Yearly Environmental Report 2011

BELWIND phase 1

Subject	Author	Revision	Date
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Public version

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1 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 46 km (Figure 1).

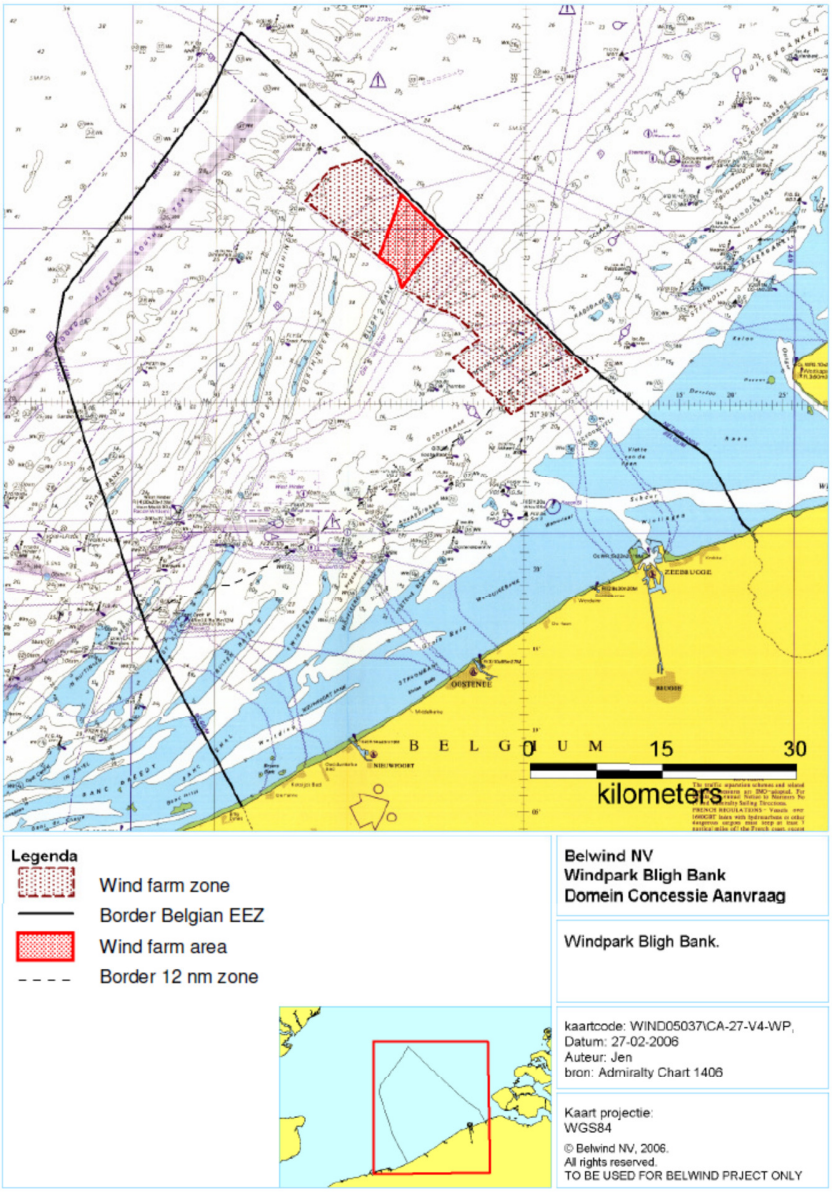

Figure 1: Location offshore wind farm Belwind

2 Project overview

According 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, the wind farm will be constructed in phases.
The pilot phase, Belwind 1 or Belwind phase 1, 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 land by a 150 kV submarine cable. Phase 1 is erected and operational since January 2011.

