



**Annual work report 2017**

**Offshore wind energy power plant**

# **Nobelwind**



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# 1. Introduction

The Nobelwind offshore wind farm is located on the Bligh Bank, part of the Belgian Continental Shelf within the Belgian Exclusive Economic zone (Figure 1). The distance from the wind farm to the nearest point at shore (Zeebrugge) is approximately 47 km. Other wind farm data can be found in Table 1.

Table 1: Wind Farm data

Quantity	50	#
Power wind turbine	3.3	MW
Wind farm power	165	MW
Offshore HV stations	1	#
Wind farm area	20	Km <sup>2</sup>
Minimum seabed level depth, approx.	26	m LAT
Maximum seabed level depth, approx.	38	m LAT
Distance to the coast, approx.	47	km

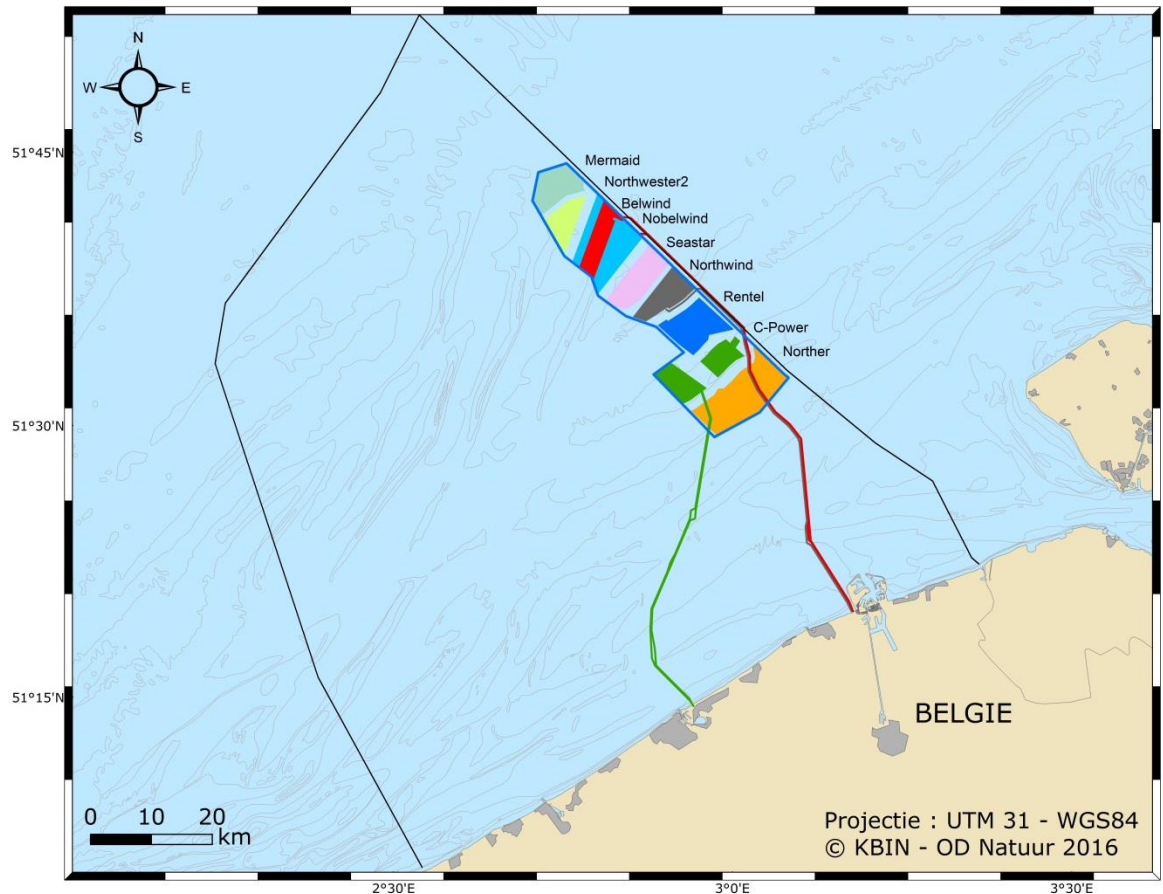


Figure 1: Location offshore wind farm Nobelwind

## 2. Project overview

The Bligh Bank offshore wind park zone is the initially Belwind concession zone, which has been split up into two separate concessions namely the Belwind and Nobelwind concession (Figure 2). In line with the Royal Decrees of 20 December 2000 (Domain concession), 12 March 2002 (Sea-cable permit) and 07 September 2003 (Marine environmental permit), the partial split of these initial permits has been applied for by Belwind and Nobelwind. Nobelwind obtained in 2015 the necessary authorization for its realization.

