



Annual work report 2021

Offshore wind energy power plant

Belwind



Subject	Author	Reviewer	Approver	Date
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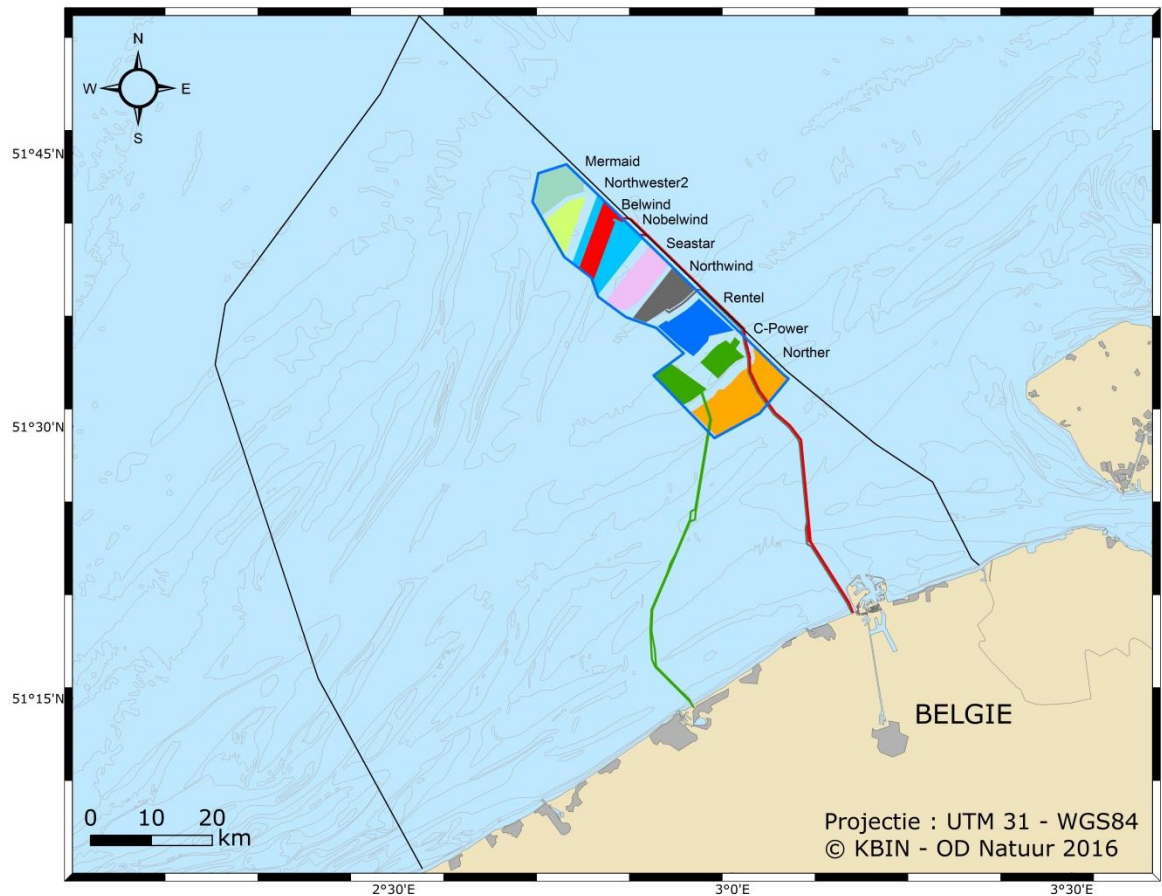
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1 Purpose of the document

The present report gives an overview of the main activities and relevant parameters of the Belwind offshore windfarm for the period as from 1 January 2021 up to 31 December 2021.

2 Introduction

The Belwind offshore wind farm is located on the Belgian Continental Shelf, within the Belgian Exclusive Economic zone. The distance from the wind farm to the nearest point at the shore (Zeebrugge) is approximately 49 km.