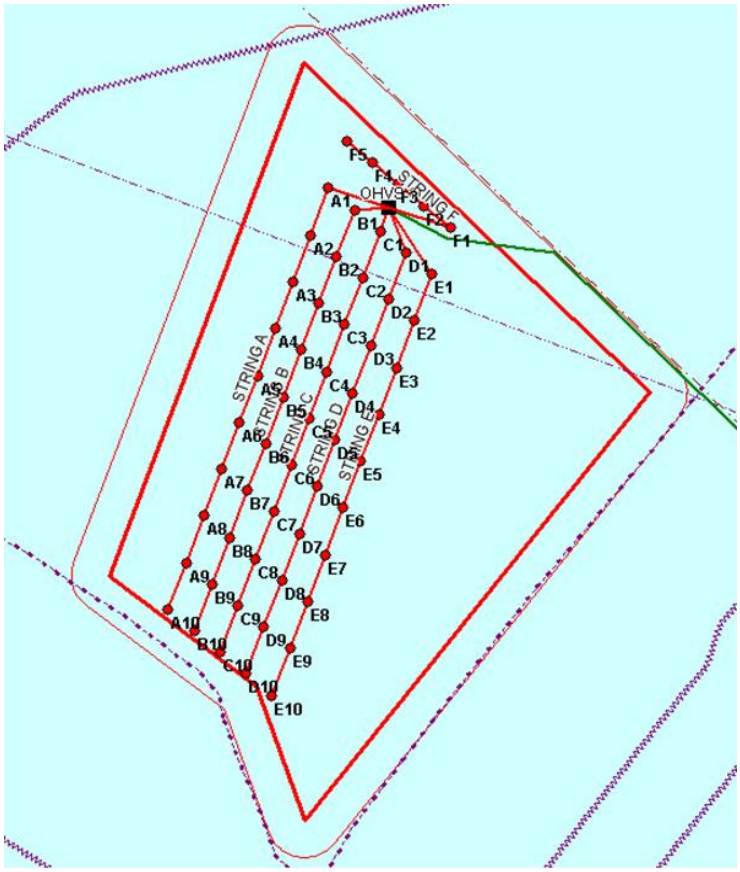

Figure 2: Locations of the wind turbines and the grid connection phase 1

Phase 2, Belwind 2 or Belwind phase 2, will consist of minimum 165MW, with its own OHVS and submarine power cable. The detail engineering has been started and the plan is to start of the construction works in 2013-2014. As there is an evolution in the development of the offshore wind turbines, the type of wind turbine isn't defined yet.

3

3.1 Description of the construction method and wind turbine

For the Belwind OWF, monopile foundations have been used. This construction method consists of a monopile, a transition piece and the actual wind turbine. Starting from the bottom, the monopile (MP) is a tube of about 50m long, diameter 5m which is hammered into the ground. On top of this monopile, a transition piece TP) is fitted. This is also a tubular section of about 30m long and 5m diameter. The purpose of this transition piece is to accommodate the boat landings and access platforms, and to ensure a perfect vertical alignment of the wind turbine, which is bolted on top of the TP.

The connection between the TP and the MP is made by a special kind of concrete, called grout. The TP is mounted on the MP, aligned with the vertical using hydraulic jacks, and then this grouted connection is made.