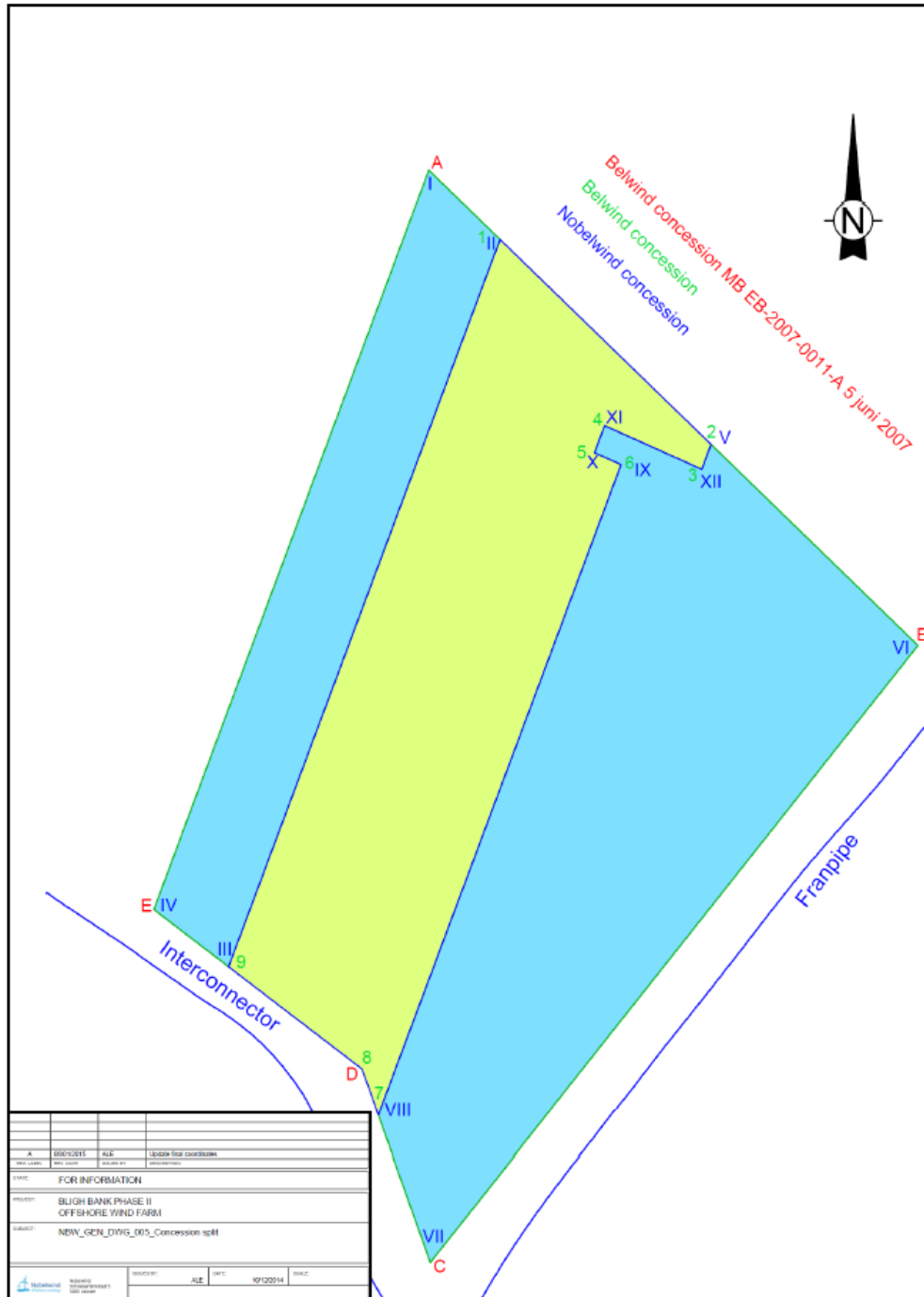


Figure 2: Domain concessions Belwind and Nobelwind

Nobelwind consists of 50 WTG's, type Vestas V112 3.3 MW, total of 165 MW and one Offshore High Voltage Station (OHVS) (Figure 3). Via a local grid (33kV) the wind turbines are connected to this OHVS. Further, a 220kV interconnector cable connects this OHVS with the Northwind OHVS. Energy is transported to land via the existing 220kV export cable, installed during the construction of the Northwind project, but the cable owner is now Cableco CVBA. Construction started in 2016. The first energy has been produced since January 2017 and Nobelwind in full production as of May 2017.