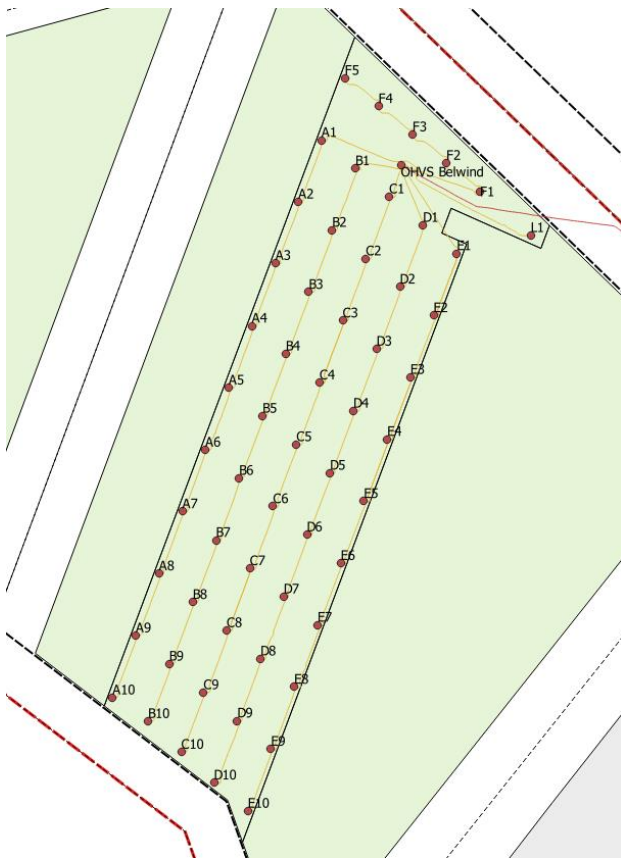


Location offshore wind farm Belwind

3 Project overview

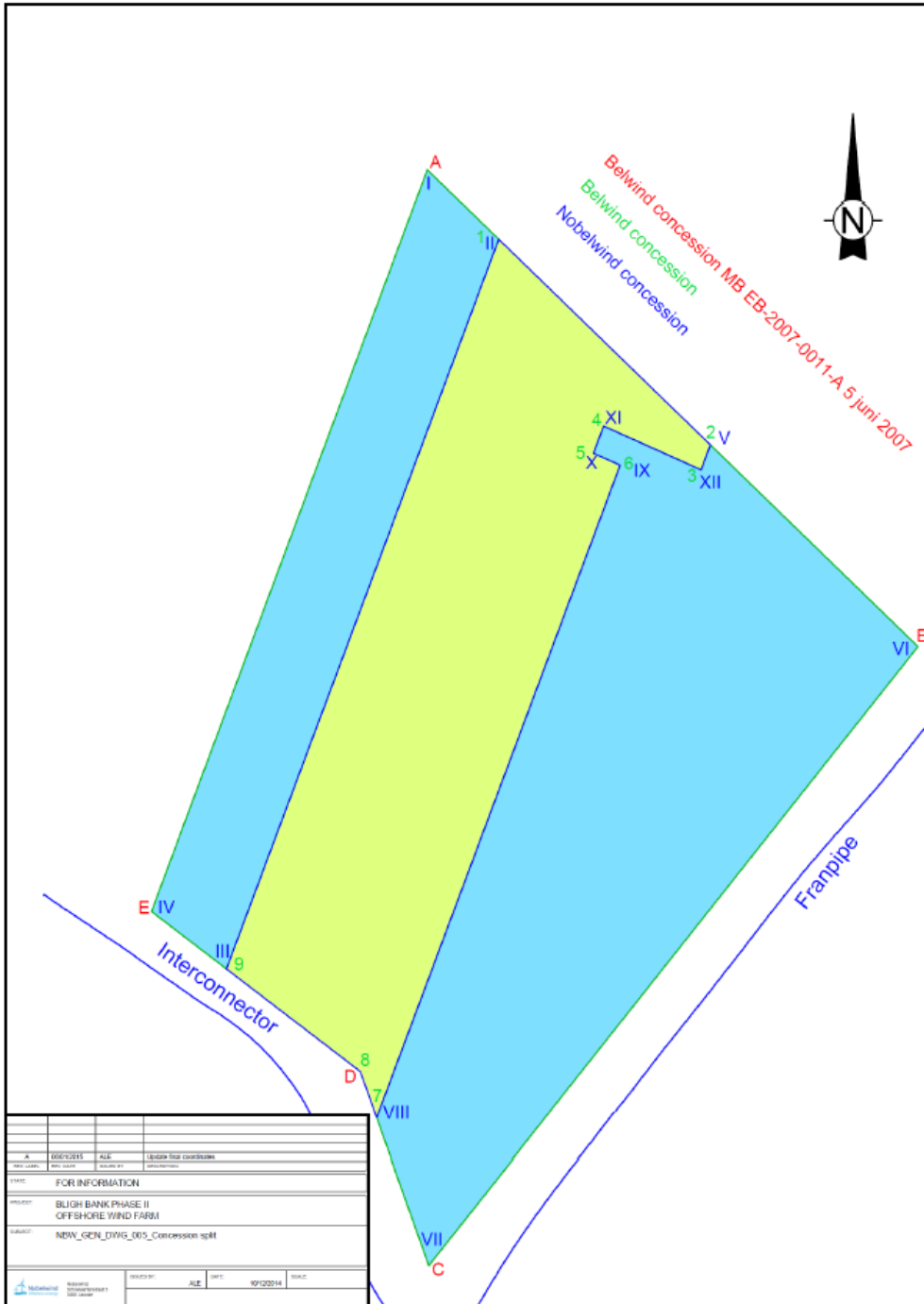
Belwind consists of 55 wind turbines of 3 MW each (Vestas V90) and an Offshore High Voltage Station (OHVS). Via a local grid (33 kV) the wind turbines are connected to the OHVS. The energy is transported to shore by a 150 kV submarine cable. Belwind has been erected in 2009 and 2010 and is fully operational since January 2011.