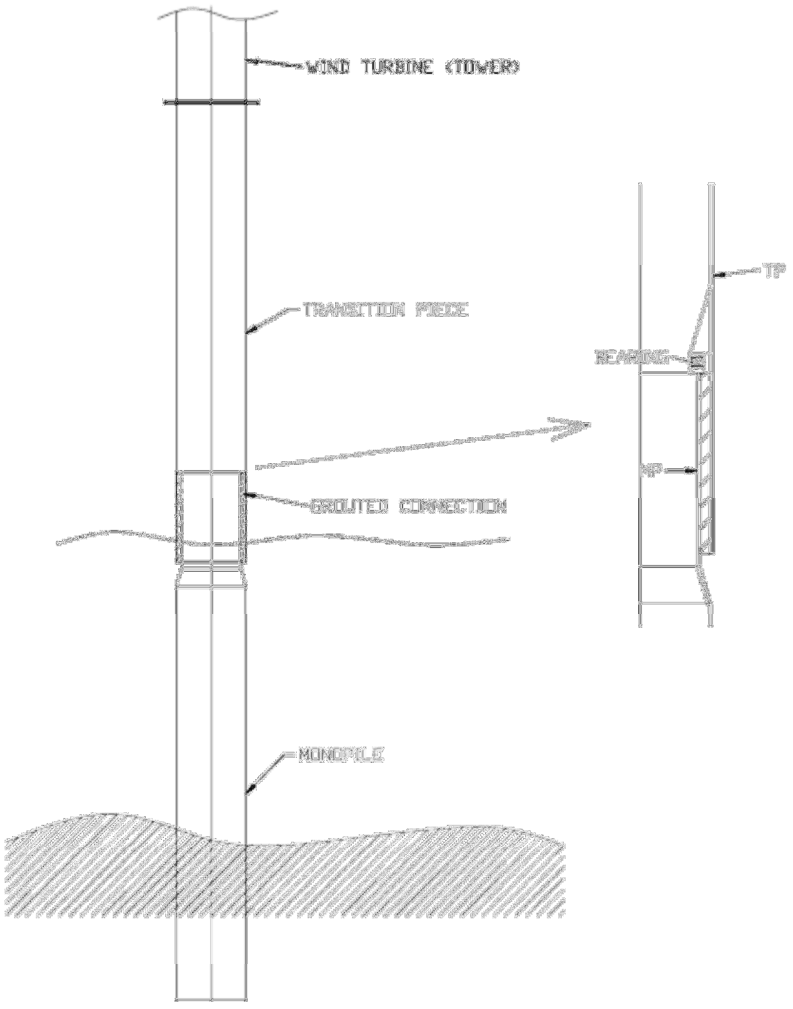

Figure 3: The Belwind Foundation

On Belwind, it has been observed that this grouted connection (despite being industry standard) has started slipping. This is obviously a serious concern.
Therefore a solution has been engineered, using elastomeric bearing. In other words, rubber blocks were fitted between the TP and the MP to support the wind turbine, and thus to relieve the load from the grouted connection.

3.2 Overview timing of the activity

The Finalization of the bearing solution to overcome the slippage of the grouted connection ran until late march 2011. After that a painting campaign was finalized and on 2 turbines the cathodic protection system was improved by diving works.

3.3 Detailed overview of the activity during 2011

01-01-11 Until 24-03-11 installation of the bearing solution
20-03-11 Until 21-04-11 painting inspections and touch-ups
28-04-11 Until 29-04-11 diving works cfr cathodic inspections
All 2011 execute punch list item works by Sea Wind on the electrical systems
The Vestas punch list items were all covered during the yearly maintenance and inspection round over the summer.

3.4 Procurement of plant

Belwind O&M team will operate the Belwind 1 wind farm, and give input to develop team of Belwind 2 (lesson learned).

3.5 Onshore works

No onshore works were performed apart from the closing of some punch list items and the O&M work.

3.6 Offshore works

3.6.1 Foundation

Bearing solution installation

3.6.2 Wind turbine

Punch list items only in 2011

3.6.3 Export cable

No project works in 2011

3.6.4 Grid connection

No Project works in 2011

3.6.5 Commissioning and tests

No Project works in 2011

3.6.6 Outstanding and remedial works

Punch list item works were performed in 2011

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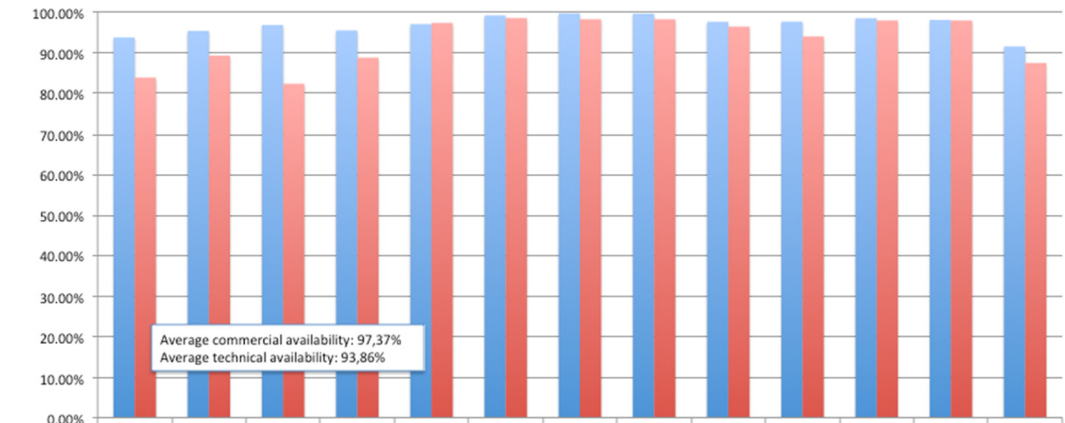
4.1 Availability



	18-31 Dec '10	Jan '11	Feb '11	Mar '11	Apr '11	May '11	Jun '11	Jul '11	Aug '11	Sep '11	Oct '11	Nov '11	1-17 Dec '11
Commercial availability	93.83%	95.46%	96.88%	95.57%	97.11%	99.24%	99.75%	99.68%	97.69%	97.72%	98.56%	98.13%	91.65%
Technical availability	83.80%	89.40%	82.30%	88.90%	97.40%	98.60%	98.30%	98.30%	96.50%	94.10%	98.00%	98.00%	87.60%

Table 1: Monthly availability 2011

4.1.1 Technical Availability

Technical availability is the overall availability of the turbines, with every downtime taken into account.

4.1.2 Commercial Availability

Commercial availability is the availability including only downtime due to the maintenance contractor, Vestas. The Belwind bearing works affected the foundations and not the turbines and are therefore not taken into account in the availability calculation with Vestas.