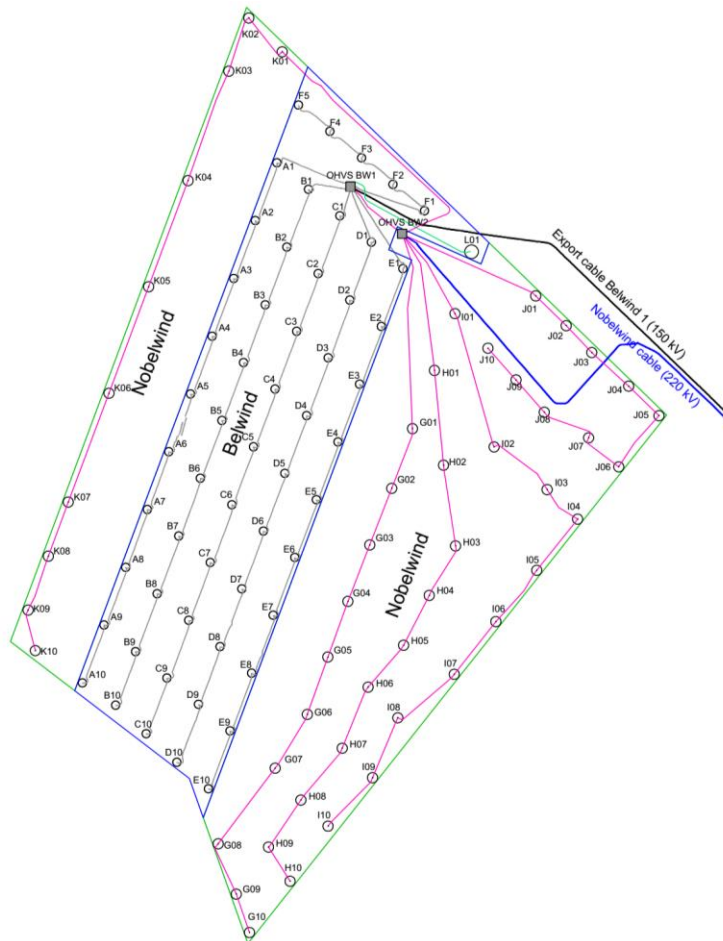


Figure 3: Locations of the Nobelwind and Belwind wind turbines and the grid connection

### 3. Construction Finalization

#### 3.1. Overview of the timing of the Project activities

Table 2: Activity overview

DATE	ACTION
29/10/2016-03/04/2017	Installation of the 50 turbines
06/01/2017-02/05/2017	33kV infield cable's energized
14/04/2017	OHVS takeover by Parkwind O&M Team
17/05/2017	WTG take-over over by Parkwind O&M team
17/05/2017	OHVS and windfarm fully operational

All foundations were installed end of 2016. The turbines were installed with the jack-up vessel Vole-au-Vent by Jan De Nul (Figure 4). All turbines were energized on 16 May 2017.



Figure 4: Installation of WTG

#### 3.2. Detailed overview of the Project activities during 2017

The following Punch-list items have been listed at Project Completion for the **Civil** package and will be managed by Nobelwind O&M Civil:

- OHVS coating repair: Jan De Nul officially stated that Parkwind could perform the repairs;
- On K01 and G08 an ICCP-anode was lost during the installation phase;
- A spare I/A cable needs to be ordered following the K01 repair.

Punch-list items have been identified at Project Completion for the **WTG** MVOW contract. Nobelwind MVOW O&M has inherited this punch list from MVOW Project team. The WTG MVOW Punch-List Items consisted of a wide range of topics such as:

- Paint damages;
- Davit crane cable routing;
- Punch-List Items from inspections;
- ...

Contractually MVOW has the first 4 months after time of completion (TOC) to rectify these punch list items and in that way, deliver a windfarm in "perfect" condition. Parkwind has been willing to make an agreement with MVOW O&M, to maintain a higher availability and allow efficient works. This agreement states that Nobelwind gives MVOW an exception to perform punch list works outside of the 4-month contractual period for those punch

list items that don't influence Production of the WTG, Lifetime of the WTG and cause any negative HSE issues. For example, Parkwind has allowed MVOW to repair minor paint scratches on the inside of the WTG during maintenance year 2018. 37% of the Punch List Works topics is cleared at the end of 2017.