In 2013 and 2014, the realization of the Belwind Demo project was started. This project consists of the installation of a jacket foundation and a 6 MW windturbine (GE Haliade 6M – rotor diameter 150m) at location L01. The Belwind Demo project received its 33kV cable installation in 2014 during the summer. Once the cable was connected the commissioning of the Haliade 150 Turbine got on its way. The WTG produces since 2015 green energy via a direct drive concept and had at time of erection the biggest blade rotor size in operation. In November 2015 the division of Alstom Power has been taking over by GE Renewables. The fifty-six turbines are capable of generating 171 MW.



Locations of the wind turbines and the grid connection of Belwind

The development of Phase 2 of the initial Belwind concession, or Belwind phase 2, was started in 2014. For the development, a new company was created, named Nobelwind in which funds was found for the pre-development. In line with the Royal Decrees 20/12/2000 (Domain concession), 12/03/2002 (Sea-cable) and 07/09/2003 (Marine Environmental permit), the partial split of the initial domain concession, sea-cable permit and Marine Environmental permit, has been applied for by Belwind and Nobelwind. Nobelwind obtained in 2015 the necessary authorization for the construction and exploitation of the windfarm.



Domain concessions Belwind (yellow) and Nobelwind (bleu)

For information: Nobelwind consists of 50 WTG's, type Vestas V112 3,3 MW, total of 165 MW and one OHVS. A 220kV interconnector cable connects this OHVS with the Northwind OHVS. Energy is transported to land via the existing shared 220 kV export cable, named Cableco. Construction of Nobelwind started in 2016. The first energy has been produced since January 2017 and Nobelwind is fully operational as of May 2017.

4 Construction works in the Belwind concession

No construction works took place in the Belwind concession during this reporting period.

5 Wind farm annual operations information

Below figures cover the 55 MVOW V90 – 3 MW turbines. The GE Haliade demo project is covered in chapter 6.

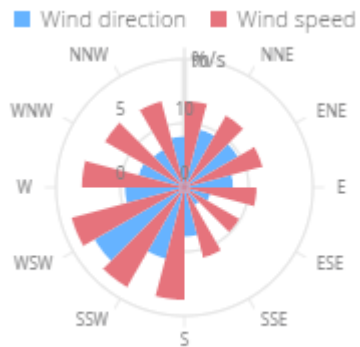
5.1 Performance of the wind farm



Monthly production V90 2021

5.2 Wind rose

The displayed wind rose is a graphical representation of the wind speed and direction measured all over the wind farm .