During the summer months, there is a difference between technical and commercial availability. That is due to scheduled service. Vestas is allowed to perform an amount of hours of scheduled maintenance on each turbine. Those “scheduled service” downtime hours are not taken into account in the availability calculations.

4.2 Availability of the electrical installation

In 2011, the main electrical infrastructure was 100% available due to no planned or unplanned shut down of the OHVS or Booster Station. All planned maintenances and inspections on the OHVS and Booster station were carried out without shut down.

4.3 Production

The wind speed in 2011 was slightly above the expected wind resource. During June, September and December the average wind speed was significantly higher than the wind speed estimated by different assessment studies. November and March on the other hand were bad wind months.

4.3.1 Wind rose & energetic wind rose

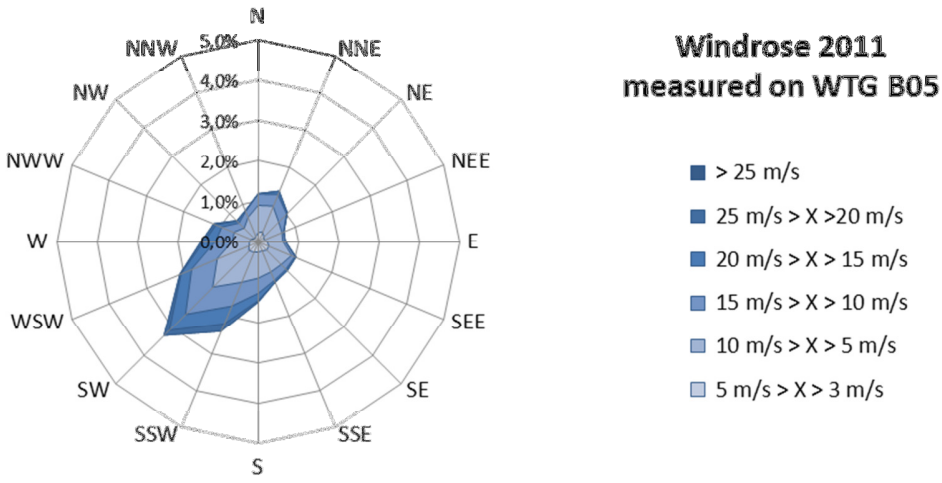


Table 2: Energetic wind-rose B05

The displayed wind rose is a graphical representation of the wind speed and direction measured on turbine B05.

The wind direction SW prevails, NNE is the second important wind direction.

4.4 Maintenance

4.4.1 Planned Maintenance

Vestas, the service contractor for the BW1 WTG's, performed the following planned maintenance and inspections in 2011:

- Three months service: after the first three months of operation, all the BW1 turbines were inspected as a last part of the commissioning. Amongst other general checks, the mayor component fixations i.e. the tower bolts were scrutinized to see if the installation works were up to standard.
- Annual service: yearly an annual service is done on all the turbines. The annual service takes three full days per turbine. Every component is carefully inspected and made sure it will operate correctly for the next year.
- Statutory inspections: on regular intervals, the personnel elevator (3 months), the Acta crane on the transition piece (1year) and the hook on points (1 year) are inspected and certified by a 3th party [Vincotte].
- Vestas HV inspections: every year, all the HV equipment on the turbines (transformer and switchgears) is inspected by Vestas.
- Vincotte HV inspections: every year, Vestas skilled technicians and a third party [Vincotte] inspect and certifies the HV installation. Vestas internal audit: Vestas performed an internal audit on the WTG`s to assure the service on the turbines was done correctly. The Belwind turbines were in excellent condition.

On the Belwind Booster station in Zeebrugge, Seahopper performed all planned maintenance:
On the Belwind Offshore High Voltage Station, Seahopper performed all planned maintenance.

5 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.

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.	Belwind submitted a modification for the diesel tank of the OHVS. In the permit request there was 10m³ mentioned. Belwind has instead installed two tanks of 25m³ each. Belwind wrote a letter to the authorities on 17 February 2011.
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.	No floating of sunken objects have been established.
14	During construction, all foundations and structures already finished must have a temporary warning light (at the highest point) for shipping and aviation traffic.	Since 8 February 2011 all navigation lights were fully operational, until then the guard vessel was present on site
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 is fully operational
16	All WTGs 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 round and in the wind farm	On 22 January 2011 an agreement was signed with Federal authority responsible for the marine environment
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 Vestas and Seahopper execute emergency exercises.
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.	Certificates of Origin supplied for all scour protection materials have been transmitted to the MUMM.
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.
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.
34	The holder must maintain the farm on a regular basis.	All installations are maintained on a regular basis.