The following punch-list items have been identified for the **electrical installation and will be managed by Nobelwind O&M ELEC**:

- DGA communication issue: DGA is a transformer monitoring system and its values were not correctly presented in SCADA due to communication issues between SCADA and DGA system. Semco was in contact with GE and they have been able to recreate the issue at their own test equipment. After receiving new version of the firmware, this has been uploaded to the reactors and main transformer in week 51. Data is now correctly presented in SCADA, but there still is a minor communication problem between SCADA and switch 2. Semco is informed about this new issue;
- Significant alarms present in SCADA screen: Still significant number of alarms present in SCADA. Open alarms to be resolved, unintended alarms to be agreed on possible removal between NBW and Semco. As a lot of the alarms are coming from the DGA communication issue and will so be closed as soon as DGA communication is solved;
- Fixation of 220kV export cable: The 3 phases are not correctly fixed as there is a 3m gap between the GIS room and the first fixation (see Figure 5). NBW has agreed with Semco that NBW will install the additional/missing supports as soon as the platform is deenergized. Semco will, if necessary, send extra materials.



*Figure 5: Fixation 220 kV export cable*

- UPS failure after K-string trip: After the cable fault on K-string the 400V breaker tripped also due to under voltage. The UPS BMA11 took over for and voltage was being restored by the Tie breaker. For an unknown reason the UPS stayed online with its batteries. UPS went completely offline when batteries were depleted. On the next intervention, we had to switch the UPS on By-pass mode to get power back. First analyses showed that L2 was missing on one of the Agil modules 20KW. NBW contacted CET and is waiting for detailed investigation report of the cause of this. At this moment, we have disconnected all consumers from UPS BMA111 but batteries still don't/want to charge. All 400V consumers are connected on BMA21. Both UPS modules are sent to CET for further investigation and repair;
- Certified metering at the OHVS: The power measurement installed on each string does not correspond to reality. Ex J-string produced so far 35GWh. On the OHVS the meter indicates 0.2GWh. Additionally,

the unit used is MWh instead of GWh. ABB DK has been asked to investigate this and has confirmed that values in RTU and SCADA are corresponding. NBW did some investigation and found out that the voltage order of the bays on busbar A (J-Array, K-Array and Coupling Cable) are reversed. By checking for voltage differences in the metering circuits, it is clear two phases are swapped. ABB DK has send a procedure to swap the wires, which will be done in 2018.



## 4. Wind farm annual operations information

### 4.1. Production

#### 4.1.1. Performance of the wind farm

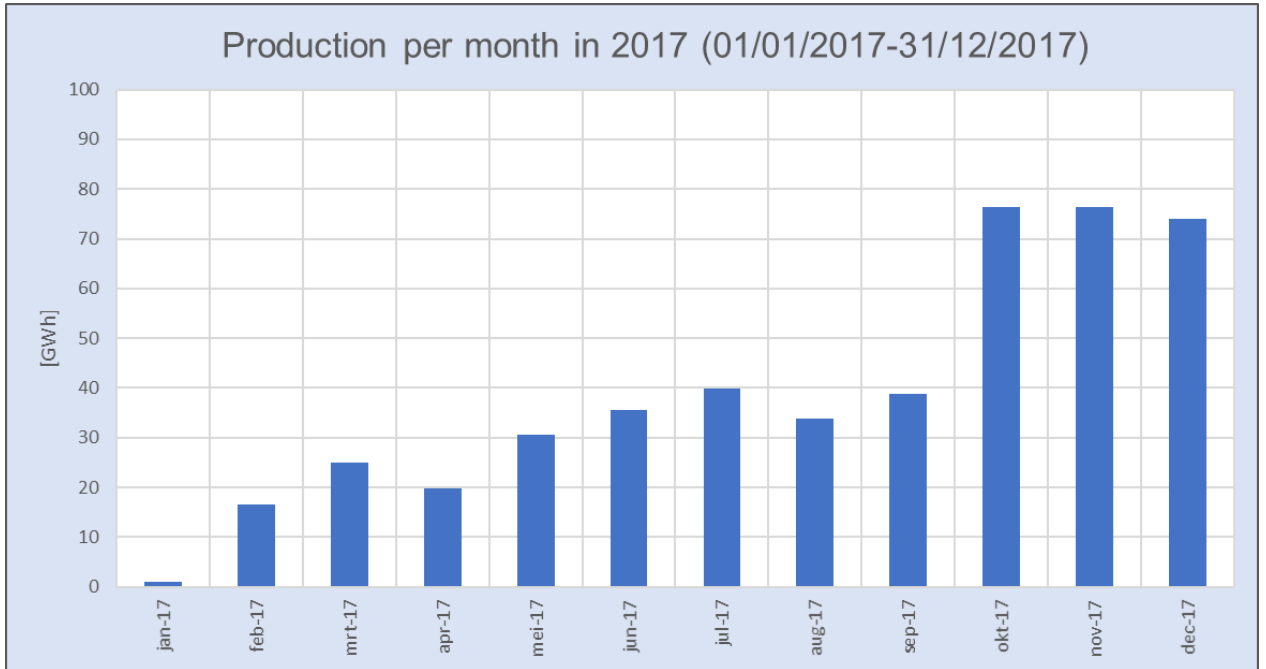
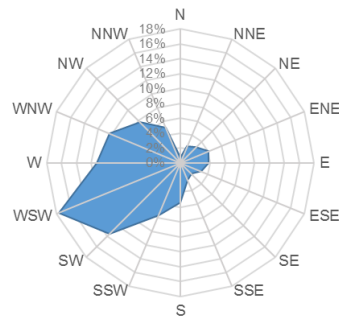


