for design verification of monopile foundations at the BWFZ. Specifically, cyclic resistance of sandy soils is addressed, taking the Tongeren Formation as an example. DNV GL confirmed that this technical note forms a reasonable basis for assessment of cyclic degradation of sandy soils, The methodology described in the technical note is in compliance with DNV OS J101.

Geotechnical Report – Seabed temperature and thermal conductivity – BWFS I to BWFS V
The thermal conductivity and seabed temperature of near-seafloor soils for BWFS I to V has been assessed. The presented information serves as input for design, installation and maintenance of planned inter-array and export cable routes in the BWFZ. This report contains results of assessments of seabed temperature and recommended values for thermal conductivity.

Figure 17 Example of a geologic chart created using the geotechnical site data of BWFS III and V



Technical Note – Biostratigraphic analyses – BWFS I to BWFS V
The results of biostratigraphic analyses, i.e age dating, carried out on selected samples has been presented in this technical note. Results of the biostratigraphy analyses can be used for verification of the stratigraphic framework used for development of the geological ground model. This technical note includes a paragraph discussing results of the biostratigraphic analyses in comparison to the stratigraphic framework used for the BWFZ.

To verify the stratigraphic framework developed for the BWFZ, an age dating programme was performed. The age dating focused predominantly on soils believed to be of Tertiary age. Two samples from Quaternary formations were analysed. Age dating used biostratigraphic assessments by means of palynological analyses.

Five borehole locations were selected for biostratigraphic analysis. Results include:

- Chronostratigraphic succession;
- Palynological zonation;
- Biostratigraphic examination with listing of primary age diagnostic events together with selected additional events;
- Stratigraphic discussion.

In general, the biostratigraphic interpretations support the Fugro geological model. Some differences are evident, for which, explanation is provided in the Technical Note. It may be noted that ages of the unit boundaries are not as fixed and unambiguous as may be suggested by the various biostratigraphic tables. Assigning a different age to a geotechnical unit does not influence the geotechnical properties of the unit. Geotechnical unit boundaries, as interpreted by Fugro based on results of geophysical and geotechnical site investigations, do not require amendments based on the results of the palynology analyses.

Technical Note – Supporting information for GIS deliverables – BWFS III (including site V as part of the original BWFS III)
This Technical Note provides background information in support of the Geographic Information System (GIS) deliverable which was prepared as part of the Geological Ground Model Reporting for the BWFS III, IV and V. The purpose of this technical note is to provide information on the used methodology for gridding and contouring of the depth to base and thickness of the identified units. It specifically aims to clarify minor differences in grid values and contour positions at the boundary between the Investigation Areas within the developed Geological Ground Models.

4.7.5 Conclusion

All relevant geotechnical parameters for the zone have been measured and an overall geological model has been created using the data.

4.8 Morphodynamical desk study

4.8.1 Introduction

This study assesses the seabed dynamics at the BWFZ and is designed to:

1. Improve understanding of the seabed morphology at the BWFZ;
2. Improve understanding of the seabed morphodynamics at the BWFZ over the consent period for the BWFS (30 years, including building and decommissioning);
3. Determine the design reference minimum and maximum seabed levels at the BWFZ and help predict potential seabed level changes over the consent period for the offshore wind farms.

4.8.2 Supplier

Research institute Deltares performed an initial morphodynamical desk study for the BWFZ using existing data. Based on the geophysical survey, the institute provided an update of this study, specifically aimed at BWFS III, IV and V. Deltares has previously conducted similar studies for other offshore wind farms, including Princess Amalia, Butendiek, Luchterduinen, Nordergründe and Belwind. The Belwind project is adjacent to the BWFZ, on the Belgian side of the border. Therefore, Deltares has developed in depth knowledge of the morphology of this specific part of the North Sea.

DNV GL performed a review of the morphodynamical studies and issued a Verification Letter for them.

4.8.3 Results

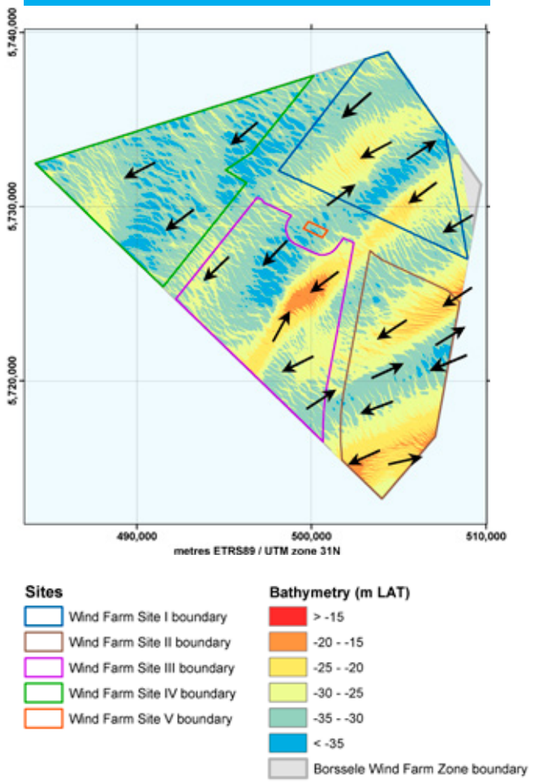
The studies consisted of two phases: One of the deliverables of this survey is a high resolution bathymetrical dataset that has been used to update the morphodynamical desk study.

- Phase 1: desk study (December 2014) prior to the geophysical survey which was performed mid-2015;
- Phase 2: update of the report of phase 1 (January 2016) based on the findings from the geophysical study.

This report (phase 2) supersedes the report from phase 1.

The morphology of the system is classified as highly dynamic, with a complex bathymetry consisting of static (in the timespan between 2000 and 2015), shore-parallel sandbanks overlain with dynamic shore perpendicular sand waves. Within the area, opposing migration directions for the sand waves were found with sand going towards SW-direction and to the opposing NE-direction (with a variation of up to 30° in both directions), as shown in Figure 18.

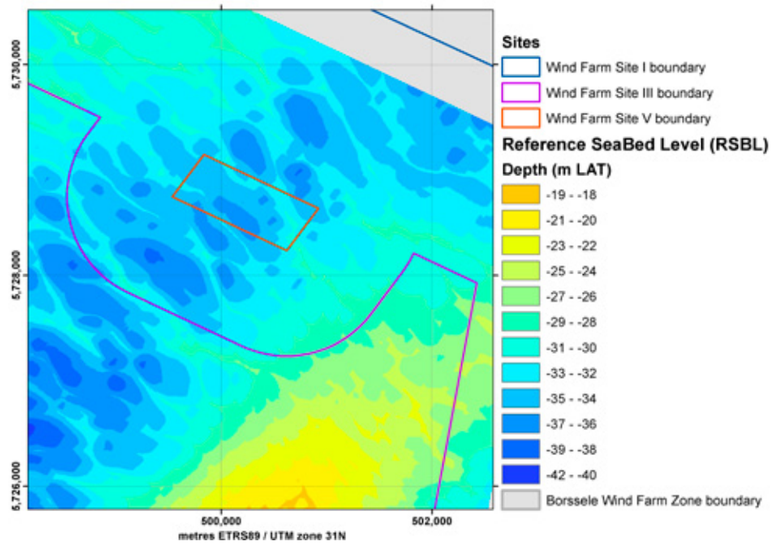
Figure 18 Morphodynamics: Sand dune movement in the Borssele Wind Farm Zone



Sand wave characteristics were determined for the combined area of BWFS III, IV and V, as well as for the individual sites by means of consistent tracking of crest and trough points of individual sand waves from various transects of 1,750 m, equally distributed throughout the BWFZ. The sand waves in BWFS III, IV and V have a wavelength between 120 and 430 m, a wave height between 1.6 and 7.0 m and migration speeds in the order of -1.6m/yr (i.e. in NE-direction) to 1.8m/yr (in the governing SW-direction).

Next, the reference seabed level (RSBL) and maximum seabed level (MSBL) were determined, indicating the predicted lowest and highest seabed levels during the lifetime of the wind farms in the Borssele area (see Figure 19).

Figure 19 Reference Seabed Level in the Borssele Wind Farm Zone



Comparison of the RSBL with the most recent bathymetry from 2015 showed a potential maximum local lowering of the seabed of approximately 5 m. A comparison of the RSBL with the base of the Holocene Formation showed that no unrealistic values for the seabed lowering were computed in this study.

The predicted seabed level changes follow from the applied morphological analysis techniques, describing the (uncertainty of the) physics and the natural variability of the analysed morphological system. Uncertainty ranges (e.g. representing measurement inaccuracy and amplitude of fast morphological features such as (mega-)ripples) have been taken into account in the analysis, but no additional safety margins for design purposes have been applied.

4.8.4. Webinar

The study was presented and discussed at a webinar in February 2016. The webinar can be found at: ***offshorewind.rvo.nl/workshopborssele***.

4.9 Meteorological and oceanographic (Metocean) desk study

4.9.1 Introduction

The metocean desk study defines the relevant meteorological and oceanographic data used for design and installation calculations made by companies submitting bids to develop projects in the BWFZ. The study covers the following:

1. Determination of all meteorological and oceanographic parameters required to conduct design calculations for offshore wind farms in the BWFZ;
2. Wave and wind persistence tables relevant for operational assessments relating to wind farms and offshore high voltage station installations in the BWFZ.

4.9.2 Supplier

Deltares performed the metocean desk study. The institute has an extensive track record in offshore wind, with studies related to topics such as scour prediction and protection, metocean conditions, wave loads, cable burial depth and morphodynamics. Deltares also has an strong track record on offshore wind farms in the near vicinity of the BWFZ. DNV GL has certified the methodology and the results of the study, and provided a Verification letter.

4.9.3 Results

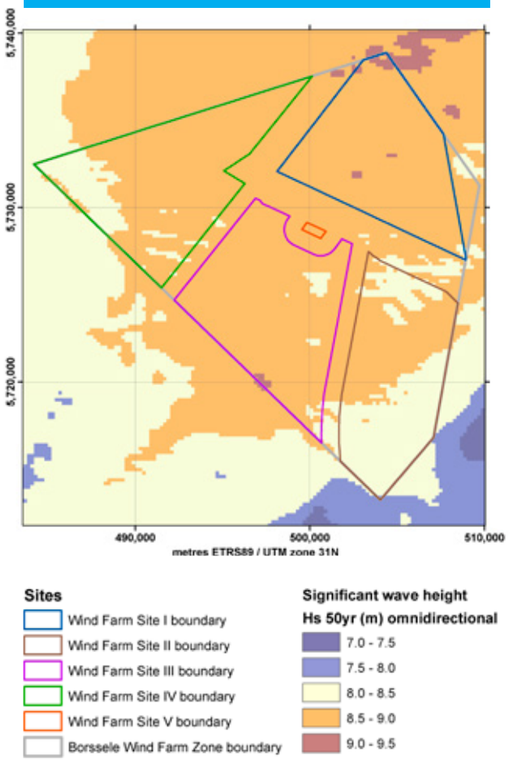
The general objective of this study is to determine the metocean conditions (wind, wave, current and other meteorological parameters) applicable at the BWFZ. A metocean report has been produced for each of the sites I – IV within the zone, with BWFS V included as part of BWFS III. In each report, the data presented is related to a specific reference point selected as a representative point for the overall site.

To determine local variations in the five BWFZ sites, dedicated numerical modelling was required for wave, water level and current related parameters. The local modelling simulations cover a relatively long period (20 years), sufficient for deriving the requested metocean parameters. Local variations in metocean parameters are mainly caused by variation in bathymetry, i.e. the presence of sand banks and sand waves. Therefore, the numerical modelling takes into account the bed level variation in detail. The wind conditions are based on the high resolution HARMONIE data from the Koninklijk Nederlands Meterologisch Instituut (KNMI). The project was conducted, partly in collaboration with KNMI. Information from KNMI was also used for the wind resource assessment conducted by Ecofys, which conducted its study later than the metocean desk study (See § 4.10 for more information).

The metocean conditions were assessed by means of detailed re-analysis of available model and measurement data. The data was statistically analysed for each selected output location. The analyses comprised normal conditions and extreme conditions, for several recurrence periods of 1, 2, 5, 10, 50 and 100 years, as per the requirements of the DNV GL standard. Wind, wave and current normal conditions were computed empirically and given in terms of frequencies of joint occurrences and the extreme climate in terms of return values obtained by means of extreme value analyses. The parameters specifically related to hub height were determined for heights of 70 m, 80 m, 90 m, 100 m and 150 m.

Figure 20 shows an example of dedicated numerical modelling results: the 50-year return value of the significant wave height. The effect of the presence of sand banks and sand waves on the wave propagation can be observed.

Figure 20 50 year return value of significant wave height for the Borssele Wind Farm Zone



4.10 Meteorological and oceanographic (Metocean) measure-ment campaign

4.10.1 Introduction

More accurate metocean data would most likely lead to a lower risk surplus and therefore lower cost of capital (strengthening the business case) for an offshore wind farm. Therefore, DNV GL was 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 wind resource data in the Dutch North Sea so it could be used in the project development and design studies of the two wind farm zones under development.

Publicly available offshore meteorological mast data is available from the existing IJmuiden and OWEZ masts (approximately 130-140 km from the BWFZ). Combined with publicly available data from Europlatform, Lichteiland Goeree and Vlakte van de Raan stations (30-50 km from the BWFZ), this is expected to provide 'bankable' wind data for the BWFZ. Fixed LiDAR measurements at Lichteiland Goeree started in October 2014. Fixed LiDAR measurements at Europlatform started may 2015. Data is available at ***www.windopzee.net***. This information will further increase the 'bankability' of wind data for the BWFZ.

The dataset collected can be used for production calculations for the all the BWFZ tenders.

Based on DNV GL's assessment, Netherlands Enterprise Agency contracted Fugro OCEANOR in 2015 to deploy an onsite floating LiDAR, which can provide on-site metocean data for the BWFZ.

The improved data should allow developers to:

- Carry out more accurate calculations for annual energy production;
- Improve/validate metocean models used for wind farm design.

4.10.2 Supplier

The metocean measurement campaign is being conducted by Fugro OCEANOR, a limited company owned by the Dutch Company Fugro NV. Fugro OCEANOR specialises in the design, manufacture, installation and support of environmental monitoring, ocean observing and forecasting systems.