Wind-rose

5.3 Planned maintenance

MVOW, the service contractor for the Belwind **V90 WTG's**, performed the following planned maintenance and inspections in 2021:

- **11th-yearly service:** Yearly, an annual service is done on all the turbines. Every component is carefully inspected and made sure it will operate correctly for the next year. On 16th December MVOW should have finished the 11-yearly-maintenance on BW, which takes 5days/turbine. MVOW has a delay and is anticipated to end in Februari 2022.
- **Statutory inspections:** on regular intervals, the service elevator (3 months), the Acta crane on the transition piece (1year) and the hook-on points (1 year) are inspected and certified by a 3rd party. Since July 2020 legislation has been changed into yearly inspection for the service elevator (combined inspection).
- **HV inspections:** every year, MVOW skilled technicians and a third party inspect and certifies the HV installation. Both the switchgear and the transformer are inspected. The switchgear in the turbines is inspected with ultra-sonic equipment;
- **Blade inspections:** Drone inspections were performed in the summer of 2021.

Parkwind performed the following works of the electrical installation :

Booster station (onshore) :

- Yearly mandatory statutory inspections of high voltage installation;
- Yearly maintenance on all low voltage parts of the installation;
- 3 Monthly visual inspection of the high voltage parts of the installation;
- Annual maintenance of Fire detection & Fire Fighting;
- 3 Monthly maintenance on all SCADA systems and IT infrastructure.
- SCADA upgrade/ replacement

Offshore High Voltage Station:

- Yearly mandatory statutory inspections of high voltage installation carried out by supplier: this inspection was carried out according to legal criteria (AREI) and no major observations were made;
- Yearly maintenance of all equipment by Parkwind: the maintenance focuses on visual inspection, cleaning and functional testing of low voltage systems and components;
- 3-monthly 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;
- 3-monthly mandatory statutory inspections of all personal protective equipment by supplier: the inspection focuses on the state of all PPE's used and verifies if all PPE are maintained and used as intended by the manufacturer;
- Yearly inspection and maintenance of the fire detection system this maintenance campaign focuses on testing of the fire detection equipment and fire control cabinet functions;

- Yearly inspection and maintenance of the firefighting 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 maintenance of HVAC installation: annual replacement of filters, functional tests of all valves & sensors, inspection of the ice water machine and cleaning of the heat exchange condensers is performed;
- Yearly inspection of diesel fuel system: general inspection of the diesel generator, pumps and valves are focused during this yearly maintenance. The diesel tank and its leak detection is also checked;
- Yearly inspection of life saving equipment (life jackets, life raft, immersion suits and portable fire extinguisher) by supplier;
- Thermal Imaging LV, MV and HV equipment: Parkwind carried out regular inspection using thermal imaging camera;
- Ultrasonic inspection of MV and HV equipment: Parkwind carried out regular inspection using ultra sonic measuring equipment;

On the BOP (Balance Of Plant : foundations – cables), the following tasks have been performed in 2021 as part of the routine maintenance:

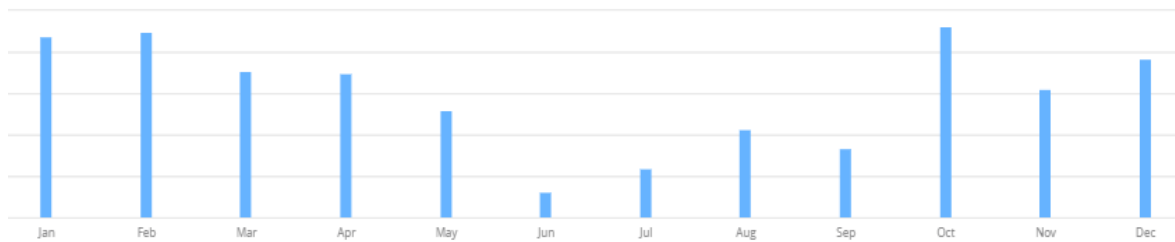
- Inspection, maintenance and recertification of the fall arrest systems: the complete fall arrest system is inspected and recertified by qualified technicians. If any system is non-compliant it gets replaced as soon as possible;
- Inspection of cathodic protection: the cathodic protection needs to prevent/limit the corrosion on the primary and secondary submerged steel. During this campaign the protection is measured and evaluated if the protection grade is still enough compared to design values. The measurement of the actual cathodic protection was done by handheld drop cell Ag/AgCl reference electrode and with an ROV mounted stab probe;
- Survey of inter-array cables: this multibeam survey takes a snapshot of the sea bottom condition and the results are used to determine the depth of burial of the cable assets;
- Survey scour protection: This multibeam survey measures the level of scour protection compared to the level during as-built, design and earlier years. The scour protection is surveyed during the survey of the inter-array cables;
- Internal and external NDT-inspections of welds, bearings and boat landing studs;
- ROV inspection of outer submerged foundation to evaluate the marine growth and presence of ropes, fishing nets, rocks or other debris;
- Inspection of paint by qualified paint inspector and subsequent touch-up, especially on the ladders and top platforms;
- Paint repairs: on selected foundations, repairs were done on some of the circumferential welds, external platform and railing on the topside scope. Additionally, repairs on the ladder rungs were also done in damaged locations.
- Smart foundation monitoring: the WTG C01 is equipped with several sensors in order to monitor the grout, loads, and vibrations.
- Frequency monitoring: this monitoring is performed on 20% of the foundations. During half an hour the natural frequencies are measured by accelerometers. These results are analyzed and compared against design frequencies and excitation frequencies caused by

blades. This to monitor those natural frequencies are in a safe zone where there is no chance of resonance.

- Belwind has stepped into a cable repair framework managed by Parkwind, called Safe Link project. The Safe Link project will ensure that in case of a cable failure, the repair works will be executed within reasonable time to minimize the loss of electricity production, reduce idle time of WTG's and reenergize the cable as soon as possible. To be able to cope with a quick repair, the Safe Link project has been signed with a cable expert contractor and is threefold:
 - Carry out preparedness services = be prepared to mobilize personnel and marine spread + equipment within agreed response time and prepared to carry out the repair works
 - Carry out repair works on the Belwind export cable and Inter Array Cables
 - Carry out the spare parts management

The Safe Link project has an agreement for five year. The preparedness documentation is subject to a yearly review round to implement new working methods and lessons learned.

6 The Belwind DEMO project 'Haliade' GE



Monthly production GE-Haliade 2021

7 Environmental Research

The MUMM coordinated all the foreseen standard environmental monitoring activities in the field. There was a continuation of the bird assessments, the fish assessments by line fishing and trawl net fishing as further research activities on the fouling organisms on the foundations and scour protection, the seabed and the fauna at the reef balls. In collaboration with scientific organizations, some dedicated programs were also started-up in 2017 and further executed by the MUMM whereby Belwind cooperates where relevant (Bat-monitoring, fish campaign, fish-tracks, diving operation, ...).

8 Permit conditions

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

Table 1: 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 in 2021.
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 Belwind offshore activities are recorded in the online reporting tool, the SOS system, and reported on a quarter basis. .
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 2021.
15	The holder must set up the necessary safety systems to assure the signalling of the wind farm and structures at all times.	Since 8 February 2011 all navigation and aviation signalisation are fully operational. All cases of defects or malfunctioning (only Tier 1 events) were reported to the relevant authorities and repaired as soon as possible.
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.
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	On 22 January 2011, an agreement was signed with Federal authority responsible for the marine environment. Further clarification regarding the practicalities of the agreement have been clarified in vision text signed by the Secretary of State, DG Environment, MUMM and wind farms C-power, Belwind and Northwind.
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 Belwind MVOW execute internal emergency exercises (see 10.1.3 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.	No new construction material to be approved in 2021.