Figure 6: Monthly production V112 2017

#### 4.1.2. Wind rose & energetic wind rose



The displayed wind rose is a graphical representation of the wind speed and direction measured all over the wind park. The wind speed is calculated as an average from all turbines. For all wind speed categories, the wind direction WSW prevails.

## 4.2. Maintenance

### 4.2.1. Planned Maintenance

MVOW, the service contractor for the Nobelwind **WTG's**, performed the following planned maintenance and inspections in 2017:

- Yearly Service: 7/50 WTG's completed;
- Yearly Statutory inspections: 44/50 WTG's completed;
- HV inspections: all WTGs were inspected for takeover.

On the **electrical installation**, there was one planned shutdown on 26 September 2017. On request of Elia, a complete shutdown has been performed as they wanted to take a thermal image of transformer T6 220/150 kV at Blondeellaan post. The estimated time for this switch off was maximum 4 hours, real time was approximately 2 hours. Besides the shutdown, the following tasks have been performed for 2017 as part of the routine maintenance:

- Yearly mandatory statutory inspections of high voltage installation: this inspection was carried out by supplier according to legal criteria and no major observations were made;
- Yearly mandatory statutory inspections of all lifting equipment by supplier: all secondary equipment, cables, chains, slings, hooks and the cranes mechanisms are inspected to see if any aging or damage has occurred to the equipment. An exception has been obtained from Vinçotte to go from a 3-monthly inspection to a yearly inspection as all lifting equipment is rarely used;
- Yearly maintenance of all lifting equipment by Parkwind: the maintenance focuses on visual inspection, cleaning and functional testing of low voltage systems and components;
- Yearly inspection and maintenance of the fire detection system by supplier: this maintenance campaign focuses on testing of the fire detection equipment and fire control cabinet functions;
- Yearly inspection and maintenance of the firefighting by supplier: this maintenance campaign focuses on the firefighting equipment, e.g. pressure on the firefighting gas and portable fire bottles and test of the release valves and activation push buttons;
- Yearly inspection of First Aid kits;
- 3-monthly maintenances to all SCADA systems and IT infrastructure by Parkwind and supplier: during the SCADA and IT maintenance all equipment is tested and some performance and connectivity tests are performed;
- Yearly maintenance of HVAC installation by supplier: check of filters, functional tests of all valves & sensors, inspection of coolers and cleaning of the heat exchange condensers is performed;
- Yearly inspection of diesel fuel system by Parkwind: general inspection of the diesel generator, pumps and valves are focused during this yearly maintenance. Also the diesel tank and its leak detection is checked;
- Generator maintenance and load test have been done on a 6-monthly basis to ensure the correct working;
- Yearly inspection of life saving equipment (life jackets and immersion suits) by supplier;
- Yearly inspection life raft by supplier;
- Regularly high and medium voltage equipment checks have been performed by CG as they are NW main HV/MV contractor;
- Small preventive maintenance has been done (e.g.: changing defect light bulbs, ...);
- Preventive paint repairs have been performed to avoid excessive corrosion;

- Onshore: Generator load test has been done on a 3-monthly basis to ensure the correct working + 6 monthly maintenance;
- Onshore: Fire extinguishers have been replaced;
- Onshore: Yearly HVAC maintenance has been performed by supplier.

On the **foundations**, the following tasks have been performed in 2017 as part of the routine maintenance:

- Latchway performance: the O&M team has been assisting both onshore and offshore in problem solving with several Latchway issues during the construction phase;
- Coating repair: During installation, many coating damages were caused which needed repair prior to handover to O&M. The O&M team assisted the project team if necessary and will finalize outstanding coating repairs in 2018.

## 5. Environmental Research

### 5.1. Fish track sampling

The fish track sampling campaign, as executed with the research vessel Belgica in Autumn 2017, included one fish track in the Nobelwind domain concession (see Figure 7). The established mitigation measures of the HAZOP in 2016 (see Annual Work Report 2016 for Belwind) were once more applicable to assure the highest levels of safety during such high-risk activities in the windfarm for both the research vessel and its personnel as the windfarm assets.