4.10.3 Results

Fugro OCEANOR has placed two metocean buoys in the BWFZ. The measurement campaign of the first buoy, positioned in the centre of the BWFZ, started in June 2015. Monthly results are being made available on ***offshorewind.rvo.nl***.

In November 2015, the second buoy was installed close to the southern border of the BWFZ. This will help assess any wake effects from neighbouring Belgian wind farms. Both buoys have experienced unplanned service needs onshore. The service needs are mainly the effect of unsatisfactory marinisation of the Lidar. In February 2016 , however, both buoys were redeployed. Since then, they have delivered high data availability. Available data is quality approved by ECN. See Figure 21 as an example of available data.

Figure 21 Measured wind speeds in the centre of the BWFZ in July and August 2015

4.11 Wind resource assessment

4.11.1 Introduction

The goal of this study was to provide a preliminary wind resource assessment for the BWFZ. At the time of the assessment (May 2015), there were no specific on-site measurement records available.

Therefore, the results are based on mesoscale modelling, validated against nearby offshore wind measurements. Note: as mentioned earlier in this PSD, wind measurement data will become available from the metocean measurement campaigns. This data may be used to perform further wind resource assessments. However, this task shall not be carried out by Netherlands Enterprise Agency.

4.11.2 Supplier

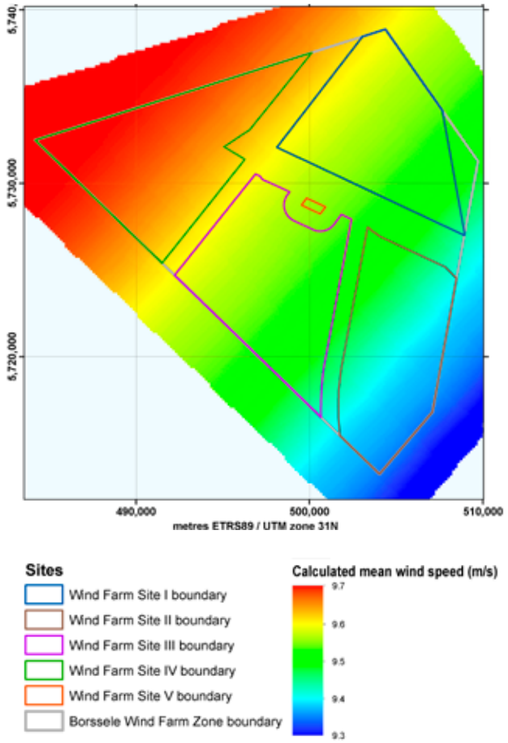
Netherlands Enterprise Agency selected Ecofys to conduct the wind resource assessment. Ecofys has experience in offshore wind resource assessments, having prepared bankable reports on several large offshore wind farm, often at sites where wind measurements were not available previously. Moreover, the company is skilled in the validation and application of mesoscale model data, including detailed uncertainty assessment. The Verification letter has been issued by DNV GL.

4.11.3 Results

The report presents a wind climate assessment for the BWFZ. This assessment is based on the combined use of offshore wind measurement campaigns and mesoscale model data. No specific on-site measurement records were used for this study. The Offshore Meteomast IJmuiden is the primary source of data for this assessment, based on the overall greater accuracy of the wind measurements the mast provides, including the horizontal extrapolation to the entire BWFZ. The extrapolation is based on the KNMI KNW mesoscale model, selected due to validation being based on the need for four offshore met mast datasets (site V information being included in the data for site III). KNMI provided six relevant grid points. Ecofys attributed one representative grid point with each of the main sites. These enable sufficient information to be attained to assess the variation in wind speeds across the zone.

The results indicate that the wind resource is reasonable for an offshore site in the Dutch North Sea and consistent across the modelled heights. Based on the assessment, the mean wind speed at a hub height of 100 m MSL at the centre of the BWFZ is calculated to be 9.6 ± 0.5 m/s.
The variation across the site is about 0.3 m/s, as seen in Figure 22. Note the wind speeds found in the Ecofys report differ from the wind speeds found by Deltares in the metocean study. These differences are related to the use of the Harmonie model by KNMI. The differences between the studies are within uncertainty tolerance range and can be explained. Therefore, the metocean report(s) already published will not be updated.

Figure 22 Mean wind speed at 100 m in Borssele Wind Farm Zond (using mesoscale model data)



4.11.4 Conclusion

Based on previously available KNMI data, Ecofys has created a wind resource assessment. However, tender applicants are advised to create their own assessment. For example, new metocean data will be available from different measurement campaigns.

4.12 Site Investigation quality and cerfti-fication procedures

4.12.1 Procedure

The Netherlands Enterprise Agency has sought guidance and information by consulting with different sources. Energinet.DK, the organisation in Denmark responsible for organising the Danish offshore wind tenders, has shared lessons learned and shown Netherlands Enterprise Agency how these projects are managed in Denmark. Further, Netherlands Enterprise Agency, the Ministry of Economic Affairs, Rijkswaterstaat (part of the Ministry of Infrastructure and the Environment) and TenneT, organised several workshops on various subjects with industry stakeholders, invited via the Dutch Wind Energy Association (NWEA) and other communication channels.

4.12.2 Procurement

The procurement of the different studies was carried out in compliance with the applicable procurement procedures within Netherlands Enterprise Agency. 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, which exceeded the expected maximum budget for a limited tender, were procured through a public European tender. All proposals have been selected on the basis of determining the most economic advantageous offer.

4.12.3 Quality assurance

Netherlands Enterprise Agency supported by BLIX Consultancy maintained a quality assurance procedure to provide accurate and usable studies. BLIX is specialised in project management of large offshore wind energy projects. First, the scope of the different studies was determined using the following steps:

1. Netherlands Enterprise Agency and BLIX determined the preliminary scope of the different studies;
2. Where applicable, input was provided on these scope descriptions by internal experts from other governmental departments, agencies or external experts;
3. During market consultation sessions, the scope descriptions were discussed with industry stakeholders who were able to provide input on the completeness of the descriptions.

In the case of studies where the results will become part of the design basis for the developer, the certifying authority DNV GL was contracted to confirm the completeness of the scope.

After the study tenders (and whilst work was being conducted by the specific contractor), quality assurance was performed as follows:

1. The project team and experts from other ministries reviewed several drafts of the report, provided feedback and assured the execution of the scope was in compliance with the scope description;
2. The draft report was reviewed by independent internal and external experts;
3. The certifying authority (DNV GL) reviewed the report and provided a Verification letter to assure the results were acquired in compliance with the DNV-OSJ101 and other applicable industry standards. Verification letters are added to the report if applicable.

Internal experts which have provided input in the process include:

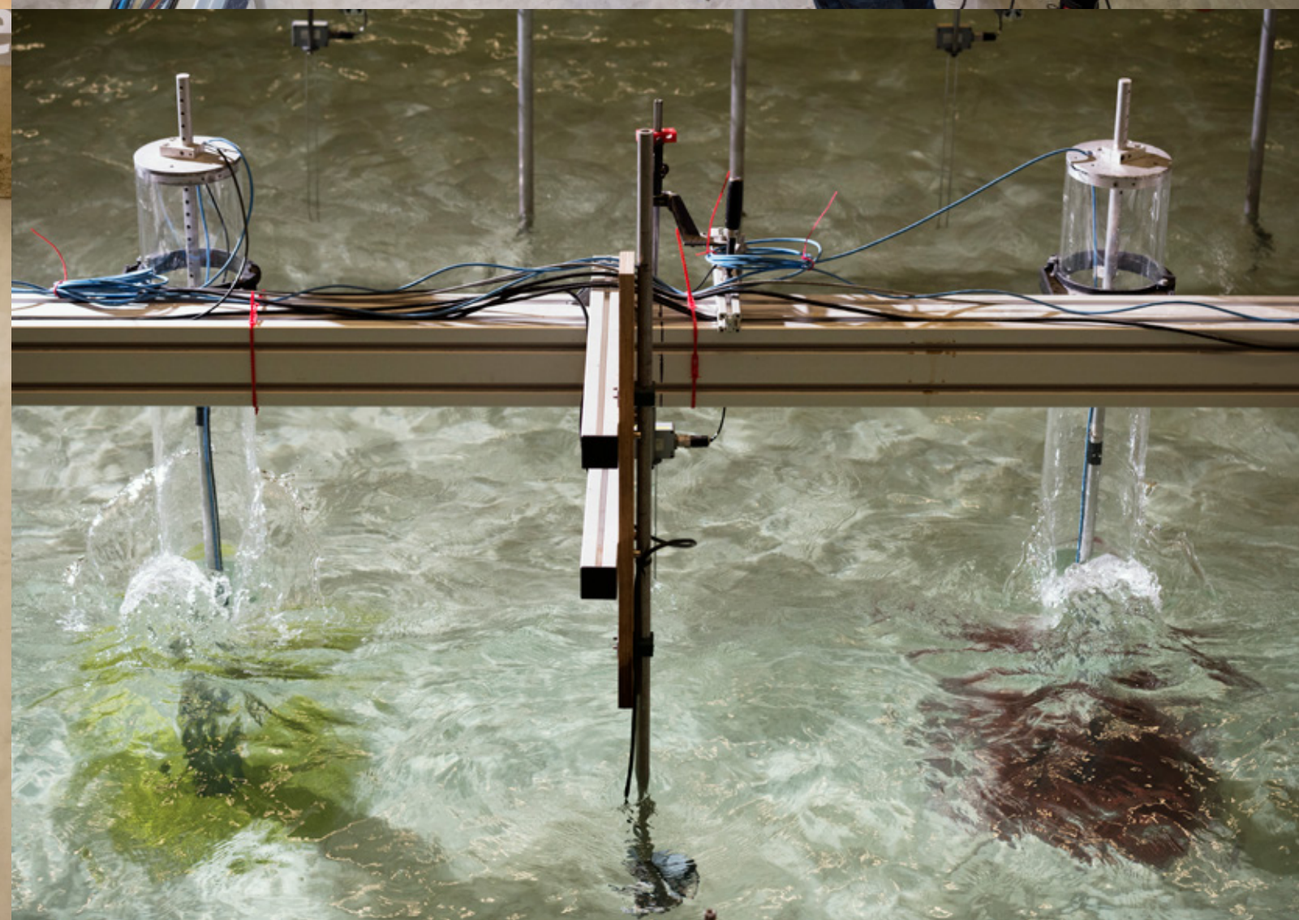
1. The Cultural Heritage Agency (Archaeological desk study);
2. The Ministry of Infrastructure and the Environment (Morphodynamical desk study).

External experts which provided input into the process include:

1. Windsupport Ltd (Geotechnical site investigations);
2. Reynolds International Ltd (Geophysical site investigations);
3. RPS Energy Ltd (Geotechnical site investigations), HSE;
4. ECN (Metocean measurements);
5. Carbon Trust (Metocean measurements);
6. Periplus Group (Geophysical site investigations).


Deltares


Deltares



5. *Legal Framework*

5.1 Introduction – Offshore wind energy roadmap

With offshore wind energy seen as a key technology for the Netherlands, the Dutch Government published a new roadmap for offshore wind energy in September 2014. The roadmap outlines plans for new designated offshore wind energy areas, a new regulatory framework for licenses and subsidies, and offshore grid expansion and operation by TSO TenneT.

The roadmap sets out a schedule of tenders offering 700 MW of development each year in the period 2015 – 2019, under the condition that the cost of offshore wind power will decrease by 40% in 2023, compared to 2014. One site, BWFS V, has been set aside specifically for demonstration of 20 MW of innovation project(s).

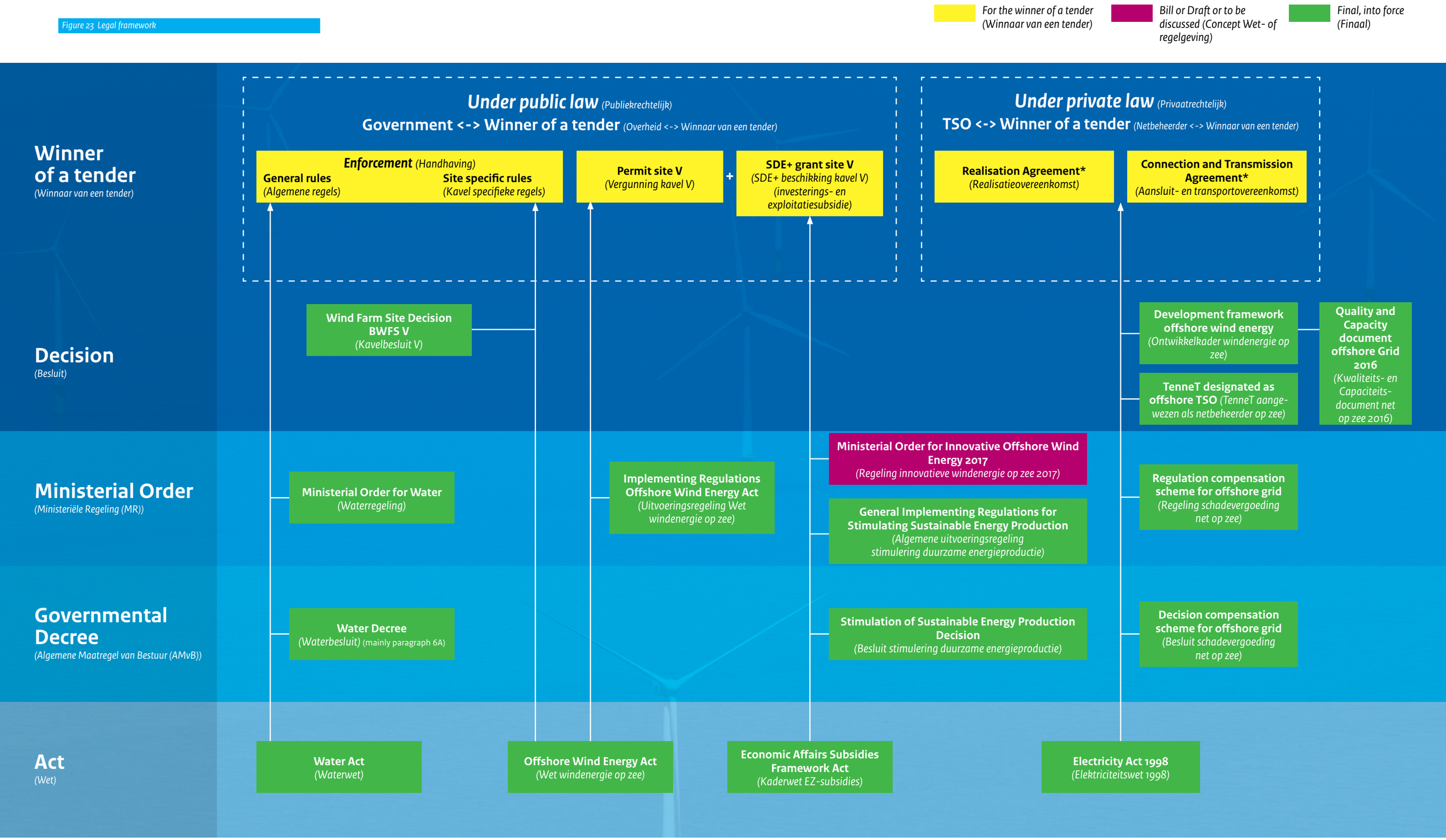
The Government has streamlined the entire development process and taken on direct responsibility for key elements including spatial planning, site surveys and environmental impact assessments. This new approach alleviates much of the industry burden and costs traditionally associated with offshore wind energy development.