Condition Number	Condition Summary	Current Status
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 2021.
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 2021.
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. 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.
35.4	The covering of the cables must be assured at all times. If the annual monitoring shows that the cable is exposed, the necessary work must be done in the shortest possible time, three months at most, so that the cable can be placed at its original depth.	Annual cable burial depth surveys are executed during the operational phase. Based on the result of the cable risk analysis (Cable Risk Management), a reburial campaign will be set up.
48	<p>A logbook must be kept in which the following is specified for each turbine:</p> <ul style="list-style-type: none"> ➤ Date, time and all relevant data of incidents that occur which have an impact of the environment, stating the measures taken; and ➤ 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. 	We confirm that logbooks have been kept for all turbines since start-up of the first WTG and this has continued during operation.

9 R&D project

9.1 Edulis project :

Offshore activities were dismantled in 2019 and final reports submitted in 2020. Project closed.

9.2 United project :

Horizon 2020 call : "Multiuse of oceans & coastal waters

Belgian partners :

- Ugent (coordinator)
- ODNature
- Jan de Nul
- Brevisco
- Colruyt Groep
- Parkwind

Project objectives:

- Restoration of flat oysters and the development of an aquaculture activity of the species :
 - New type of scour protection (matrasses)
 - Defining equipment for holding oysters for aquaculture (broodstock and spat)
- Comparing growth of seaweed offshore and nearshore

Duration : 01/01/2020 -> 31/12/2023

Activities by Belwind :

In 2021, restoration (oyster) tables were installed at scour protections of A04 (2 tables) and A07 (2 tables with adult oysters). Each table has 6 gabions (sampling). The sampling of one gabion from table at A04 was also done.

Pending offshore activities to be performed in 2022: screw anchors installations for longlines of oysters and seaweeds; longlines installations and sampling of restoration tables and longlines.

10 Operations Management

10.1 Health Safety and environment

10.1.1 Unwanted events over the reporting period

No unwanted events (LTI) happened during the reporting period.

10.1.2 Proactive safety initiatives

To ensure that our O&M employees continue their good progress of recent years, the company decided to establish a KPI for 2021 that combined the KPIs of previous years:

1. Identically to 2018, 2019 and 2020 we continued to encourage both our own employees and Contractor personnel to report all hazard observations, near misses, incidents, first aid cases and opportunities for improvement using the online "SoS" reporting system. For O&M personnel a KPI was set on the reporting of unwanted events in SoS for both on- and offshore locations.
2. A second KPI was set on the O&M Team's revision of existing risks assessments and the preparation of risk assessments of activities not yet appropriately risk assessed.
3. A third KPI was set on the execution of workplace inspections (WPI).

To provide our employees and Contractors with a better understanding of our HSSE procedures and requirements, additional online inductions were developed, and existing inductions were updated in our Online learning platform. The Online learning platform is linked to the online "SoS" reporting system this to make sure that training certificates and induction certificates of both our employees and contractors are followed up on.

In the light of the current Covid 19 pandemic, the HSSE Team, together with the O&M team took all appropriate measures, in line with legal requirements, to prevent the spread of Covid 19 during work-related activities, both on- and offshore, and implemented necessary procedures on the management of possible and confirmed infection cases. The measures included, but were not limited to:

- Use of facemasks;
- Fixed team constellations;
- Social distancing in both offices and vessels (limited PAX);
- Rapid-testing, self-testing and PCR-testing;
- Distribution of personal sanitation means;
- Self-Health declarations;
- Contact tracing;
- Etc.

10.1.3 Safety Exercises

Overview emergency exercises 2021	
WTG	20/03/2021: Contractor : Elevator Self Rescue Exercise
	22/03/2021: Contractor : RON, Inside Tower Sked rescue and TP evacuation
	15/11/2021: Parkwind : Safety exercise Person falling through open grating
	07/10/2021: Parkwind : Safety exercise powered Milan rescue
Vessel	13/07/2021: Parkwind : man overboard
Onshore	17/01/2021: Contractor : leakage (gearbox oil)