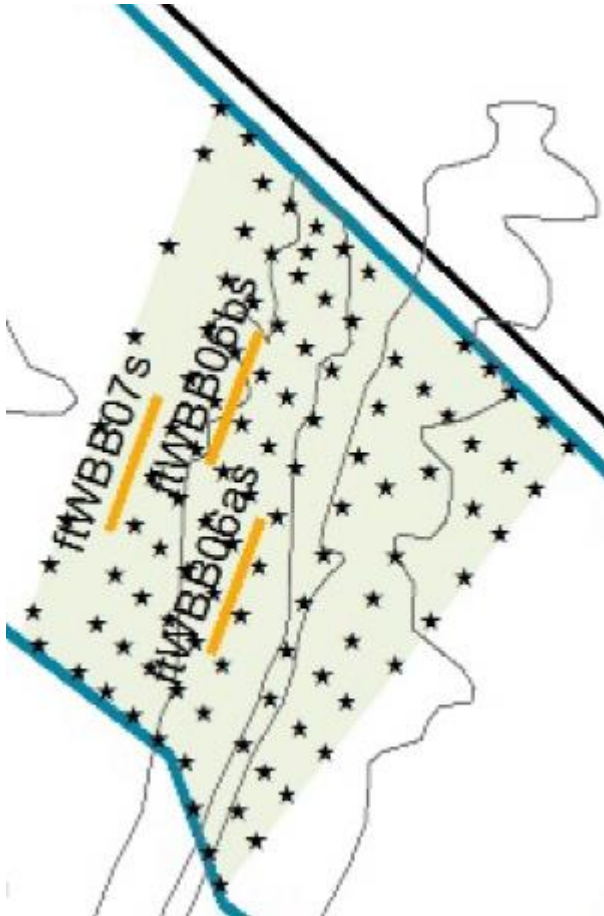


Figure 7: Fish track on the Bligh Bank

## 6. Permit conditions

In compliance with the authorization for the construction and a license for the operation of a wind farm on the Blich Bank in the Belgian sea areas article, we give an overview of the environmental permit conditions as mentioned in Schedule 1 of the authorization for the construction and a license for the operation of a wind farm (see Table 3).

Table 3: Permit conditions overview

Condition Number	Condition Summary	Current Status
2	Each planned modification must be reported to the Board and will be included in the annual work report.	No modifications to be reported in 2017.
4	The holder undertakes to find and recover all floating or sunken objects used for its activities which, for any reason, have ended up in the sea during the construction, operation or dismantling stages.	All dropped objects related to Nobelwind offshore activities (#4) are recorded in the online reporting tool, the SOS system, and notified to the Board. In March 2017, marker buoy BB02 got drifted thus leaving the anchor stone and chain on the seabed. Several actions were undertaken to recover the material, however without success. On 29 June 2017, Nobelwind requested a deviation from this permit condition for this specific case. The Supervisory Committee of 12 October 2017 discussed and agreed with the latter, thereby closing this case.
14	During construction, all foundations and structures already finished must have a temporary warning light (at the highest point) for shipping and aviation traffic.	No new foundations installed in 2017.
15	The holder must set up the necessary safety systems to assure the signalling of the wind farm and structures at all times.	Since 14 July 2017 all navigation and aviation signalisation are fully operational and monitored. In February 2017, during construction phase, the navigational light on marker buoy BB03 had a malfunction but was repaired and functional in one day. In December 2017, the feedback signal of the navigational aids of G10 was inactive. After a very extensive fault finding, the feedback has been identified as functional again. All events were reported to the relevant authorities (i.e. MRCC and MUMM).
16	All WTG's must be numbered individually at the base of the mast and at the top of the nacelle.	The foundation and the WTGs have been numbered in accordance with the requirements of this condition.
17	All WTGs and transformers must be provided with collection receptacles to prevent liquids from being released in the environment.	The design of the WTG is such that in case of leakage in the nacelle, all fluids are collected in the central part of the nacelle. From here, collection receptacles are installed under the oil pumps and hydraulic systems as standard. In 2017, 4 events with an environmental leakage occurred and were reported to the relevant authorities (i.e. MUMM and DG Environment).
20	During the operation stage, the availability must be facilitated of a specially equipped intervention vessel (or combination of vessels) for assignments concerning the prevention of shipping traffic accidents and cleaning up sea pollution around and in the wind farm	An agreement was signed with Federal authority responsible for the marine environment.