This chapter provides a broader overview of the legal framework and the requirements for the BWFS V (Innovation Site) tender, which will award an SDE+ (operating) grant and permit as well as an investment subsidy. This includes the following:

- Legal framework - Offshore Wind Energy Act, Wind Farm Site Decision, Water Decree, National Waterplan, tender process and brief overview of how it will work for BWFS V;
- SDE+ subsidies and permit - overview of the subsidy process, specific SDE+ details and permit terms for BWFS V, including the conditions that apply and who is responsible for enforcement;
- TenneT beta platform - framework overview, permitting and planning process, Realisation Agreement and Connection and Transmission Agreement, applicable codes, and a summary of the step-by-step process to connection.

The legal framework can be found in Figure 23. An unofficial translation of the relevant law in English can be found in Appendix A.

Figure 23 Legal framework



* TenneT has offshore model agreements available online.

5.2 Legal framework

To cement its plans, the Dutch Government introduced new legislation and a new bill on offshore wind energy, the Offshore Wind Energy Act (Wet windenergie op zee), which came into force in July 2015. The Act prohibits the construction, exploitation and removal of a wind farm in the Dutch territorial sea or Dutch Exclusive Economic Zone (EEZ) without a license, sets out the requirements for a license application, and provides the legal framework for the designation of sites for the construction and exploitation of wind farms in the so-called Wind Farm Site Decision (WFSD).

The 'general rules' for offshore wind farms (Water Decree) also apply for all locations within the Dutch EEZ. Paragraph 6A of the Water Decree provides general requirements for the construction of offshore wind farms. These requirements are listed in chapter 6.2.

Together with these 'general rules' in the Water Decree, the WFSD contains the specific conditions for building and operating a wind farm on a designated site. The Dutch Government provides all relevant site data, via the Netherlands Enterprise Agency (RVO.nl), an agency of the Ministry of Economic Affairs. It should be noted that an Environmental Impact Assessment (EIA) is required for the Government to prepare its WFSD. This means that no additional EIA will be required by companies bidding to develop projects. Appendix B contains a summary of the Environmental Impact Assessments for BWFS III, IV and V.

Under the new legal framework, Dutch TSO TenneT is responsible for the electricity transmission infrastructure needed for the offshore wind farm. The Electricity Act 1998 was amended to formally designate an operator of the offshore grid, including the legal framework for the planning of the roll-out and the establishment of its statutory liabilities for delays and faults. The amended Electricity Act 1998 came into force in April 2016 and TenneT was formally designated in September 2016.

5.2.1 National Waterplan update

The National Waterplan (2009-2015 including amendments in 2014) had designated Borssele, Hollandse Kust (zuid and noord outside the 12 nautical mile zone), IJmuiden Ver and north of the Frisian islands as Wind Farm Zones (WFZs).

A new National Waterplan 2016-2021 was sent to Parliament in December 2015. This included the reconfirmation for all designated WFZs from the National Waterplan 2009-2015. It also reconfirmed the investigation of potential offshore wind development in the Hollandse Kust zone (zuid and noord), 10-12 nautical miles offshore (adjacent to the existing designated areas). Development in this area has been approved. The National Waterplan 2016-2021 also contains the framework for the assessment for shared use of the designated WFZs. This has been translated in the policy memorandum North Sea (Beleidsnota Noordzee). This includes the processes for distance between shipping routes and wind farms, the distance between mining operations and wind farms and rules for passage and shared use.

5.2.2 Tender process

Under the regular process, the Government first designates a Wind Farm Zone. It then carries out the site investigations, determines the conditions for building and operating a wind farm, and issues tenders for the associated subsidies and project permits. Winners of the site development tenders will be granted a permit to construct a wind farm according to the Offshore Wind Energy Act (Wet Windenergie op zee), an SDE+ grant and offered a grid connection to the mainland. The innovation site (BWFS V) will mirror, as much as possible, developments at the regular Borssele sites, deviating from them where necessary. Unique to the BWFS V innovation site tender is that the successful bidder will be awarded an investment subsidy in addition to the SDE + operating subsidy (section 5.3.4). The Dutch Government recognises that, by its very nature, the demonstration of new technologies is more expensive than standard rollout. Hence the decision to subsidise the additional costs of BWFS V with an investment subsidy, because an investment subsidy allows advance funding.

The Ministry of Economic Affairs via Netherlands Enterprise Agency provides site data, which can be used for the preparation of bids for the tender for BWFS V. This system is expected to contribute to cost savings.

In summary, the process for BWFS V is as follows:

- The Ministries of Economic Affairs and Infrastructure and the Environment issue a Wind Farm Site Decision (WFSD). The WFSD for BWFS V was published April 2016 and amended in September 2016 and in June 2017. A final WFSD is expected to be published in October 2017;
- The boundary and coordinates of BWFS V can be found in Chapter 6 and in the Memo Boundaries and Coordinates. This memo has been fully updated since it was last published in November 2016. The updated memo is included in Appendix C;
- The Dutch TSO TenneT will develop and operate the offshore grid connection;
- The Government will issue the call for tender for BWFS V on 2 January 2018, with final bid submissions due 18 January 2018 at 17:00. The tender will be for the development of one site, comprising the installation of one or two turbines with a nominal capacity per turbine of at least 6 MW. The total nominal capacity of the site is not allowed to exceed 20 MW;
- Applicants submit a proposal for one or both of the positions;
- There will be one winner. The winner of the tender is allowed to build the wind project on the specific site and therefore receives: An SDE+ grant and a permit, based on the Offshore Wind Energy Act, allowing it to build, operate and decommission a wind farm; and an investment subsidy.
- The winner and TenneT agree upon (respectively) a Realisation Agreement and a Connection and Transmission Agreement, required prior to realisation or operation of the connection (see 5.5) The models for these agreements are available via TenneT website. And requirements are comparable for all wind farms connecting to the offshore grid;
- The operation phase will commence as soon as the installation is commissioned. Production will be able to start from 31 August 2020 at the earliest when TenneT's Borssele beta grid connection system is scheduled to be ready.

5.2.3 Enforcement

Rijkswaterstaat (Ministry of Infrastructure and the Environment) is appointed as the competent authority charged with enforcing the general rules that stem from the Water Act (mainly § 6A of the Water Decree) and specific rules that stem from the Wind Farm Site Decisions.

5.3 Subsidies and permit tendering

5.3.1. Sustainable Energy Production (SDE+) overview

The Stimulation of Sustainable Energy Production (SDE+, Stimulering Duurzame Energieproductie) is an incentive mechanism aimed at companies and (non-profit) organisations for the production of renewable energy in the Netherlands. Renewable energy is generated from clean, inexhaustible and sustainable sources, such as wind, solar or biomass. The SDE+ is an operating (feed-in-tariff) subsidy. Producers receive a guaranteed payment (subsidy) for the energy produced (as opposed to funding for any equipment or services they need to invest in to make this production possible, as in the case of an investment subsidy).

The SDE+ process for offshore wind is treated separately from other renewables, with its own dedicated tender programme. Under the SDE+, the price for the electricity generated is subject to a cap, providing a base amount for the calculation of subsidy to be received. The SDE+ compensates producers for the difference in costs between this base amount and the market price of electricity derived from fossil fuels.

As with the other offshore wind rounds, the grant and permit for BWFS V will be awarded through a dedicated call for tenders by the Netherlands Enterprise Agency under the SDE+. For BWFS V, the SDE+ subsidy is provided with an additional year for the purpose of banking and the ranking criteria for judging bids are different - based on qualitative criteria rather than lowest cost. In addition, winners receive an investment grant.

5.3.2 SDE+ Decision amendments and new Ministerial Order

To proceed with the innovation tender for BWFS V the Decision on the SDE+ has been amended accordingly. The subsidisation of producers of offshore wind energy constitutes state support. On the basis of Articles 41 and 42, fourth paragraph of the General Block Exemption Regulation (hereinafter: GBER), the subsidisation of innovative offshore wind energy is permitted under the present Decision. The SDE+ Amendment Decision and explanatory notes are included in Appendix A: Applicable Law.

In addition, reflecting the amendments and the different nature of the innovation tender, a new Ministerial Order for Innovative Offshore Wind Energy will take effect from 1 October 2017 and expire from 1 October 2022. Again, please see Appendix A for the full Order.

5.3.3 SDE+ for BWFS V

The Ministerial Order for Innovative Offshore Wind Energy 2017 is expected to be published in September 2017. The draft Ministerial Order can be found in Appendix A. The SDE+ is an exploitation/operating subsidy, whereby producers receive financial compensation for the renewable energy they generate. The price for the production of renewable energy is capped (base amount).

For BWFS V the base sum is the amount the winner of BWFS III (Blauwwind II c.v.) receives (€54.49/MWh). The yield of fossil energy is established in the correction amount. The SDE+ contribution = base – correction amount. This makes the level of the SDE contribution dependent on energy-price developments. The base electricity price is published in the Ministerial Order for Innovative Offshore Wind Energy and is €25/ MWh. The SDE+ subsidy is provided for a period of 15 years plus one year for the purpose of banking. The start date for the period may vary per installation. Advanced payments are paid monthly based on the maximum production set out in the WFSD. The advanced payments amount to 80%. The maximum number of full-load hours is the net P50 value of full-load hours included in the application.

Annual profile costs and imbalance costs are determined by ECN. The policy is to determine the profile costs and imbalance costs for all wind farms in the Dutch section of the North Sea on an annual basis, rather than determine them for individual wind farms. The base amount will not be adjusted for inflation during the construction and operating phase. A provisional correction amount will be determined for the 12 months prior to the publication of the definitive correction amount. This is published in October, so the provisional correction amount will be determined for the period from October until September. The definitive correction amount will be determined for the period from January to December.

The subsidy is awarded under the condition that within two weeks of the decision to award a subsidy, an implementation agreement is signed between the Dutch State and the subsidy recipient in accordance with the agreement included in the appendix to the Ministerial Order. In addition, the subsidy is only awarded under the condition that within four weeks of the date of the decision to award a subsidy, the subsidy recipient provides proof that a € 600,000 bank guarantee has been issued to Netherlands Enterprise Agency in Zwolle. A second bank guarantee of € 2,000,000 which will replace the first bank guarantee, must be provided within 12 months. These conditions are explicitly stated in the decision, along with the exact dates.

The bank guarantee is returned after the subsidy recipient has put the production installation into operation. The term 'put into operation' used in the context of returning the bank guarantee, refers to the date on which evidence is submitted of the first electricity supply. This means that once the Netherlands Enterprise Agency has received proof that Guarantees of Origin have been issued for the electricity produced, the bank guarantee and accompanying letter will be returned to the bank and a copy of this letter will be sent to the applicant.

These guarantees can only be issued by a bank for which the branch in question is established in a European Union Member State and they must be based on the model published in the Ministerial Order. The bank guarantees cannot be divided into multiple sections to enable different collaboration partners to submit their own share of the bank guarantee. It is also noted that in the event of the SDE+ decision and award of the subsidy being reversed in an appeal at any point, the Netherlands Enterprise Agency will return the bank guarantee to the bank with a copy to the applicant.

5.3.4 Permit

In line with the SDE+ regime, as well as the SDE+ subsidy, a tender winner also receives a permit to build, operate and decommission the relevant wind project, valid for a 30-year period. The project must be operational within four years after the permit is irrevocable, and can operate until the end of the 29th year. Decommissioning should be completed within two years maximum after the power generation operations have stopped, but at the latest in the 30th year. The Minister of Economic Affairs can allow for replacement of turbine(s) and/or support structure(s) before year 25 if this contributes to the goals of innovation and or electricity production. This has no effect on the subsidies.

5.3.5 Investment subsidy

Unlike the other two offshore wind farm tenders, bidders for BWFS V will also receive an investment subsidy in addition to the SDE+ grant. This amounts to 45% of the additional costs relative to the 'investment costs' for BWFS III. Regarding additional costs, the investment costs for BWFS III will be taken as a reference, though they are not public. However, the amount the winner has offered (€54.49/MWh) is public. The goal of Dutch Government for the innovation site is to subsidise the additional investment costs associated with initial innovative applications. This uses a 'notional' investment level (per MW) for calculations, which is derived from the average of all parties which offered on Site III. The notional amount will be made public by the Netherlands Enterprise Agency.

A surcharge (an additional amount of investment subsidy) of 10 percentage points for mid-sized enterprises and 20 percentage points for small enterprises applies. Advances are paid automatically per quarter based on the budget milestones. The advance amounts to 90%. Payment of the investment subsidies ceases as soon as the turbines start delivering electricity to the grid, at which point the SDE+ operating phase commences. This is a condition of the support framework.

The terms relating to the investment subsidy are all in accordance with Article 41 of the General Block Exemption Regulation. See Appendix A: Applicable Law for more details.

5.3.6 Ranking criteria

The Minister ranks the applications. In practice, the Minister requests advice from a committee of independent experts. This committee assesses the applications based on the ranking criteria. A minimum of 1 and a maximum of 5 points are awarded per criterion. The score of the expert committee, and the resulting ranking (from high to low scores), is submitted as a recommendation to the Minister. The Minister will adopt this recommendation provided it has been prepared carefully and transparently. The Minister will award a higher number of points to a project:

a. The more the project contributes to cost reduction of offshore winds farms;
b. The greater the project's possible contribution to the Dutch economy;
c. The more innovative the project is relative to international standards of research and technology and the more the project boosts the knowledge position of the Netherlands;
d. The better the project quality is, as evidenced by the detailing of the approach and method, risk handling, feasibility, the participating parties and the degree to which the available resources can be deployed more effectively and efficiently.