Condition Number	Condition Summary	Current Status
48	A logbook must be kept in which the following is specified for each turbine: ➢ 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.

Table 3: Permit conditions overview

6 Results monitoring

As agreed with BMM, Belwind O&M is continuously monitoring certain various aspects of the wind farm. Below is an overview of all monitoring campaigns at hand.

6.1 Overview of the monitoring activity

In 2011, the following items have been monitored:

- Bathymetrical changes along the route of the export cable (thus indirectly depth of burial)
- EMV radiation on the beach in Zeebrugge
- Scour protection and infield cable (the four corner locations A10, E10, F1, F5, and infield cable of C-string)
- Cathodic protection

6.2 Results of the monitoring

6.2.1 Burial depth of export cable

The depth of burial of the export cable has been communicated to the MUMM.

6.2.2 EMF (Electro Magnetic Field) radiation

The EMF on of the export cable on the beach at Zeebrugge has been measured, and the maximum is 0.59µT at ground level directly above the cable, for the maximum current in the cable (712A). Attention is drawn to the fact that this maximum value will only be reached a fraction of the time and only during high wind periods when it is expected that no-one will stay steady on the beach. The effect is going down exponentially with the distance removed from the cable. The Export cable poses therefore no threat to humans on the beach.
The maximum EMF around the cable has been identified, in order to assess the magnitude of the electric and magnetic fields present on the seabed. The B-field (magnetic field) is below all documented hazardous levels for marine life. The Ei (induced electric field) field is above the detection level for certain species of fish, but there is no evidence of this being harmful to these species.

6.2.3 Scour protection and infield cable

As agreed with the MUMM Belwind will monitor on a yearly basis the 4 corner points (F01, F05, A10, and E10) and the central point of the OHVS. These points give a good representation of the whole wind farm and will allow trending over the years. All other scour protections will be checked minimum every 5 years.
2011 Survey results show slight differences between the as-built situation and the current situation, but the variations are within acceptable tolerances. The scour protection level remains above the minimum “design fixation level” everywhere. Attention is also drawn to the accuracy of the surveys. Despite best efforts, the accuracy is only within the dm range, and strongly depends on the references and datum. Therefore, no conclusion can be drawn based on differences below 0.5m.
Below is the topographic charts of F05 in its present state, with the cross sectional view for comparison to the as-built situation, as an example.