Condition Number	Condition Summary	Current Status
21	Once or twice a year, the holder must take part in simulated nautical accidents, emergency towing exercises and pollution combating exercises.	On a regular base Nobelwind MVOW execute internal emergency exercises (see 8.2.3 of this report).
24	Before laying protective mattresses or other artificial erosion protection on the seabed, the holder must verify and certify that all components chosen can be used without any danger of leaching into the marine environment. The composition of the erosion protection must be presented to the Board for approval. The use of monoliths and slag is hereby prohibited.	For the support of the IA (Inter Array) cable K03-K01, the approval from the MUMM has been obtained in March 2017 regarding the components of the bags. The composition of the sand bags as cable support during the repair works in July 2017 of the IA cable OHVS-K01 has been approved by the MUMM. Once the repair works were finished, the bags were recovered as requested.
29.1	The construction materials and rip-rap must be made of natural materials and must not contain any waste materials or a secondary raw material... the use of slag is prohibited.	No new construction material to be approved in 2017.
31.2	Pile driving activity between 1 January and 30 April will be subject to additional, special monitoring in the amount of EUR 50,000 at most, which is not included in the estimated budget and is completely at the expense of the holder	No piling activities have been performed in 2017.
33.1	The lighting of the turbines for the benefit of shipping and aviation traffic must comply with the conditions set by the competent authorities.	Lights are installed according to the Navigational Aids Plan and have been fully operational in the O&M reporting period. In December 2017, the feedback signal of the navigational aids of G10 was inactive. After a very extensive fault finding, the feedback has been identified as functional again. Since Nobelwind is built around Belwind, the Navigational Aids Plan of Belwind has been changed into a Navigational Aids Plan of the Bligh Bank, considering the whole zone of Belwind and Nobelwind as one zone.
33.2	Foghorns, which come into operation automatically in the event of a meteorological visibility of less than 2 sea miles, must be placed on the corner turbines.	Fog horns are installed according to the Navigational Aids plan and have been fully operational in the O&M reporting period. See also 33.1.
34	The holder must maintain the farm on a regular basis.	All installations are maintained on a regular basis.
48	A logbook must be kept in which the following is specified for each turbine: <ul style="list-style-type: none"> <li>➤ Date, time and all relevant data of incidents that occur which have an impact of the environment, stating the measures taken; and</li> <li>➤ The recording of hazardous waste materials, the date of removal of the relevant batch of waste, the quantity and the name of the carrier and the recognised waste processor must also be recorded.</li> </ul>	We confirm that logbooks have been kept for all turbines since start-up of the first WTG and this has continued during operation.

## 7. Operations Management

### 7.1. Health Safety and environment

#### 7.1.1. Proactive safety initiatives

In 2017 some proactive safety initiatives, to avoid unwanted events from happening, were initiated:

Further development and improvement of the online full near miss and hazard observation reporting system. Personnel is encouraged to report all unwanted events using the online reporting tool, the 'SoS' [SafeOffshoreOperations] system. The system facilitates the notification, reporting and follow-up of events.

Existing work procedures were updated and new work procedures were implemented. Some examples are:

- *Visitor procedure*
- *Diving procedure*
- *Work Vessel Coordination Procedure*
- *LOTO procedure*
- *Inspection procedure*
- *Organization of exercises (ongoing)*

Steps were taken in the development of General HSSE Employer Requirements for Contractors during the Project and O&M phase. These HSSE Employer Requirements give a clear overview of what is expected of the Contractor during his work scope regarding training, induction, environmental protection measures, the work vessel coordination procedure, risk assessments and method statements, management of change procedure, etc.

Offshore workplace inspections, on the OHVS and the wind turbines, were executed by the external Service for Prevention and Protection at Work, Securex.

Several trainings were organized to improve safety, such as a VCA-VOL training, ISM / ISPS course, a training on how to use air monitoring equipment in confined spaces, etc.

The ERP BW/NBW was revised. The changes are related to the transition of Nobelwind from a project-phase to an O&M-phase.