In case there is more than one project with the highest score in the ranking, the winner will be the project that requests the least investment subsidy. In case the highest ranked projects request equal amounts of investment subsidy, the winner will be determined by lottery.

Contribution to cost reduction

Here we consider the degree to which a project contributes to cost reduction of offshore wind farms whereby cost is understood to mean Levelised Cost of Energy (LCOE). A reduction of LCOE can be achieved by lowering costs (e.g. CAPEX, OPEX, financing costs) or raising revenues (energy production, value). The reference amount here is the amount bid by the winner of the BWFS III (€54.49/MWh). The LCOE is not the LCOE of the demonstration project, but the expected LCOE in case the innovation is applied in a commercial wind farm.

Contribution to the Dutch economy

The economic perspective of the project will be considered, with entrepreneurial success being the determining factor. A project scores higher under this criterion the more the project outcome results in greater turnover, exports or employment in the Netherlands among the participating enterprises or, where relevant, in the sector concerned. Expected outcomes should be properly substantiated, providing quantitative information were possible and with explicit assumptions and estimates were necessary. Indirect employment effects will not be considered.

A project scores higher under this criterion on the basis of:

a. The better a description provided of a strategic vision for implementation;
b. The greater insight provided into the development and marketing of the technology following completion of the project and possibly up to its market launch; and
c. The greater the probability of the project outcomes being successfully applied in the market.

To increase the likelihood of an innovation being successful, the project plan will have to demonstrate that the non-technological aspects that play a role in the market launch have been considered, with activities being included in the project plan where possible and necessary to facilitate these aspects.

Innovation

This relates to the research and innovation aspects. A project scores higher under this criterion the more innovative the project and the higher the research quality and level of innovation involved. This relates to both the number of innovations applied (the quantity) and the originality of the applied innovations (the quality).

The innovation concerned may be a new technology with respect to products, processes or services, or it may be actual new improvements to or real new applications of an existing technology. The international state of the art will be taken as the benchmark.

This criteria will be deemed more satisfied the greater the level of the project's technological innovation, varying from a marginal technical improvement to a technological breakthrough. The use of both available positions will weigh positively in the assessment, as will the linking of a scientific research programme to the project.

The technical risks associated with the project must be controllable. With respect to the demonstration of components in projects in particular, a weighting is made of how the lessons learned are safeguarded and applied in subsequent development within and beyond the project.

Quality of the project

In terms of the quality, a project is ranked higher as follows: the better the research method, method of demonstration and specific approach used, the better the project plan describes the background of the problem or the new steps being made, the problem definition, the objectives, the specific approach, the activities to be carried out by each partner, the project phases (including 'go/no-go' moments), the resources to be used and the results, and the greater insight the project provides into risks (and the more effectively it deals with these risks).

The project also scores better under this criterion if the consortium includes all parties that are useful and necessary for the project (involvement of the value chain), the collaboration partners (availability of the required knowledge) are better able to carry out the project at the desired level of quality and the contribution of each participant is clear. Participation by Dutch SMEs will be valued.

Finally, the assessment of quality will also consider the degree to which the available resources are deployed effectively and efficiently. A project will score better in this regard if the financial resources are targeted more effectively at the project objectives. Financial resources include both the requested grant and other funds used to finance the project. In the interest of avoiding unnecessary project costs, the assessment will consider the impact the project may have on the cost-price reduction of offshore wind farms and on the Dutch economy (see criteria a and b), viewed in relation to the total of subsidised project costs. Projects that have a greater impact relative to the total project costs will score higher than projects that have a smaller impact with the same project costs.

5.3.7 Relevant grounds for refusal

As well as assessing bids in terms of the criteria discussed in previous sections of this Chapter, the Minister will also take into account the relevant grounds to refuse (reject) an application. There are a number of grounds for refusal that all applicants should be mindful of when preparing their submissions. These are specified in the following legislation:

- Section 59 of the Stimulation of Sustainable Energy Production Decision;
- The draft Ministerial Order for Innovative Offshore Energy; and
- Section 14 of the Offshore Wind Energy Act.

Grounds for refusal largely relate to when the bid is perceived to be technically and/or economically implausible, fails to sufficiently meet the ranking criteria or Site Decision requirements, or when the financial status of the applicant(s) is in question. Late submission of a bid is also grounds for refusal.

A full summary of the grounds for refusal can be found in Section 6.3 (Financial and Legal Requirements) of this PSD.

5.4 Amendments of the Wind Farm Site Decision

The Wind Farms Site Decision for Borssele V (WFSD V) was published in April 2016.This WFSD V was amended and published in September 2016. As a result of the internet consultation held for the Ministerial Order for Innovative Offshore Wind Energy at the beginning of 2017 the Wind Farm Site Decision for Borssele V (innovation) has again been amended. The total rotor area allowed has been adjusted, as well as the nominal capacity per wind turbine and the minimal nominal capacity for the innovation site. The regulations of this Wind Farm Site Decision can be found in Appendix A.

5.5 TenneT - offshore grid operator

5.5.1 Introduction

The Authority for Consumers and Markets (Regulator) decided to certify TenneT as the offshore grid operator in July 2016. This was a requirement for the Ministry of Economic Affairs to formally designate TenneT as offshore grid operator in the Netherlands in September, 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 amended in June 2017.

5.5.2 Framework

As prescribed in the Development Framework and elaborated on in the offshore Quality and Capacity Document published in May 2016, TenneT will build grid connections for the planned 3,500 MW new offshore wind capacity.

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. The two platforms Borssele alpha and Borssele beta will be connected via a 66 kV link. Output from BWFS V will be connected to Borssele beta using one 66 kV cable. Borssele beta grid connection system is planned for operation on 31 August 2020.

5.5.3 Realisation Agreement and Connection and Transmission Agreement

In close consultation with the offshore wind industry, the Ministry of Economic Affairs, 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. Model agreements are available for parties to be connected to the offshore grid (see www.tennet.eu/netopzee).

All agreements will basically be the same for all winners of the subsidy tenders. The agreements will be concluded on an equal basis with the parties concerned. For the sake of completeness: the content of these agreements is non-negotiable.

5.5.4 Applicable codes

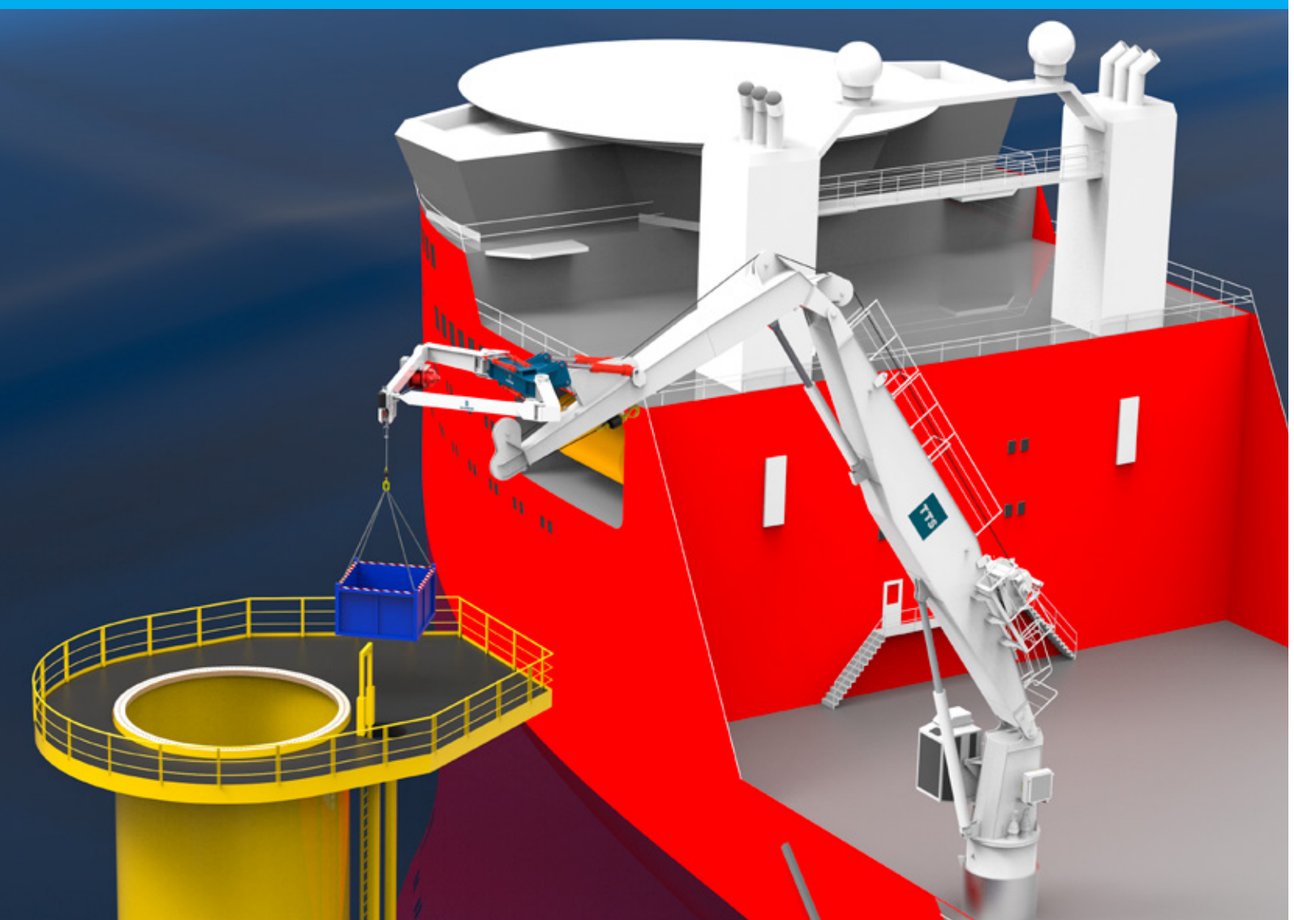
The generic technical requirements for offshore wind farm connections are established as technical code requirements, and as such are based on public law. In December 2016, ACM concluded and published the offshore code. Further generic technical requirements by TenneT can be found in the annexes to the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

5.4.5 Step-by-step process to connection

After the Implementing Agreement and the bank guarantee are arranged by the winner(s), Netherlands Enterprise Agency will, when requested by the winner, organise an introduction for the winner(s) of the tender with Netherlands Enterprise Agency, Ministry of Economic Affairs, 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 specific 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;
- Signing of both agreements by both the winner and TenneT may take place between four to six months after the start of the connection process;
- After the agreements have been signed by both parties 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.

6. Specific requirements and relevant information from the legal framework



This chapter contains tables summarising the specific requirements that need to be adhered to when competing in the call for tenders for BWFS V. These are grouped in line with the different wind farm development stages (design, finance, build, operate and decommissioning).

Please be aware this summary is a service to indicate the most important aspects of the legal framework and is not limiting. The text of the mentioned regulations as published by the Dutch government is leading.

6.1 Boundaries and coordinates

The boundaries of the Borssele Wind Farm Zone have been published in the memo Boundaries and Coordinates. This memo can be found in Appendix C part of this Project and Site Description.

The wind farm at Site V will be situated within the contours of the following coordinates, see also table 6.

Table 6: Coordinates of Wind Farm Site V.

UTM coordinates (ETRS89, zone 31)			
Location	Point	Easting	Northing
Site V	P_83	500,922.0	5,728,636.0
Site V	P_84	500,621.0	5,728,234.0
Site V	P_85	499,534.0	5,728,745.1
Site V	P_86	499,839.2	5,729,146.6

The map with the location of site V is included in the appendix C to this PSD.

The route of the grid connection to Borssele beta platform is within the following coordinates, see also table 7.

Table 7: Coordinates of the route of the grid connection to Borssele platform beta.

UTM coordinates (ETRS89, zone 31)			
Location	Point	Easting	Northing
Route	T_2	497,620.7	5,730,622.2
Route	T_14	497,615.4	5,730,568.7
Route	P_88	497,769.0	5,730,118.6
Route	P_86	499,836.2	5,729,146.6
Route	P_87	499,774.9	5,729,064.9
Route	P_54	497,575.3	5,730,099.1
Route	T_22	497,603.4	5,730,569.9
Route	T_21	497,609.5	5,730,630.6

The map with the location of the route is included in the appendix C to this PSD.

6.2 Design and operation requirements

Table 8: Bandwidth of design characteristics for BWFS V.

Requirement	Applicable Law
BWFS V is appointed as a location for wind turbine(s) with a total minimum capacity of 6 MW per turbine and a total maximum capacity of 20 MW.	WFSD V, I
The wind turbine(s) will be situated within the contours of the coordinates listed in Table X of the PSD.	WFSD V, III 2.1
The route of the grid connection to the offshore substation Borssele beta platform is within the coordinates shown in Table X of this PSD.	WFSD V, III 2.2
A wind turbine, as well as another installation forming part of the wind park, satisfies in practice a system of strength and constructional safety standards that is applicable to the designs of installations in a wind farm. The licence holder must prove this in writing no less than four weeks prior to the commissioning of the wind farm.	WFSD V, III 2.3
The rotor blades of the wind turbines must remain completely within the contours cited in Table X of this PSD WFSD V and completely outside of the maintenance zones cited in Table X of this PSD.	WFSD V, III 2.4
The maximum number of wind turbines to be installed is 2.	WFSD V, III 2.5
The maximum total swept area permitted: 76.924 m^2	WFSD V, III 2.6
Only wind turbines of minimal 6 MW nominal capacity are to be installed in the wind farm.	WFSD V, III 2.7
The minimum distance between wind turbines must be 4 times the rotor diameter expressed in metres.	WFSD V, III 2.8
The minimum tip lowest level is 25 m above sea level (MSL).	WFSD V, III 2.9
The maximum tip highest level is 250 m above sea level (MSL).	WFSD V, III 2.10
The cables from the wind turbines must be connected to the Borssele beta platform.	WFSD V, III 2.11
The permitted foundations for the wind turbines are: monopile, tripod, jacket, gravity based, suction bucket and floating foundations. Mooring systems for floating foundations must be deployed within the contours of the site. 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. The environmental impact must not exceed the limits set out in this Decision.	WFSD V, III 2.12
If sacrificial anodes are used as cathodic protection of steel structures, these must consist of alloys of aluminium or magnesium. The alloys may contain small amounts (< 5 weight %) of other metals.	WFSD V, III 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 company is required to create an action plan, to be delivered to the Ministry of Economic Affairs no later than eight weeks before the planned start of construction. Construction work must adhere to this plan.	WFSD V, III 2.15
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. Extra installations are not allowed if they are not directly related to the wind turbines to be constructed. In this respect the company is required to create an action plan, to be delivered to the Ministry of Economic Affairs no later than 8 weeks before the planned start of construction. Construction work must adhere to this plan.	WFSD III and IV, III 2.15
The permit as referred to in Section 12 of the Offshore Wind Energy Act will be issued for a period of 30 years.	WFSD V, III 3.1
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, Art. 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: its location, the type of quality and security provisions. Within three months after installation an operator will provide Our Minister with the position of foundations and export cables and related works.	Water Decree, Art. 6.16d

6.3 Financial and legal requirements

Table 9: Financial and legal requirements BWFS V.

