Netherlands Enterprise Agency

Nederwiek I-B draft regulations explanatory notes

Commissioned by the Ministry of Economic Affairs and Climate Policy

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

7.8 Explanation of requirements

7.8.1 Turbine size and number of wind turbines

This Wind Farm Site Decision is accompanied by a regulation (Regulation 3) that (also) aims to limit collision casualties by setting a lower limit on wind turbine capacity and an upper limit on the number of wind turbines to be installed in the wind farm. The total rotor area has also been standardised with a view to limiting the risk of collision among birds and bats.

For Nederwiek Site I-B, the upper limit for the number of wind turbines has been set at 76 in Regulation 3.2. Regulation 3.3 applies to the turbines to be installed, each with a minimum capacity of 15 MW. According to the definition of 'installed power' in Regulation 1, this is based on the maximum electrical power, also known as 'rated power', at which a wind turbine is designed to be used under normal conditions for the production of renewable electricity, as can also be determined by independent certifying parties. This definition is in line with the definition used in the NEN standard IEC 61400-1. In addition, the maximum tip height, pursuant to Regulation 3.6, is 304.8 metres, and pursuant to Regulation 3.5 a tip depth (lowest level) of at least 25 metres applies. Pursuant to Regulation 3.7, the total rotor swept area within the site does not exceed 3,509,788 m^2.[1] This bandwidth accommodates current and future models and is in line with the best available technologies in the field of wind turbines.

7.8.2 Reducing collisions among birds during seasonal migration

To prevent collision casualties among birds during seasonal migration as much as reasonably possible, a regulation (Regulation 4.3) is attached to this Decision that focuses on predicted mass bird migration.

Every year, during spring and autumn migration, millions of migratory birds fly over the entire North Sea. This includes several hundred different species, such as songbirds, waders, ducks, swans, geese and birds of prey. Migratory birds, if they fly at rotor height, can collide with rotor blades. Some of the migratory birds fly in the highest layers of the air, so that no collision with wind turbines is to be expected. However, research has shown that a significant proportion of migratory birds fly at rotor height, which can make them collision victims. Especially under less favourable conditions during the night (headwind, fog, rain), the birds move in the lower layers of the air and there is a risk of collision with wind turbines.

Minimising mortality among these migratory birds requires a vision that transcends the level of individual wind farms. In view of the plans for the expansion of wind farms in the North Sea, this collision risk is increased and ecological measures must also be viewed from the perspective of the entire North Sea. After all, the flight behavior of birds transcends site boundaries. Measures that protect birds in a specific site also affect the numbers that move across the entire North Sea. The development of measures to limit bird strikes in the North Sea is not only a responsibility for the Government, but also for and of all offshore wind farms. In view of the above, the Minister has decided that measures will be included in the Site Decision to limit collision casualties among birds. A feasibility study into a similar facility in Eemshaven Wind Farm and further literature on the effectiveness of measures show that the application of a turbine shutdown (curtailment) mechanism in the event of (night) migration peaks is an effective measure to prevent collision casualties.

During nights within migration periods, the permit holder reduces the number of rotations per minute per wind turbine to less than two during the period in which there is predicted mass bird migration. Predicted mass bird migration is defined as a short period of time during migration periods at night, during which conditions will be such that there will be a predicted peak in the movement of migratory birds.

The times when the shutdown provision must be in force are not specified in this Site Decision, but will be determined in each subsequent decision-making process. The period in which there is predicted mass bird migration is determined by the Minister on an ongoing basis. This

[1] This is based on the 'overplanting' scenario of 57 wind turbines with a rotor diameter of 280 metres, which is the maximum in terms of rotor surface area investigated in the EIA.

determination is based on a forecasting model to be managed by or on behalf of the Government. This forecasting model gives a signal when mass bird migration is predicted. The following parameters are, at least, used by the forecasting model:

- wind speed and wind direction at departure locations, among other things;
- temperature;
- amount of precipitation, and;
- the phenology of specific relevant migratory bird species.

The model will undergo continuous development to improve the accuracy of its predictions. In evaluating this measure, the Minister will involve the parties involved, such as the offshore wind farm permit holders, the transmission system operator, nature conservation organisations and, insofar as they are involved, or their involvement is desired, ornithologists (bird experts). Taking into account the permit duration and further development, the need for evaluation may decrease.