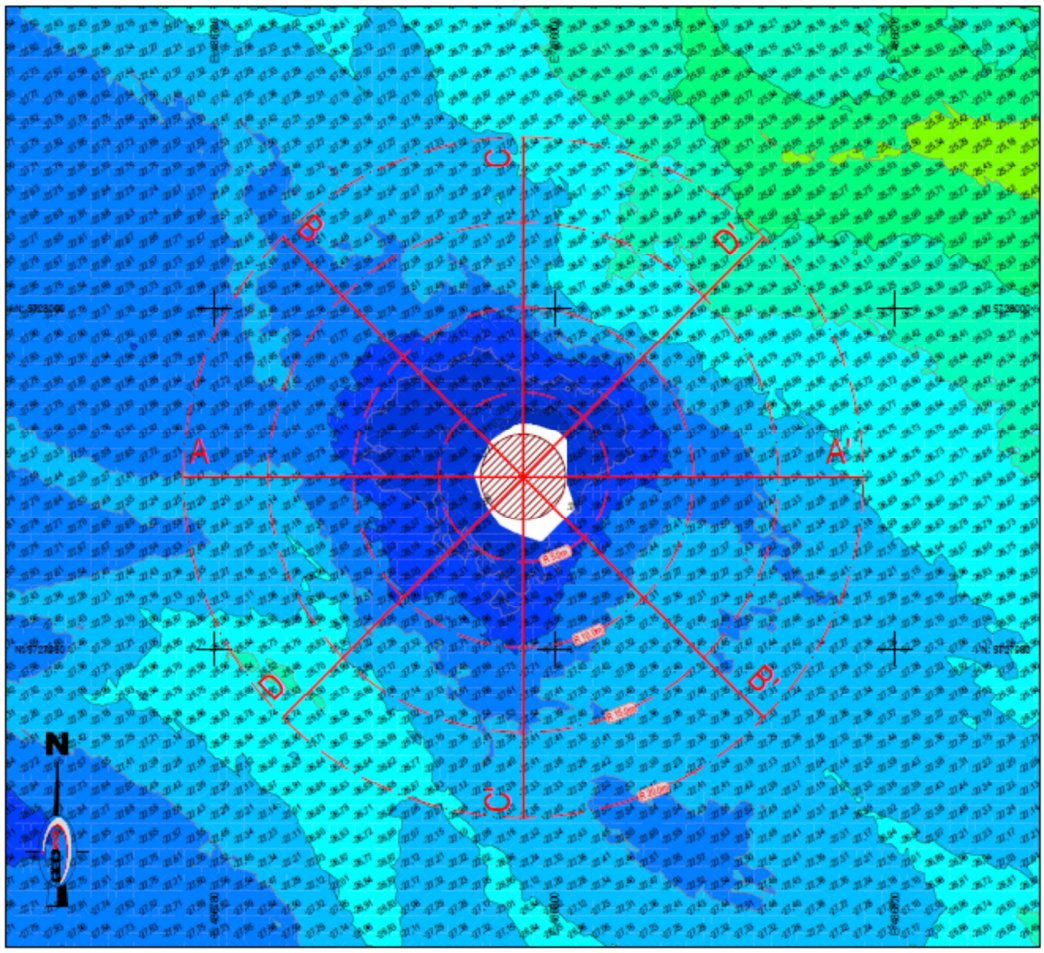


Figure 4: Topographic map of the bathymetry around MP

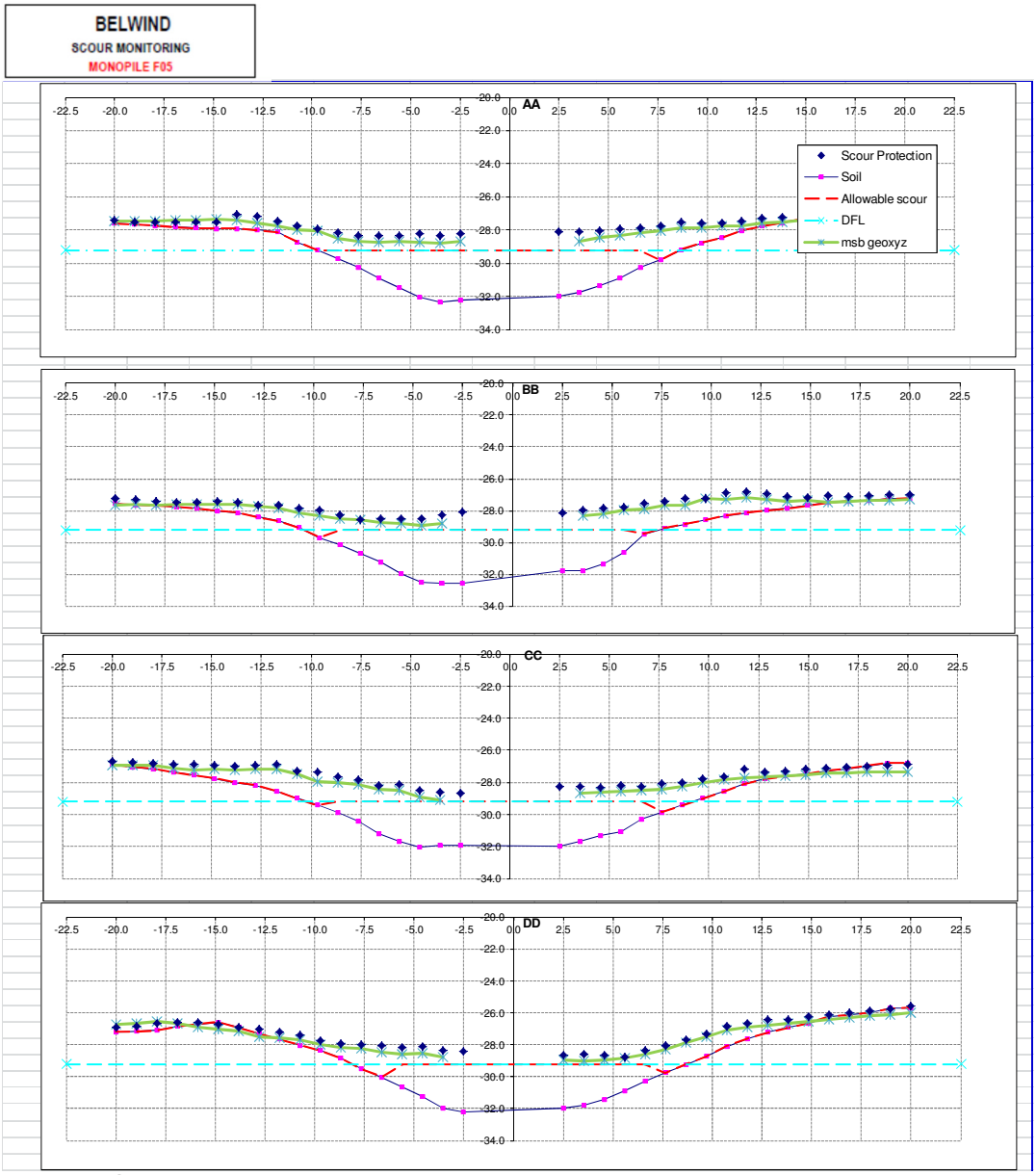


Figure 5: Scour monitoring around MP

The burial of the infield cables is checked together with the scour protection.
At present the depth of burial is monitored indirectly: the seabed profile is surveyed, and compared to the as-built data, supposing that the cable does not move. This results in a profile view of the cable and the seabed, so the depth is clearly shown.
The depth of burial of the infield cables is less critical then the export cable, because no shipping is allowed in the wind farm, so there is far less risk of anchoring or fishery damage. Nevertheless, a good burial protection remains important, and action will be taken if needed. So far, no significant difference between current situation and as-built has been noticed.

6.2.4 Bearing installation

All bearings have been installed, and no problems have arisen. The system works properly, and the grouted connection issue is solved. In the spring of 2012 the measuring system (load cells + displacement sensors) will be installed on the bearings of C01, which will allow us to get an accurate insight into the behavior of the bearing and the grouted connection.

6.2.5 Sirris campaign

Belwind is working with partner Sirris in setting up cooperation between the offshore industry and academic institutes. Belwind hereby wants to take the lead with research activities in domains where knowledge is still rare. In November 2011 a first measurement campaign has been initiated. With vibration sensors placed at different levels in the mast of the wind turbine measurements will be done in order to determine via operational modal analysis the damping frequency. Damping is one of the hardest to estimate parameters in the design of the foundations and has a direct impact of the lifetime expectancy of the offshore foundations. According to preliminary results, the measured situation corresponds to the design expectations.

In 2012 further measurement campaigns will be done in other domains. It is foreseen that over time turbine C01 will be equipped as a smart turbine.

7 Operations Management

7.1 Health Safety and environment

7.1.1 Accidents and incidents over the reporting period

A summary of the project QHSSE statistics are shown below. There is a high focus on QHSSE in the project and Belwind is satisfied with the QHSSE performance of its sub-contractors. The project focus on preventive QHSSE management and the high number of safety observations shows the commitment of the project to QHSSE.