Requirement	Applicable Law
The nominal capacity of the offshore wind farm on site V, amounts to: a) at least 6MW per turbine and b) at most 20 MW total capacity.	MOIOWE, Art. 3 and WFSD V, I
The deadline for tender submissions is 18 January 2018 17.00 Dutch time.	MOIOWE, Art. 4
The Minister will in any event refuse an application if: a. The application does not satisfy this decision and the provisions based on it; b. The minister considers it implausible that the production installation will be commissioned within five years; c. The minister considers it implausible that the realisation of the production installation is: • Feasible; • Technically feasible; • Financially feasible; • Economically feasible.	Stimulation of Sustainable Energy Production decision, Art. 59
The Minister will also reject an application if: a. Fewer than three points are awarded per ranking criterion; b. The financial substantiation shows that the applicant's equity is less than 10% of the total investment costs for the production installation concerned; at the request of the applicant, the following will be included in the calculation of the applicant's equity: a. If the applicant is a joint venture, the equity of each of the participants in the joint venture; b. If the subsidy applicant or a participant in a joint venture is a subsidiary, the other equity of the parent enterprise may be included provided the parent enterprise assents to such in writing. c. Late submission of a licence application as referred to in Section 20, first subsection, of the Offshore Wind Energy Act; d. The application does not satisfy the criteria for a licence, under or pursuant to Section 14, first subsection, part d or f, or second subsection of the Offshore Wind Energy Act, which states: Offshore Wind Energy Act, Section 14: 1. A licence can only be awarded if, based on the application, it is sufficiently plausible that the construction and operation of the wind farm: d. Can be started within four years of the date on which the licence has become irrevocable; f. Satisfies the site decision. 2. Rules can be set by ministerial order with respect to the assessment criteria as referred to in the first subsection. e. If there is an outstanding recovery order against the applicant as referred to in Section 1, fourth subsection, part a, of the GBER; f. The applicant is an enterprise in difficulty, as referred to in Section 1, fourth subsection, part c, of the GBER.	MOIOWE, Art. 6
The equity of a participant in a collaborative venture or the equity of a parent company are included in the equity of no more than two applicants.	GIR SDE+, Art. 2a.6
The insight into equity will be offered by the provision of the most recent annual accounts of the applicant, its parent company and/or the participants in the collaborative venture.	GIR SDE+, Art. 2 §7
If an applicant will invest less than 20% equity in the project itself a letter of intent from a financier for the financing of the remaining part of the 20% is included.	GIR SDE+, Art. 2a.3
The total subsidy cap is €57,000,000	MOIOWE, Art. 7
The investment grant available is capped at €42,000,000	MOIOWE, Art. 7
The operating grant available is capped at €15,000,000	MOIOWE, Art. 7
For the SDE+ operating grant, a price cap of €54.49/MWh applies (= winning price for BWFS III).	MOIOWE, Art. 13
Tender winners will be granted the SDE+ subsidy under the following conditions: a. The tender winner shall enter into an execution agreement with the Ministry within two weeks from award of the contract to build and operate the respective wind farm. b. The tender winner shall provide a bank guarantee of €600,000 within four weeks from Award.	MOIOWE, Art. 10

Requirement	Applicable Law
The tender winner shall provide a second bank guarantee of €2,200,000 within twelve months from award of contract, unless the Dutch State withdraws, on request of the tender winner, the Award within that period.	GIR SDE+, MOIOWE, Art. 10 + appendix A
The grant will be provided for a period of 15 years. The wind farm should be commissioned within five years after the date of the Decision to award the grant.	MOIOWE, Art. 9
The SDE+ subsidy programme subsidises the difference between the market price of electricity and the tender price offered by the lowest bidder. If the market price falls, the subsidy amount rises, so the overall income of an operator remains the same. However, if the market price falls below the base electricity price (floor price), the subsidy will not increase any further, so the overall income of an operator will be lower.	Stimulation of Sustainable Energy Production decision
The base electricity price (floor price) for the BWFS V tender will be € 0.025/kWh.	MOIOWE, Art. 15.1
The maximum number of full load hours (eligible for subsidy) is equal to the net P50-value full load hours that is included in the application.	MOIOWE, Art. 15.2
When calculating the P50 value for net electricity generation per annum of the wind farm, the following losses should be taken into account: availability, proximity effects, electricity losses, own consumption, environmental effects on the turbine, turbine yield and curtailment losses.	GIR SDE+, Art. 2b.4
When calculating the wake effect for the P50 value, only Belgian wind farms that are operational as of July 1st 2016 and the site itself should be taken into account.	MOIOWE
The project has to be executed in accordance with the project plan submitted with the application.	SDE+, Art. 62
In the Decision to award the subsidy, the obligation can be imposed that a maximum of one report per year be submitted on the progress and results of the project, which the Minister considers of sufficient quality and in which the subsidy recipient publishes the non-business-sensitive knowledge and information obtained through the project.	MOIOWE, Art. 11
The subsidy recipient has to submit an application for interim determination of the investment subsidy within thirteen weeks after the production installation has been commissioned.	MOIOWE, Art. 22

6.4 Construction

Table 10: Construction requirement parameters for BWFS V.

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, Art. 6.16d1
Prevention of permanent physical harm and/or effects on porpoises, seals and mortality of fish: a. Companies must use an acoustic deterrent device during piling and half an hour before piling work starts. b. Piling work should adopt a soft start, to enable porpoises to swim to a safe location.	WFSD V, III 4.1
Measures to limit and prevent disturbance to porpoises, seals and fish (sound level): during the construction of the wind farm, the sound level under water at any given time during piling work may not exceed the sound levels cited. From Jan-May the maximum piling sound level is lowest. The permit holder prepares a piling plan and submits this to the Minister of Economic Affairs at least eight weeks before the commencement of the construction. The work must be performed in accordance with the piling plan. The permit holder will make every effort to generate as little subsea sound as possible and as short a continuous period of time as possible.	WFSD V, III 4.2
Measures to protect archaeology and cultural history: a. Exploratory field research to assess the presence of archaeological monuments is required prior to cable laying and placement of the turbine foundations. b. The results will be presented to the Minister no later than three months before construction of the wind farm starts. c. Depending on the conclusions of the study: a. the work can proceed without changes; b. a follow-up study is required; c. physical measures must be taken to protect archaeological sites; d. sites are to be excluded from interference taking into account a buffer zone; e. the work must be supervised archaeologically.	WFSD V, III 4.5
Concerning the visible structures at the seabed surface, as long as the archaeological value of the remains is not determined, it is advised not to conduct disturbing activities on the locations including a buffer zone of 100 m around. This also applies to cable trenching and anchorages of work vessels. The buffer zone of 100 m is a standard that applies to the protection of cultural heritage, this distance may be reduced if it can be substantiated that the applied disturbance has no effect on the archaeological object. If it is not feasible to avoid the reported magnetometer locations, additional research is required in order to determine the actual archaeological value of the reported locations. It is advised that the UXO research within 100 m of the 65 magnetometer anomalies is carried out under on-board archaeological supervision. Depending on the outcome of the UXO research, it may be decided that additional research (for instance by means of ROV or dive investigations) is needed. If the UXO research indicates the object has no archaeological value, the location can be omitted. 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 programme of requirements. In accordance with the Monuments Act 1988 (Revised 2007), those findings must be reported to the competent authority.	Archeological Assessment
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, Art. 6.16f1
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.	Water Decree, Art. 6.16g1
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, Art. 6.16h1 and 2

6.5 Operation

Table 11: Operational requirements for BWFS V.

Requirement	Applicable Law
Vessels used by or on behalf of the permit holder must take into account the presence of seals in the shallows and designated resting areas. The measures cited in the Voordelta Management Plan and the Delta Water Management Plan must be taken into account hereby. This regulation will be withdrawn once the Voordelta Management Plan and the Delta Water Management Plan have been updated/amended to include these restrictions on ships.	WFSD V, III 2.14
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, the number of rotations per minute per wind turbine will be reduced to less than 1; b) for the purpose of implementing this regulation, referred to in subparagraph a, the control system of the wind turbines will be linked to a system that effectively observes bird migration; c) in a plan, the permit holder describes the system to which the wind turbines will be linked and the transect line based on which bird density will be determined. The permit holder must submit this plan to the Minister of Economic Affairs at least eight weeks before the commencement of the construction; d) the connection mentioned in part b of this regulation will be executed within the plan mentioned in part c; e) July 1st and January 1st of each year the permit holder reports how and in what way the regulation rules have been executed. Government will pay for the system that effectively observes the bird migration and its maintenance (WFSD: II.7.8.4).	WFSD V, III 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 this regulation is implemented and submit it to the Minister of Economic Affairs.	WFSD V, III 4.4
1. The Minister of Economic Affairs will create 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 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; • 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 V, III 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, Art. 6.16i

6.6 Decommissioning of the wind farm

Table 12: Decommissioning requirements for BWFS V.

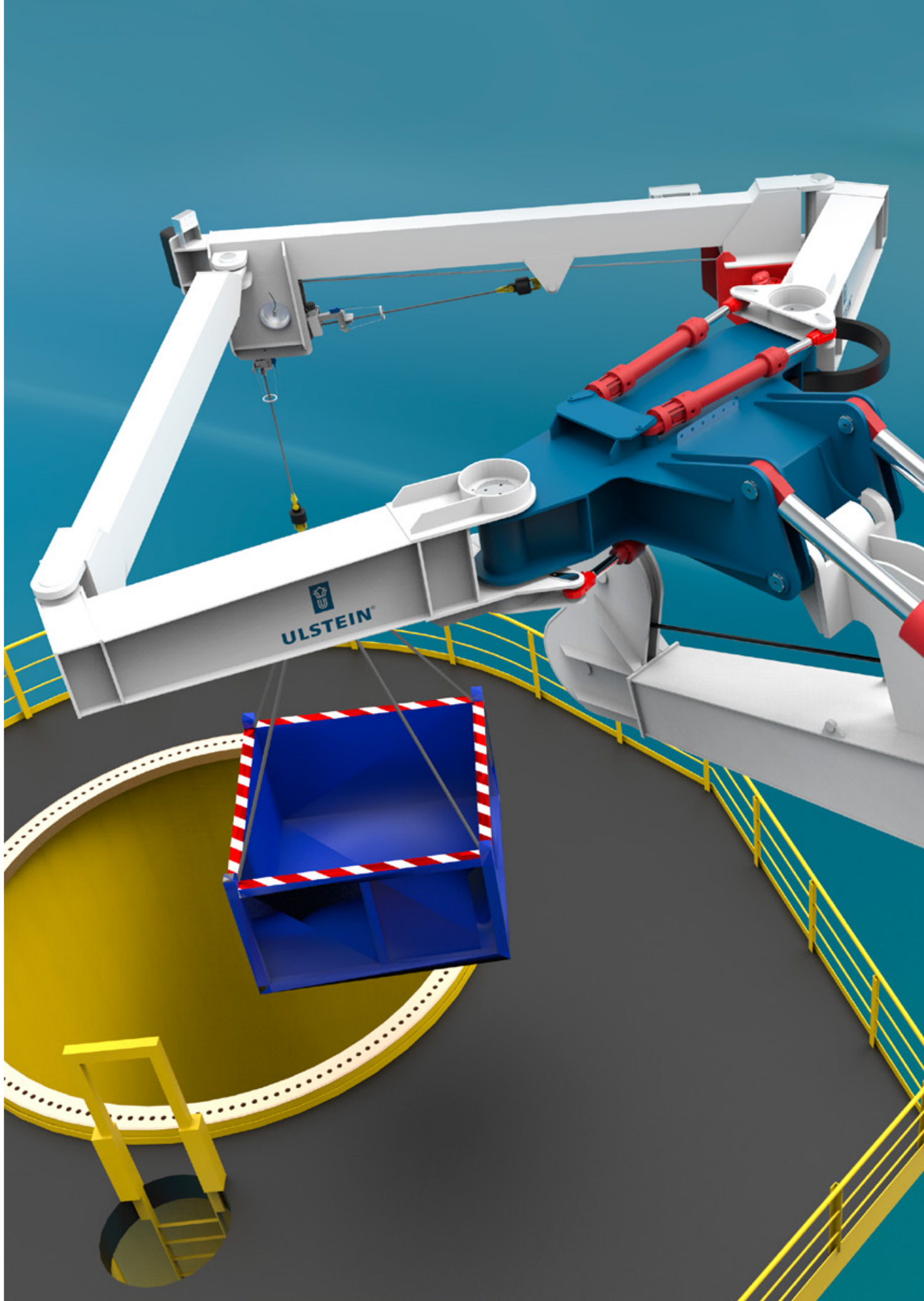
Requirement	Applicable Law
After the power generation operations have stopped the permit holder will dismantle and remove all elements of the wind farm within two years at the latest, but always within the term of validity of the permit.	WFSD V, III 6
1. At the latest, at the moment of given proof of produced electricity by the means of so-called 'Guarantees of Origina' (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 a by 2% as a consequence 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 ask the Minister of Economic Affairs to redetermine the amount referred to under 1 and its indexation.	WFSD V, III 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, Art. 6.16l
The operating term can commence from year three from the time the licence becomes irrevocable and last through to year 29. The removal term can commence from year 25 and last through to year 30.	WFSD V, III 3

6.7 Electrical infrastructure

Table 13: Electrical infrastructure requirements.