#### 7.1.2. Emergency exercises

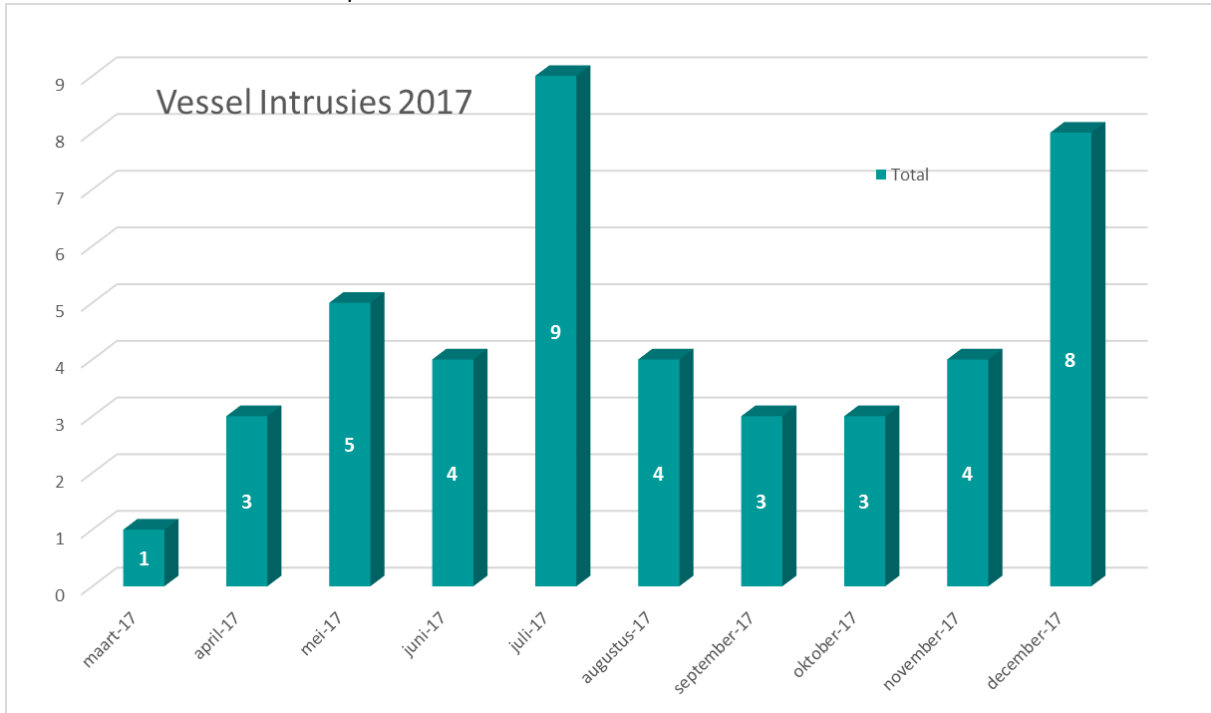
Overview emergency exercises 2017	
WTG	03/04/2017: Jan de Nul - Medivac external platform TP using the Milan
	18/12/ 2017: MHI Vestas - Abandon ship drill (Muster) Esvagt.
	18/12/2017: MHI Vestas - Fire drill (Muster) Esvagt.
	18/12/2017: MHI Vestas - MOB drill (Muster) Esvagt.

#### 7.1.3. Emergency actions (TIER2)

No TIER 2 situations, that need external assistance, were reported in 2017.

### 7.1.4. Intrusions

In 2017 we had 44 intrusions reported on the Nobelwind concession:



Vessel	Amount of intrusion
ARM 15	1
ARM20	1
ARM22	3
ARM 25	4
Chancard	1
Cindy VLI 25	1
Cornelis Jeannet	2
De Vrouw Jannetje	1
Donna Rosa	1
Ephyra	1
Firestorm	1
Fugro Pioneer	1
Fv Rony	1
Good Hope 1	1
Impetus	1
Ketchup	1
Lady Blue	1
Lady Genevieve	1
New Horizons	1
Op Hoop Van Zegen	1
Onderneming GO-09	1
RMS Blackout	1
Samara	1



SC Elite	1
Sea Hunter	1
SL42	1
s/v Kuipido	1
Tack Five	1
TH06 Johanna Cornelia	2
UK 48	1
Unknown	1
Vashti	1
Vedette	1
Walrus II	1
Waterman	2
YM8 Rony	1

## **7.2. O&M office Parkwind**

O&M team offices are located in the harbor of Ostend:

Esplanadestraat 10B

8400 Oostende

## 8. Conclusion and outlook

Nobelwind was fully commissioned since mid-May 2017. However, technical availability was lower than the commercial one given the cable failure on the K-string. This cable issue was resolved in mid-July and from then onwards, Nobelwind was fully operational again. The availability during the last semester of 2017 was quite high, but due to lower wind conditions than expected, production in 2017 wasn't in line with the theoretical expectations.

Punch-list items were identified at Project Completion for the WTG, civil and electrical packages. Some items were resolved in 2017, mostly WTG items. All other punch-list items shall be taken up for closure in 2018.

Given the O&M take-over in May, the planned maintenance and inspections for the WTG, civil and electrical installations was started and will continue in 2018 (i.e. first contractual year). Nobelwind and contractors were challenged a few times though with unexpected issues. However, due to correct preparation and execution the impact on availability and production was limited (with exception of the K-string issue). With the correct lessons learned implemented in both scheduled and unscheduled tasks, it is expected that in 2018 the maintenance routine can continue without any major surprised to overcome.

No big HSSE incidents were recorded and all tasks as mentioned under the operational permits are well managed.