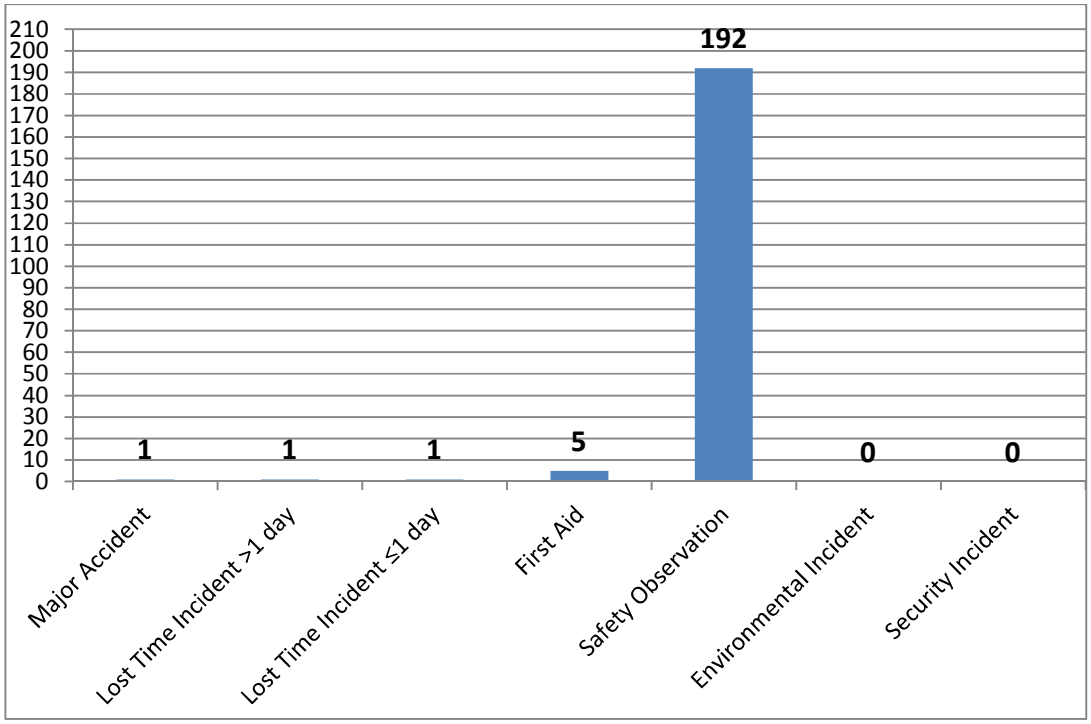


Figure 6: HSSE overview 2011

One Lost Time Incident (LTI) with absence of one day or more occurred on the 13th of August 2011. A crew member of the hotel vessel Esvagt Supporter injured his ankle while transferring from the hotel vessel to the Fast Rescue Craft (FRC). Immediately after the incident the injured person was carried to on deck and ice packs were placed on the ankle. This incident resulted in 9 days of absence from work for the crew member. A root cause analyses was conducted by Belwind and Vestas and corrective actions were identified. The transfer procedure was review and updated and the netting on the FRC that causes the tripping was removed.

7.1.2 Proactive safety initiatives

In 2011 Belwind has proactively worked with improving the QHSSE monitoring of its contractors as well as improving the emergency response preparedness of the project. The project has moved from focus on reactive Key Performance Indicators (KPIs), LTIs and incidents, to active KPIs such as safety training and safety observations. These KPIs have been developed together with the contractors and will be implemented from 1st January 2012.

7.1.3 Emergency exercises

The Emergency Response Plans (ERPs) of the contractors have been approved and are in compliance with the ERP of Belwind. During 2011 several emergency exercises were conducted as stated below.

- ERP training with the captain of the hotel vessel Esvagt Supporter with responsibility for work vessel coordination was undertaken in April;
- ERP training with the full Belwind O&M team took place in May 2011. The purpose of the training was provide up to date information on HSSE policies and systems and to galvanize the team towards continual HSSE improvement;
- An emergency drill involving the Belwind O&M team took place in June 2011;
- An emergency evacuation drill on the OHVS for Seahopper personnel took place in September 2011;
- An emergency evacuation drill for transfer of Vestas personnel from WTGs to the hotel vessel Esvagt Supporter took place in April 2011

7.2 Vessel & accessibility

For maintenance on the turbines the Esvagt Supporter is used as hotel/mother ship. Small crew transfer crafts, FRC's, are being used for transfer of personal, tools and equipment on the wind turbines.

Name vessel	Call sign	IMO number	MMSI number
Esvagt Supporter	OYXU2	8704858	219 993 000

For maintenance on the OHVS, for delivery of parts and equipment to the wind farm, for visits and for carrying out surveys and measurements campaigns the following vessels were used:

Name vessel	Call sign	IMO number	MMSI number
M.V. Provider	ORPN		205 562 000
GEOSURVEYOR IV	2DEW4		235 078 371
SC PUMA	2DAR9		235 077 343
M.V. Brandaris	ORLN		205 342 000
Blue Whale	2DLM9		235 080 023
Nautical Server	PCBD		
GEOSURVEYOR VI	2ENE7		235086554
Callisto Maassluis	MZFE7		232004598
ODIN Jack-up Barge	DAYQ	8768062	211106900
SCIROCCO	2FDR4	9638305	23509068

On a number of occasions Vessels were spotted that approached the wind farm to close (less than 500 m) and in one event a vessel entered the wind farm unauthorized. In all occasions the Esvagt supporter was able to inform the captains that they were in a possible dangerous situation and in the case of the unauthorized access the vessel was intercepted by FRC and send away. Since end of 2011 the standard intruder form is filled-out as supplied by the coast guard.

8 Conclusion and outlook

2011 Was a fruitful production year with less than expected downtime and slightly better weather conditions then the long-term forecast. All maintenance that needed doing has been performed as required and Belwind is lined-up ideally to go into the second year of production. The Belwind O&M organization itself was set-up in the mean time and runs professionally. Although we regret 1 LTI in 2011 we can state that overall safety is still priority number 1 and all works are performed only after strict HSSE assessments and approving of procedures.

In early 2012 we will further close-out the last remaining punch-list items and start-up the maintenance works on the foundations. With all lessons learned from the first operational year Belwind will adapt where necessary its maintenance procedures and strategies to further optimize the long term operationability of all assets in order to allow yield maximization over the full lifetime of the installations. Together with our internal knowledge build-up Belwind will further cooperate with institutes and platforms such as the MUMM and SIRRIS to will develop specialist knowledge on all influencing factors.