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.	EACT7, 16f.1
A downtime of five days per calendar year is allowed without compensation.	COMPS8, 2.3
Compensation consists of consequential damages and damages resulting from lost or postponed revenue.	EACT, 16f.2
In case of late commissioning, the compensation is: postponed income from electricity price (E-E/3.87) + postponed SDE-subsidy (SDE-SDE/2.95) + 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 + Lost SDE + consequential damages. In formula: (Eprice+(SDEprice-SDEprice/1.4)*(kWhmissed-kWhtransported_in_5_days) + consequential damages.	COMPS, 4.2
The connection voltage level of the inter-array systems to the TenneT offshore transformer platform will be standardised at 66 kV.	Development framework offshore wind energy, 3.7
Number of J-tubes. One (1) J-tube will be installed for Site V. Number of bays. The 66 kV inter-array cable of BRS V will be connected to a 66 kV coupling bay with dedicated cable disconnector for BRS V.	Development framework offshore wind energy, 3.8
Access to platform. Boat landing and Walk-to-Work (W2W) solutions are the standard access method to the offshore substation. The offshore substation will have a helicopter hoisting facility for emergency response (if allowed by authorities) and no helicopter platform.	Development framework offshore wind energy, 3.4
Organisation of metering. TenneT will centralise the organisation of the accountable metering requirements via one certified party, 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, 3.9
Overcapacity. No overplanting possible on site V. TenneT does however always guarantee a transmission capacity of 20 MW for site V.	WFSD V
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, 3.9
The basic approach to the protection system is described in the offshore agreements. The selected project developer may propose additional protection systems for its installation at its own cost. TenneT will review if the overall protection system is technically feasible and eventually decide on the detailed design.	Development framework offshore wind energy, 3.8
TenneT is inclined towards: (i) not installing, nor making provisions for, a (diesel engine powered) back-up generator plant on the offshore platform to provide auxiliary power for the PPMs; and (ii) 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, 3.5(i)/ TenneT(ii)
Planning. The date for delivery of the Borssele beta grid connection system is 31 August 2020.	Development framework offshore wind energy, 4.2

For further technical requirements you are referred to TenneT's model agreements published on ***www.tennet.eu***.



7. Next steps

Preparations by the Government for the BWFS V (Innovation) tender are being finalised. This Project and Site Description, version September 2017, contains all available site data and requirements that are relevant to prepare a tender bid by January 2018.

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

- Key dates you need to know to participate in the request for tender for BWFS V (Innovation);
- Useful websites which provide the most up-to-date information on the tenders and status of all relevant studies, the legal framework and the application for a subsidy and permit;
- Key industry authorities and contacts, and links to further information on incentive schemes and finance contacts that may be of interest.

7.1 Key dates

The key dates participants in the tender for BWFS V (Innovation) need to know are:

- *September 2017:* publication of amendments to the SDE+ Decision.
- *October 2017:* publication of the final and irrevocable Borssele Wind Farm Site Decision V.
- *October 2017:* publication of the Ministerial Order for Innovative Offshore Wind Energy.
- *Autumn 2017:* application forms can be downloaded from ***www.mijnrvo.nl*** (Dutch only: Please note all applications must be completed using the Dutch language);
- *2 January 2018:* tender Innovative Offshore Wind Energy 2017 BWFS V opens;
- *18 January 2018, 17:00 (Dutch time)*: tender closes.

7.2 Useful websites to help to 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 can be found at ***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 tender for BWFS V (Innovation) can be downloaded from ***www.mijnrvo.nl***;
  More information on the SDE+ grant and permit and the FAQ SDE+ grant and permit can be found at ***www.rvo.nl/windenergie-op-zee and www.english.rvo.nl/offshore-wind-energy***;
- Wind Farm Site Decisions are published at ***www.rvo.nl/windenergie-op-zee and www.english.rvo.nl/offshore-wind-energy***;
- An overview of all relevant wind measurement locations in the North Sea: ***www.windopzee.net***;
- General information about offshore wind energy from the Dutch Government: ***www.rijksoverheid.nl/onderwerpen/duurzame-energie/windenergie***;
- Information from Holland Trade and Invest on opportunities in the Netherlands for offshore wind: ***www.hollandtradeandinvest.com/key-sectors/energy/publications/publications/why-explore-the-netherlands-for-offshore-wind-energy/06/06/why-explore-the-netherlands-for-offshore-wind-energy***;
- "Noordzeeloket" provides information on several spatial topics concerning the North Sea, including offshore wind ***www.windopzee.nl*** and ***www.noordzeeloket.nl/functies-en-gebruik/windenergie/***;
- An overview of all relevant wind measurement locations in the North Sea: ***www.windopzee.net***;
- Information on the permitting procedure for the grid connection: ***www.rvo.nl/windenergie-op-zee***;
- All information resulting from TenneT's consultation process with the offshore wind sector (technical, legal, planning and other topics): ***www.tennet.eu/netopzee***

7.3 Key industry and finance contacts

There are several routes and key organisations that can help offshore wind companies investigate the potential for business in the Netherlands and find out more, for example, about getting involved with TKI Wind Op Zee, Top Sector Energy, and working with knowledge institutes within the offshore sector. This can include setting up preliminary meetings and providing up-to-date, personalised information about the Netherlands in general, relevant business locations, Dutch legislation and tax regulations, labour issues, permit procedures, governmental incentives and so on. Customised fact-finding trips can also be organised in close cooperation with regional economic development partners, local administrations, Dutch industry networks and service suppliers, and other relevant contacts in the investment process.

Two of the key government agencies are:

- *Netherlands Enterprise Agency (RVO.nl)*: An agency of the Ministry of Economic Affairs, the organisation is charged with implementing the Netherlands' offshore wind programme as well as other renewables development via the SDE+ framework and R&D subsidy programmes. (***www.rvo.nl***)
- *Netherlands Foreign Investment Agency (NFIA):* As part of the Dutch Ministry of Economic Affairs, in 22 offices worldwide, the NFIA offers customized information, practical assistance via fact-finding trips and introductions to national and local administrations. (***www.nfia.nl*** and ***www.investinholland.com***)

Other useful industry contacts and sources for information are:

- Top Sector Energy: ***www.topsectorenergie.nl***
- TKI Wind op Zee: ***www.tki-windopzee.nl***
- Dutch Wind Energy Association (NWEA): ***www.nwea.nl***
- Holland Home of Wind Energy (Dutch export association for wind energy, HHWE): ***www.hhwe.eu***
- The Association of Dutch Suppliers in the Oil and Gas Industry (increasingly active in offshore wind): iro.nl

Some of the key incentive schemes and/or financing sources that may prove useful to those working in the Dutch wind industry are:

- *The WBSO (R&D Tax Credit Act):* Covering both salaries and other costs, the WBSO stimulates R&D activities by providing for a reduction of wage tax due on the wages of employees engaged in R&D of technologically new products. (***www.rvo.nl/wbso***)
- *Subsidies for Wind Power R&D (TSE subsidies):* Subsidies on Fundamental Research, Industrial Research, Experimental Development and Demonstration (***www.rvo.nl/subsidies-regelingen/subsidies-energie-innovatie***)
- *Energy Investment Allowance (Energie Investeringsaftrek, EIA*): Tax advantages when investing in energy-saving systems and technologies and in renewable energy supplies. (***www.rvo.nl/EIA***)
- *Environmental Investment Allowance (Milieu Investeringsaftrek, MIA) and Vamil:* Tax advantages when investing in environmentally-friendly systems and technologies. (***www.rvo.nl/miavamil***)
- *Innovation credit (Innovatiekrediet):* Credit for the financing of highly promising and innovative projects. (***www.rvo.nl/innovatiekrediet***)
- *Loans for SMEs (BMKB):* Bank loans for small and medium-sized enterprises, with favourable conditions. (***www.rvo.nl/bmkb***)
- *The MKB+ Innovation Fund (Innovatiefonds MKB+)*: Supports innovative entrepreneurs with three financing instruments - Innovation Credit, the SEED Capital Scheme, and the Fund-of-Funds. (***www.innovatie-fondsmkb.nl***)
- Other support for entrepreneurs: ***www.rvo.nl/ondernemingsfinanciering*** or ***www.rvo.nl/ondernemersfinanciering***

8. Innovation offshore wind power

The Dutch Government fully understands that in order to achieve its Energy Agreement goals, including a 40% cost reduction for offshore wind, support for innovation is critical. It offers good incentive programmes that support and stimulate energy innovation (including tax exemptions for R&D activities), strategic public-private partnerships and world-class R&D facilities.

The Energy Top Sector policy was specifically established to take forward the country's energy knowledge and innovation agenda. This recognises that innovations are not solely technological in nature, but have important economic and social aspects too. The Energy Top Sector's various programme lines are reflected in public-private partnership programmes, such as TKI Wind op Zee for offshore wind. The work in innovation capitalises on the Netherlands' rich R&D landscape. It is at all TRLs, from basic research, R&D and demonstrations to market launch, and is conducted in collaboration with industry, knowledge institutions, organised interests and authorities.

Indeed, some of the world's leading knowledge institutions and universities with a focus on energy R&D are based in the Netherlands. Many originate from university research groups and almost all have very close links to one or more universities and other education establishments. In this Chapter some of those at the forefront of offshore wind R&D are profiled, as follows:

- TKI Wind Op Zee
- Large Technological Institutes[1]
  - The Dutch National Aerospace Laboratory (NLR)
  - Energy Research Centre of the Netherlands (ECN)
  - Maritime Research Institute Netherlands (MARIN)
  - Deltares
- Universities
  - Delft University of Technology (TU Delft/Duwind)
- Other Knowledge Institutes
  - Knowledge Center WMC
  - NIOZ
  - IMARES
  - Netherlands Organisation for Applied Scientific Research (TNO)
  - DOB-Academy

This list is not exhaustive - there are simply too many high quality R&D organisations and university groups in the Netherlands working on offshore wind to mention within this PSD. Moreover, the Netherlands Enterprise Agency does not in any way advocate one organisation over another. Most of the organisations profiled have links to the wider Dutch R&D network. All are making a valuable contribution to the Netherlands' long-term sustainable energy goals.

8.1 TKI Wind Op Zee

8.1.1 Programme

The Top consortium for Knowledge and Innovation Offshore Wind (TKI Wind op Zee) works closely with the knowledge institutes mentioned above, with the offshore wind industry (there are over 150 companies participating) and with the government, to drive forward innovation work in the sector. It is part of the Dutch Topsector Policy: a government policy that targets the further development of successful industry sectors (in this case offshore wind) through research and development in cooperation with Universities and Knowledge Institutes.

Working as a public private partnership, TKI Wind Op Zee was specifically initiated to facilitate innovations that will help achieve the Netherlands' 40% cost reduction target for offshore wind. Beyond that, its mandate is to help ensure offshore wind power makes a substantial, affordable, reliable and socially responsible contribution to energy supply.

The TKI Wind op Zee has an R&D and innovation programme with the objectives to:

- Reduce cost of offshore wind farms;
- Contribute to and expedite the energy transition;
- Strenghten the contribution to the Dutch offshore wind industry.

R&D projects can range from discovery, development to demonstration and deployment. To allow demonstration of innovations, the TKI submitted a proposal for test and demonstration facilities for offshore wind energy in 2014. The proposal was based on a market consultation the TKI held in the period 2013-2014. As a result, the decision was taken to guarantee space for innovation by designating an innovation site for maximum two wind turbines with a total nominal capacity of a maximum of 20 MW at Borssele and organising a separate subsidy tender for this, with different criteria than for the other sites. This resulted in the designation of Wind Farm Site V at the Borssele Wind Farm Zone (BWFZ) as the first site that is specifically intended for the production of electricity form wind energy using innovative technology (BWFS V).

Targeted R&D programme

Every year, TKI Wind op Zee opens a number of grant programmes for applications, providing financial support for R&D and innovation projects. Since it began its work in 2012, TKI Wind Op Zee has overseen several key projects, many of which have delivered their results to the industry. By end 2016, TKI Wind op Zee provided more than €27 million towards technical R&D. It should be noted that TKI

[1] *(GTI - Groot Technologisch Instituut - is a status given to some knowledge institutes with a focus on applying fundamental knowledge)*

Wind op Zee's funding goes beyond technical R&D and includes market framework and outlook studies, cost reduction analysis reports, supply chain analysis and policy recommendations, and so forth.

Under TKI Wind op Zee's R&D programme, activities focus on six innovation themes, namely:

- Foundations: fixed and floating foundation technology;
- Wind Turbines and the offshore wind farm – wind turbine components and the optimization of the complete wind farm;
- Inter – array network and grid connection – all related components, SCADA systems and integration of offshore wind power in the energy system; this can also include offshore energy storage and conversation;
- Transport and Installation – from manufacturing to offshore construction;
- Operations and Maintenance – including the full life cycle of the wind farm;
- Offshore wind and the environment – cooperation with other users of the North Sea and interaction between the wind farm and ecology.

For each theme, TKI Wind op Zee brings together industry companies with universities and knowledge institutes to collaborate on R&D projects.

Find out more about TKI Wind op Zee by visiting ***http://tki-windopzee.eu***

8.1.2 Networking

TKI Wind op Zee can help facilitate the organisation of consortia of companies interested in participating in the tender round for BWFS V. It can introduce companies to each other, for example bringing technology and component suppliers together with engineering and construction companies, project operators and knowledge institutes and universities.

TKI Wind op Zee and the Netherlands Enterprise Agency have already organised a Networking Event relating to BWFS V. It took place in November 2016 with the objective of giving parties a chance to meet others who may be interested in forming a bidding consortium with for the BWFS V tender. Overview presentations were given by both TKI Wind op Zee and Netherlands Enterprise Agency along with 14 pitches from companies and knowledge institutes hoping to form consortia. All of the presentations from the event can be found at ***http://tki-windopzee.eu/nieuwsbericht/match-making-borssele-wind-farm-site-v***.