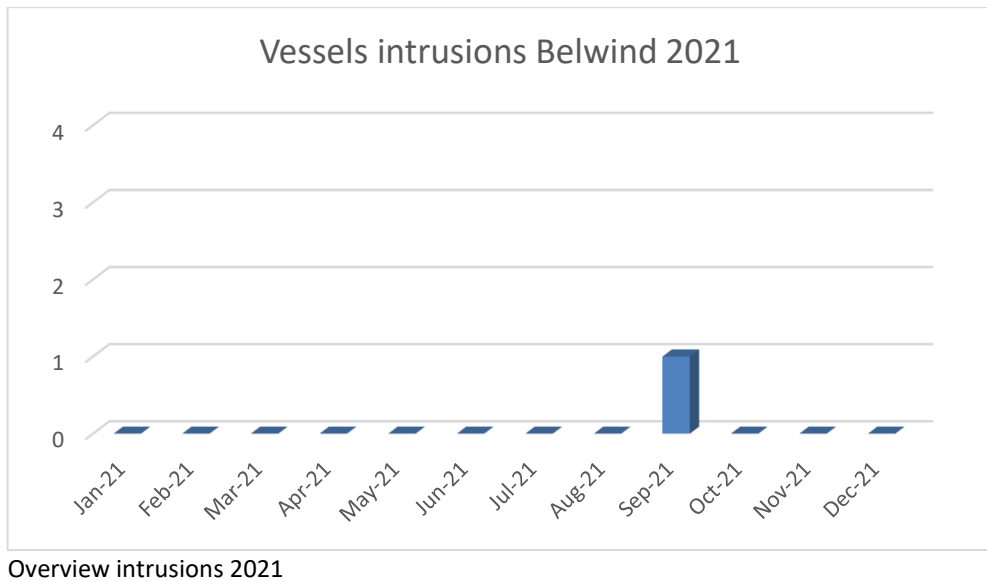
NOTE: The COVID 19 pandemic had a great impact on the organisation of exercises due to the lack of availability, the additional risks related to social distancing, etc.

10.1.4 Emergency actions (TIER2)

In 2021 there was one Tier 2 situation reported:

10.1.5 Intrusions

In 2021 we had only 1 intrusion (third party) reported on the Belwind concession.



As the intrusions were related to activities of neighbouring windfarms and only included small crossings of the safety zone (Proximity Agreement), these intrusions were managed between Belwind Marine Coordinator and the Marine Coordinators of the applicable neighbouring windparks. Thus, these intrusions were not reported towards the Authorities, using the MRCC intrusion template.

All intrusions are logged in the SOS system and are during the periodic Supervisory Committee meetings communicated to the Authorities. In case of intrusions by civilians (e.g. fishing boats) the MRCC template is used to report towards the Authorities; considered a TIER situation.

10.2 Vessel & accessibility

For maintenance on the turbines the Esvagt Mercator is used as hotel/mother ship in combination with STB`s. Small Crew Transfer Vessels, CTV's, are being used for transfer of personal, tools and equipment on the wind turbines, as well as for maintenance on the OHVS and the foundations, for delivery of parts and equipment to the wind farm, and for carrying out surveys and measurement campaigns.

10.3 O&M office Parkwind

O&M team offices are located in the harbor of Ostend.
Esplanadestraat 10B
8400 Oostende

11 Conclusion and outlook

The energy production in 2021 was significant lower than in 2020, mainly due to a lower average wind speed. Where unplanned downtime occurred, the teams managed to keep the unavailability of the turbine to its minimum.

The maintenance routine on all aspects (WTG, civil and electrical) was carried out. Parkwind, together with the contractors were challenged a few times, but with the correct organization and lessons learned implemented in both scheduled and unscheduled tasks, we managed in 2021 to do the maintenance without any major surprises.

The COVID pandemic was a major challenge for the maintenance management of the offshore windfarms. Part of essential services the operational support needed to go on under several unseen COVID constraints. A specific Business continuity plan was worked out and adapted at several occasions but in all the windfarm operations have not been measurably impacted. Almost all maintenance tasks were executed as planned and only low importance tasks were skipped or further delayed. This could only be achieved due to a tremendous flexibility and can-do attitude of all actors involved.

Belwind, managed by the Parkwind organization, will keep striving for innovation in terms of maintenance procedures, preventive actions, O&M inspection tools, etc. as it has been doing in the past. Next to the standard maintenance, it is expected that some issues might start showing after 11 years in operation which might need some more dedicated attention with age settling in. However, with a strong managing contractor as Parkwind, we are confident that any concern can be tackled adequately and preferably in a proactive matter.