Meanwhile, TKI Wind op Zee has also formed a dedicated LinkedIn group to further help companies come together. ***https://www.linkedin.com/groups/12018138***

8.2 Large Technological Institutes

8.2.1 The Dutch National Aerospace Laboratory (NLR - *www.nlr.nl*)

The Dutch National Aerospace Laboratory (NLR) is one of the Netherlands' major technological institutions. It carries out research to develop new technologies for aviation and space travel, not only from a scientific perspective, but also for the application of this research in industrial and governmental sectors, including offshore wind. NLR's aerospace capabilities have a logical spin-off to wind energy such as applying safety methods, aerodynamic design, applying high tech materials and wind tunnel testing. NLR's clients include governmental authorities, large and small industries, and aerospace organisations - both in the Netherlands and abroad.

It has a number of specialised research facilities suitable for offshore wind R&D:

- *Composites manufacturing facility with an industrial fibre placement* for development of new manufacturing concepts, structural details and full scale prototypes.
- *A well-equipped testing facility* with a range of different static and dynamic testing machines in which composite materials and structural elements / prototypes are tested.
- *Acoustic and aerodynamic wind tunnel testing facility* suitable for 2D airfoils and model scale rotors. The Foundation German-Dutch Wind Tunnels (DNW - ***www.dnw.aero***) is a non-profit organisation jointly established by the NLR and the German Aerospace Centre (DLR).
- *FPDAM*, a commercial tool-set to support in the identification of conflicts with obstacles and the design of flight procedure adaptations.
- *Wake vortex induced risk (Wavir) tool-set* to analyse impact of wake turbulence on aircraft.
- *Semi-empirical noise prediction methods for trailing edges*, which help in the design of quiet wind turbines and land use planning purposes of wind farms.
- *Safety database* of aircraft accidents and incidents worldwide, which can help wind companies in assessing potential collision risks.

NLR co-operates with TU Delft, among others, in education and training of students and graduates. It also provides ATM Safety Assessment Courses providing an overview on safety regulation and safety assessment techniques, which are also relevant for the assessment of effects of wind turbines on aviation safety.

8.2.2 Energy Research Centre of the Netherlands (ECN - *www.ecn.nl*)

ECN has been working on energy technology R&D for more than 55 years. More than 60 experts work at ECN Wind Energy, all focusing solely on offshore wind. The aim of ECN Wind Energy's research is to decrease the cost of offshore wind by improved design and greater reliability in the operational phase.

Holding a strategic position between universities and industry, most of the long-term research at ECN is financed by public agencies, but it increasingly carries out dedicated long-term research programmes for (and together with) industrial partners. Specifically, ECN Wind Energy consists of three research groups covering Rotor and Wind Farm Aerodynamics, Integrated Wind Turbine Design, and Operation & Maintenance, with two groups offering services and industrial support: the Experiments & Measurements group and the ECN Wind energy Industrial Support group (EWIS), focused on meeting growing industrial demand for knowledge, design tools and O&M tools and selling the commercially available ECN software, services and training programmes to industry.

ECN facilities and research tools available include:

- *Experimental Wind Farm and Testing Site at Wieringermeer (EWTW)*, comprising five Nordex N80 2.5 MW turbines which can be used for different research purposes. There are six other locations to test, optimise and certify prototypes. By 2018 ECN is expected to have an additional 3 prototype testing locations.
- *Scaled Wind Farm*, consisting of ten 10 kW turbines, used for experimental research in the field of wind farm aerodynamics and testing of wind farm specific control strategies.
- *Prototype Turbine Test Site* with a number of test positions for testing offshore wind turbines up to 6-10 MW.
- *Meteo Infrastructure on ECN's test site*, with several large met masts (up to 105 metres high) being operated.
- *FOCUS wind turbine design software*, a joint development with WMC, which includes software packages PHATAS and Bladmode.
- *Aerodynamic blade design tools*: Blade Optimisation Tool BOT and Aerodynamic Table Generator ATG.
- *Control design tool* for developing control algorithms for wind turbines.
- *Silant*, a software system for noise calculation.
- *ECN O&M Tool (for the planning phase) and O&M Cost Estimation Tool OMCE (operational phase)*, software systems for analysing offshore wind O&M.
- *Ee-farm*, software for electrical wind farm design optimisation.
- *Farm flow*, software for aerodynamic design optimisation.

8.2.3 Maritime Research Institute Netherlands (MARIN - *www.marin.nl*)

Marin was founded in 1929 as the Netherlands Ship Model Basin (NSMB) by the Dutch Government and industry. As offshore technology experienced extensive growth, it became involved in offshore projects in 1960, and more recently it implemented a special Renewable ENergy Team (RENT), covering all aspects of offshore renewable energy systems. MARIN offers dedicated people, research, model test facilities, simulation tools and offshore measurements. Much of its offshore wind work is related to floating and fixed structures but it also contributes to the development of wind turbine installation vessels. Installation, removal, maintenance, survivability and vessel traffic safety are topics that link offshore wind to MARIN's broad maritime expertise.

MARIN RENT has key competence in the analysis of motions and loads of marine structures, weather sensitive operations, wave hydrodynamics, model testing of marine structures, hydrodynamic testing and simulations, mooring and positioning systems, and the development of numerical simulation tools. Its facilities and research tools include:

- *Offshore basin*, a realistic environment (40x40x10 m) for testing offshore models with a current generation system which allows different vertical current profiles. Combined wind, waves and swell are generated using wave generators on both sides of the basin and a movable windbed, whilst a movable floor allows testing from shallow to deep water (a 30 m deep pit is available for ultra deep water testing).
- *Seakeeping and manoeuvring basin* (170 x 40 m), designed for making arbitrary (high-speed) manoeuvres in realistic waves from arbitrary directions.
- *Deepwater ship model towing tank* (252 x 10.5 x 5.5 m) is used to optimise resistance and propulsion characteristics of ship designs.
- *Depressurised towing tank* (240 x 18 x 8 m) used to optimise erosion and vibration characteristics.
- *anysiM-Phatas coupling* - time domain analysis of Multi Body Dynamics for Offshore operations. Working with ECN, MARIN is developing a coupled hydro-area dynamic simulation programme for floating wind turbine.
- *Dynfloat* for the assessment of dynamic mooring system loads and tanker motions.
- *Comflow*, a CFD code to compute non-linear wave loads on offshore structures (for instance green seas, wave impact loads and sloshing) and to calculate the (breaking) wave loads on an offshore wind turbine.

8.2.4 Deltares (*www.deltares.com*)

Deltares is a leading, independent, Dutch-based research institute and specialist consultancy for matters relating to water, soil and the subsurface. It conducts research and provides specialist advisory services for government authorities and the corporate sector in The Netherlands and globally.

Its hydraulic, geotechnical and ecological expertise in marine environments supports offshore engineers in the development, safe operation and monitoring of offshore wind farms. The following Deltares research groups work closely together, each from their own field of expertise:

- *Harbour, coastal and offshore engineering:* Design of scour protection, (operational) prediction of scour development in time, environmental design conditions for foundation design, operational prediction of metocean parameters during installation and maintenance, weather window analysis, evaluation of performance of existing wind parks.
- *Geo-engineering:* Geotechnical stability of offshore wind turbine foundations, offshore foundation design, cyclic liquefaction (mainly relevant for gravity base structures), geohazards, site approvals.
- *Coastal structures and waves:* Wave run-up and wave impact against foundation structures, flow through porous media like scour protections.
- *Water quality and ecology:* Ecological impacts and risks of installation of offshore wind parks, effects on local habitat and biotope mapping, marine spatial planning, environmental legislation, environmental monitoring techniques.
- *Applied geology and geophysics*: Marine surveys for monitoring local bathymetrical changes around the foundations and performance of scour protection, short- and long-term morphological changes, risk assessments for electricity cables.
- *Morphology and sediment dynamics:* Dredging technology (e.g. for soil improvement), handling of solids, characteristics of cohesive soils.

Facilities and research tools available include:

- *Atlantic Basin*, a combined wave-and-current basin (75 x 8.7 x 1.3m).
- *Delta Basin*, a multidirectional wave basin (50 x 50 x 1m), equipped with 2 multidirectional wave generators.
- *Delta flume*, whereby the size (240 x 5 x 7m) and available wave conditions make it possible to test almost every structure on a near-to-prototype scale.
- *Geocentrifuge facility* in which geotechnical phenomena can be investigated by artificially increasing the gravitational force (up to 300g) to enable proper modelling of the soil behaviour.
- *Delft-3d*, a 3D modelling suite to investigate hydrodynamics, sediment transport and morphology and water quality for fluvial, estuarine, coastal and offshore environments.
- *ComfloW*, a computational model capable of accurate and efficient simulation of the com- plex wave field near, and the wave impacts on, offshore and coastal structures (developed in cooperation with Rijksuniversiteit Groningen and MARIN).
- *D-OSCAR, D-PROBED, D-ORCA, D-Pile Group, C-Cycle and D-Sheet Piling* engineering software tools to respectively predict scour development, make a conceptual design for scour protection, perform statistical analyses on metocean data, design a pile foundation, calculate cyclic liquefaction and determine three-dimensional behaviour of single piles and pile.

8.3 Universities

8.3.1 Delft University of Technology (DUWIND - *www.tudelft.nl* and *www.duwind.tudelft.nl*)

Research on wind energy at the Delft University began 35 years ago, starting with an aerodynamic project at Aerospace Engineering. Nowadays the research programme covers almost all aspects of modern wind turbine technology, including for offshore application. The focus of Duwind is on long term, pioneering research, with PhD research at the heart of its activities. This looks at the development of turbine and wind farm technology, ranging from fundamental aerodynamic research to development of design methodologies, and anything in between. The Duwind research programme is driven by the following objectives:

- To maximise reliability of wind turbines and wind farm operation.
- To minimise loads on the structures (on both the rotors and support structure).
- To optimise the entire energy supply chain (wind, wind turbines, grid layout and onshore connection, integration into the main grid).

Work is undertaken across five faculties, as listed below:

1. *Faculty of Aerospace Engineering:* Aerofoil and blade design, rotor aerodynamics (experimental, analysis, CFD), fluid-structure-interaction, rotor dynamics, aeroelastic stability, design of turbines and of offshore wind farms, design methodology, wind field description, structural reliability, composite materials, component testing, production techniques, smart structures, urban wind turbines.
2. *Faculty of Civil Engineering and Geosciences:* Offshore design tools, support structure, access systems, offshore availability and reliability.
3. *Faculty of Electrical Engineering, Mathematics and Computer Science*: Electric conversion systems, direct drive generators, configuration of offshore wind farms. Wind as part of renewable energy systems, integration of renewable energy in the grid, stand-alone systems.
4. *Faculty of Mechanical, Maritime and Materials Engineering*: Fault-tolerant control. Nonlinear analysis, control and identification. System identification, design and testing of turbine control systems, analysis of turbine dynamics, reliability based design methods.
5. *Faculty of Technology, Policy and Management:* Introduction of new infrastructures in society, scenario for large-scale Dutch offshore wind power development.

Facilities and research tools available from DUWIND include:

- Low speed, low turbulence tunnel
- Open Jet Facility
- Several small wind tunnels
- Structures and Material Laboratory
- Wave basin, towing tank

When possible knowledge gained via the work undertaken by DUWIND's PhD researchers is transferred to the market either by direct contact and training of industry, or by design projects together with ECN. Duwind offers a MSc curriculum in wind energy, and provides courses for professionals in the wind energy industry. It is founding member of the European Academy for Wind Energy.

8.4 Other knowledge institutes

8.4.1 Knowledge Centre WMC (*www.wmc.eu*)

Knowledge Centre WMC is an independent research institute for materials, components and structures. Once the WMC Group of the Delft University of Technology, it was set up by the university and ECN to focus specifically on wind turbine materials and constructions. Its major activities are fundamental and applied research on Fibre Reinforced Plastics (FRP) and wind turbine structures.

Located along the border of the IJsselmeer, WMC is ideally located for the transport of large structures to its facilities. Its research work therefore covers testing of large components (including rotor blades, large subcomponents, hub/bearing assemblies, yawing mechanism, nacelles and other structural components), material and component research (including fundamental long term research and test programmes for industry), and software and electronics development (including the modular integrated design tool FOCUS6, used by many of the largest wind turbine manufacturers worldwide, which was developed in close cooperation with ECN). WMC is also actively involved in international standardisation committees and renders services for setting up testing facilities around the world.

Specifically, its facilities and research tools include:

- *Large test facility*, with a dedicated strong floor enabling testing of structures and components for large wind turbines.
- *Material and component test laboratory*, featuring 16 testing machines from 1 kN up to 30MN for both static and fatigue testing and climate chambers for temperatures from –180°C to +600°C.

8.4.2 Netherlands Institute for Sea Research (NIOZ - *www.nioz.nl*)

NIOZ, the Royal Netherlands Institute for Sea Research (NIOZ), is the second largest institute of the Netherlands Organisation for Scientific Research (NWO). Founded in 1876, NIOZ is also one of the oldest major oceanographic institutions in Europe and is the national hub for excellent fundamental and frontier-applied marine sciences in The Netherlands. Close co-operation is maintained with the principal Dutch universities with marine programmes, notably (but not exclusively) with the universities of Groningen (RUG), Nijmegen (Radboud), Utrecht (UU), Amsterdam (UvA and VU), Delft (TUDelft) and Twente (TUT). It also works in close cooperation with international universities and marine institutes.

Its primary source of basic funding is the NWO, although another long-term financial partner is Utrecht University. NIOZ's fundamental research contributes to solutions for today's and tomorrow's challenges posed by climate change, overexploitation and pollution of seas and oceans. Its frontier-applied science contributes to a sustainable use of our seas and oceans for economic purposes, known as 'Blue Growth', and to responsible policy decisions in the Netherlands and internationally. Hence, NIOZ science is a key factor in several of the economic Dutch top sectors, including TKI Wind op Zee.

Facilities and research tools available include:

- *National Marine Facilities*, including research vessels and equipment.
- *Location-based research facilities*, including climate laboratories and a molecular biology laboratory, on Texel and in Yerseke.

NOIZ is also a partner in the Dutch Marine Energy Centre, along with Deltares, ECN, and others. Launch in mid 2016 and formally established in April 2017, the DMEC project aims to facilitate collaborations between organisations and provide a single point of access to the Dutch marine energy sector. DMEC will also facilitate access to the expertise and the research facilities of the Maritime Consortium of Environmental Sceince and Technology, MUST (a research consortium formed in 2014 by NIOZ, Deltares, Wageningen Marine Research and TNO). MUST research focuses on the integral modelling and design of offshore structures (including for wind power) under various loads such as wind, waves, currents and ice.

Further information can be found at ***www.dutchmarineenergy.com*** and ***www.mustmarine.com***

8.4.3 IMARES (*www.imares.nl*)

IMARES is an international scientific institute for strategic and applied marine ecology and acts an independent specialised contract research organisation within Wageningen University and Research Centre. It also has structural links the Van Hall-Larenstein Applied University. Its core competencies are (marine) ecological research in support of maritime policies and innovation, conservation, water quality, contaminant risks, biological production and marine governance. For offshore wind, work takes place on contract research projects across several departments within IMARES. These projects focus on the socio-economic and ecological effects of construction, operation and decommissioning of offshore turbines.

The institute develops and executes assessments of ecological impacts of offshore wind farms on marine life, like fish, seabirds, marine mammals and invertebrates. It does this by using a wide variety of observational monitoring techniques in the field and experimental studies in the lab focused on determining dose-response relationships. The main departments performing research related to the development of offshore wind energy are the Department of Fish and the Department of Ecosystems. The focus at the Department of Fish is on research related to fish, fishlarvae, underwater noise and fisheries. Within the Department of Ecosystems, the focus is on research related to seabirds, marine mammals and zoobenthos.

Facilities and research tools available include:

- Acoustic field measurements of underwater sound, marine mammal detection, fish survey and behaviour.
- Monitoring of fish, benthos, birds, marin mamals, dynamic mooring system loads and tanker motions.
- Micro- and mesocosm facilities (marine fish & invertebrates).
- Tools for marine spatial planning and stakeholder participation.

8.4.4 Netherlands Organisation for Applied Scientific Research (TNO - *www.tno.nl*)

Netherlands Organisation for Applied Scientific Research, TNO, is a fully independent research organisation, established in 1932, with a staff of about 4400. It works for a variety of customers including governments, the small and medium enterprises sector, large companies, service providers and non-governmental organisations.

TNO Offshore Wind started in 2003 with the Dutch We@Sea research programme and the development of the 'ROBIN' bird radar for the Egmond aan Zee (OWEZ) wind farm. Other offshore wind projects include Corrosion and bio-fouling risk assessment for the Princes Amalia wind farm; Assessment of the impact and on-site measuring of produced subsea noise during installation of wind turbine foundations; and Optimisation of offshore wind farm monitoring, operation and maintenance. Since 2009 TNO has been participating in international offshore wind research programmes under the European ÆRTO's programme (Associated European Research and Technology Organisations). TNO Offshore Wind also cooperates with European Research and Technology Organisations such as Fraunhofer IWES (D), SINTEF (N) and VTT (Fin).

TNO research groups involved with offshore wind are:

- *Maritime Materials Performance Centre, MMPC, Den Helder*: Focusing on prevention of material degradation and life time prediction of offshore wind foundations and wind turbine components. Including remote monitoring.
- *Materials Performance, Eindhoven:* Focusing on specific material, wear and erosion aspects for offshore wind constructions.
- *Center for Mechanical and Maritime Constructions, CMC, Delft:* Focusing on offshore constructions, mechanical load modeling, fatigue, shock and wave impact loading.
- *Radar and Sonar, The Hague*: Focusing on radar and subsea noise effects of offshore wind farms.
- *Sensors and Monitoring, Delft*: Focusing on developing specific sensors for remote condition monitoring of offshore wind turbines and constructions. The number of full time-equivalent persons working on wind energy is 10.

Facilities and research tools available include:

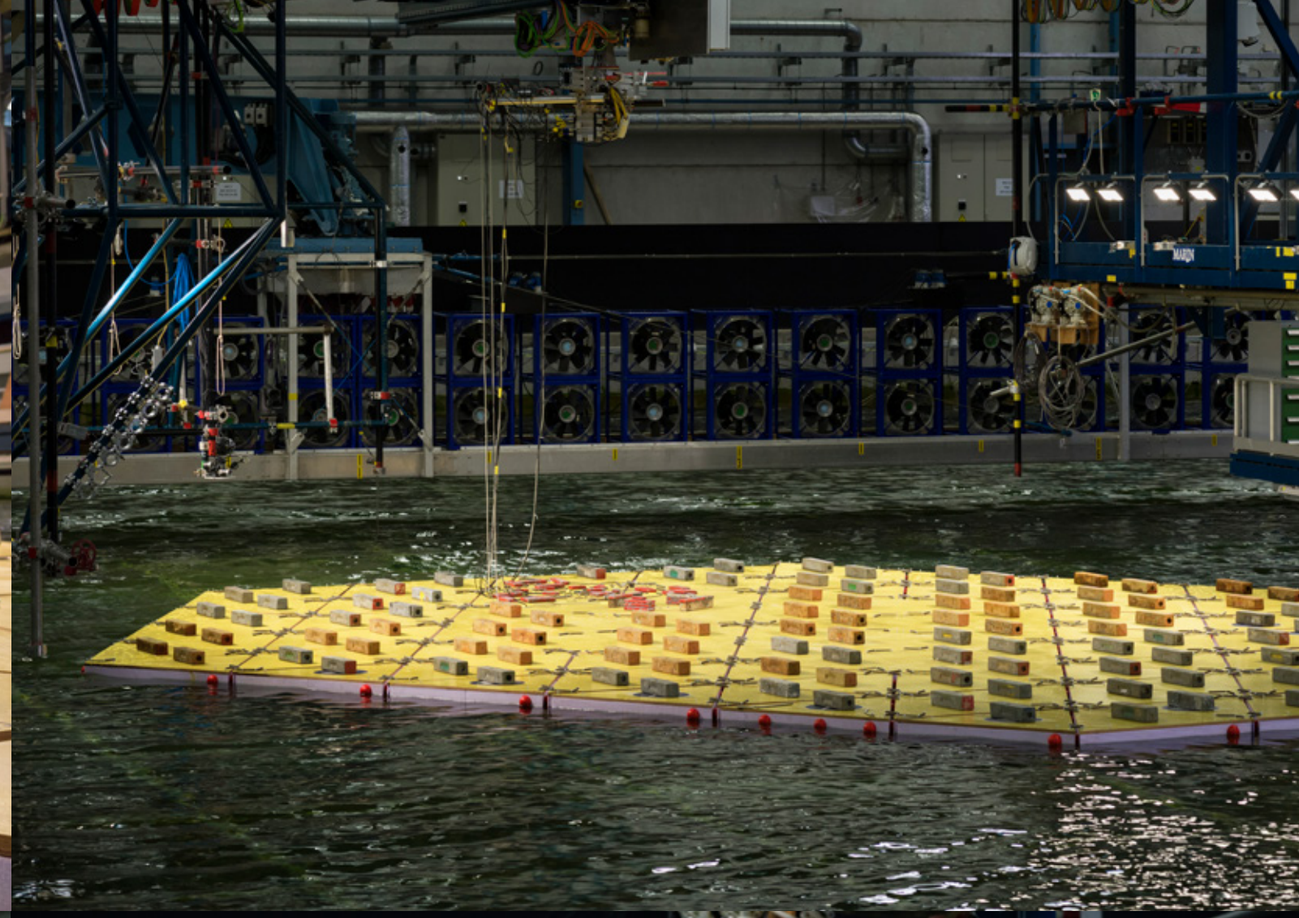
- *Maritime Materials Performance Centre, MMPC*, a natural seawater laboratory, maritime exposure site and test raft.
- *Center for Mechanical and Maritime Constructions, CMC*, which offers testing facilities for shock and vibration loading on offshore and shipment constructions and components.
- *Radar test facilities* covering radar visibility and protection of offshore structures.
- *Monitoring and sensoring*, including on site subsea noise measurement, ultrasonic testing, fiber bragg sensor technology, and a facility for the development and manufacturing of sensors.
- *Materials performance tribology and wear laboratory* for smart coatings and material development.
- *Bio-corrosion (MIC) management and monitoring* using a combination of electrochemistry, corrosion and bacterial laboratory facilities and in situ bio-corrosion monitoring.
- *Combination of microscopic techniques* for characterisation of bio-corrosion and degradation of materials and coatings on nano scale by Atomic Force Microscope (AFM).
- *Shock and vibration testing and modeling equipment* for large scale components in combination with wireless sensor systems.
- *Subsea noise measurement and modeling* capability on site.

As of 2018, TNO will be integrated into ECN.

8.4.5 DOB-Academy (*www.dob-academy.nl*)

DOB-Academy offers offshore energy education for professionals. Its mission is to provide industry capability building from introductory to expert level through lectures, classroom workshops, online modules and seminars. With this, DOB-Academy aims to bridge the knowledge gap between offshore professionals. Lectures are supplemented with practical laboratory work. Subjects covered range from offshore wind basics to offshore wind farm design, support structure design, O&M, transport and logistics, finance, health and safety, power networks, and tender procedures. Alongside its curriculum courses, DOB also provides tailor-made courses and hosts seminars.


MARIN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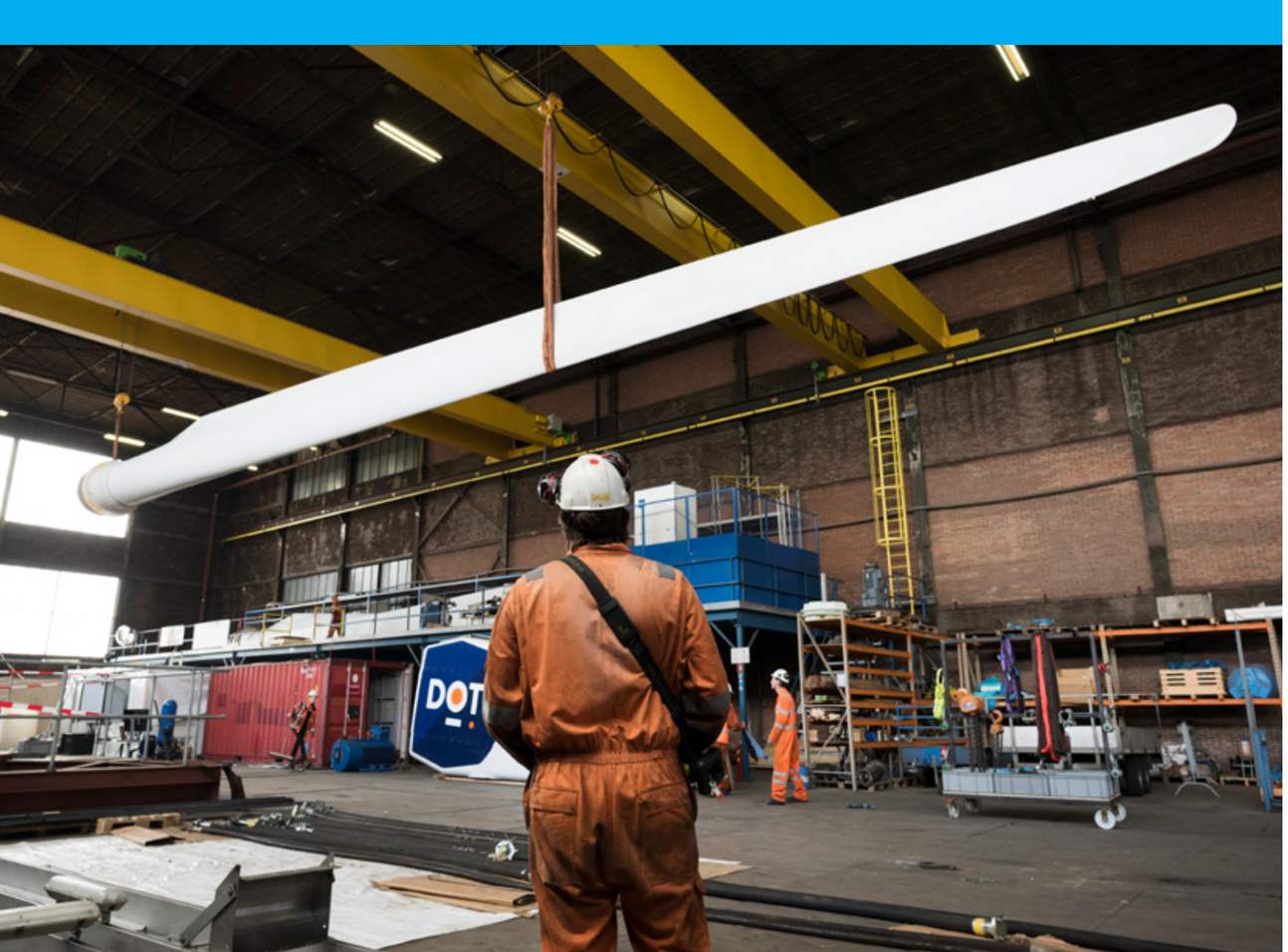
9. Applicable documents



A list of the relevant site studies and other documents which were used for this PSD.

Appendix A: Draft Ministerial Order for Innovatie Offshore Wind Energy 2017, General Implementing Regulations for Stimulating Sustainable Energy Production, Part I and III of the Wind Farm Site Decision Borssele V, Development Framework Offshore Wind Energy, Offshore Wind Energy Act, Offshore Grid Compensation Decision, Regulation Compensation Scheme for offshore grid, Policy rule concerning a change power generation facilities for offshore, Definitions and paragraph 6a of Water Decree, Section 41 of the General Commission Regulation of the European Union

Appendix B: Environmental Impact Assessments BWFZ III, IV and V

Appendix C: Boundaries and Coordinates Borssele Wind Farm Zone I - V and the coordinates of the Belgian Wind Farms.

Studies and suppliers (all reports can be found at www.offshorewindrvo.nl):
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

Energy Agreement for Sustainable Growth,
September 6 2013

Letter to Parliament rollout of offshore wind,
September 26 2014

Nationaal Water Plan 2016-2021,
December 14 2015

Act of 23 March 2016 for the amendment of the Electricity Act 1998

Appendices

Appendix A: **Applicable Law**
Appendix B: **Summary Environmental Impact Assessment**
Appendix C: **Boundaries and Coordinates BWFZ**

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Netherlands Enterprise Agency (RVO.nl) is an agency of the Dutch Ministry of Economic Affairs. Netherlands Enterprise Agency implements policy for various ministries in the areas of sustainability, agricultural, innovation and international business and cooperation. Netherlands Enterprise Agency is the contact point for businesses, knowledge institutions and government bodies for information and advice, funding, networks and legislation and regulations.