There is a maximum of 60 hours of (mandatory) curtailment downtime per year. This corresponds to about four percent of reduced casualties. The maximum hours of downtime corresponds to approximately 0.7 percent of the hours in a year. The maximum number of hours of downtime is not an end in itself. The actual number of hours of downtime in a year, within the given maximum of 60 hours, depends on the number of hours for which mass bird migration is predicted and on the basis of which a decision to stop operations for a period is taken. Capping the number of hours meets the importance of sustainable energy generation and provides the required legal certainty to the permit holder. As more birds fly over during the autumn migration, it was decided to focus on that period by calculating the number of hours starting from this autumn migration.

To safeguard the safety of both the Dutch and European grids, it is important that a large-scale reduction in the supply of electricity from offshore wind is known in a timely manner. The transmission system operator is therefore asked for advice on the possible risks of a shutdown with regard to network security prior to taking a decision to stop operations. The decision shall be published at such a time that the permit holder can reasonably comply with it. In addition, the Minister can consult ornithologists about the expected bird migration. This can help to reduce false positives from the model's predictions as much as possible. If the Minister requests such advice, this advice will also be taken into account in the decision-making process.

To ensure the prediction model is as accurate as possible, it will have to be fed with multi-year data from, among other things, bird detection systems in the North Sea. Wind farms will therefore be equipped with 'bird sensors'. The Government will pay for the costs of the purchase and maintenance of one bird detection system (with multiple components).

The permit holder must cooperate (without financial compensation) in the placement and installation of the equipment. This equipment can be placed in the turbines, but also on the (outside of the) turbine structures. The permit holder shall make structures on the wind turbines available, such as brackets and other supporting structures for attaching the equipment mentioned above. The permit holder also makes space available for the data cables (e.g. fibre optics, dark fibre) from the turbines to a collection point, ensuring the information from the sensors reaches the right locations. In addition, the permit holder (without financial compensation) is required to cooperate in providing access to the turbines for the management and maintenance of this equipment. This includes, for example, the provision of a vessel with associated crew, which does not alter the fact that it must also be possible (for example in the event of emergencies) to gain access to the facilities with your own vessel. The guiding principle is to efficiently align with the construction, management and maintenance schedule of the permit holder. The equipment remains the property of the Government. For both placement and installation and for the management and maintenance of the equipment, an agreement will be concluded with the permit holder of the wind farm. In principle, the data collected is public and can be made available (on request) to the permit holder and/or other parties.

This obligation to cooperate is included in Regulation 4.3 (c and d) and Regulation 5.1. Regulation 5.1 is explained in more detail in Section 6.18.3. In this context, it is very important that the permit holder seeks coordination with the Government (MIVSP) at an early stage, so that the placement of the sensors and the necessary digital infrastructure can be properly involved in integrated into the planning and scheduling for the construction of the wind farm.

7.8.3 Reduction of disturbance of guillemots

The guillemot is a locally resident seabird species that is sensitive to disturbance by wind farms, which is explained in more detail in Section 7.3.1. The EIA shows that a large proportion of guillemots that use the area currently will avoid the area around Site I-B with the arrival of the wind farm. This results in habitat loss, which can lead to reduced fitness and thus reduced survival and reproductivity. According to the modelling carried out as part of the EIA, this leads to 52 fatalities for the guillemot population annually. Although there is a strong avoidance reaction, some guillemots may use the wind farm to forage, rest, moult and sleep. These birds moult in the period from July to October. During this moult, guillemots lose all flight feathers, which means that they cannot fly for several weeks and are therefore strongly location-dependent for foraging and to grow new feathers. This makes them extra vulnerable.

Since habitat loss in itself already leads to increased mortality among guillemots, it is important, in view of the duty of care, to limit additional disturbance for those guillemots that do not avoid the wind farm. Research shows that shipping is the main source of disturbance for guillemots.[2] Shipping movements are expected in the wind farm throughout the year, with a peak in the summer period when a lot of maintenance work usually takes place. Guillemots that seek the relative peace and quiet of the wind farm during the moulting period will mainly be disturbed by local traffic related to the operation of the wind farm. Several studies suggest that the risk of disturbance of guillemots can be reduced by keeping sufficient distance with ships and limiting the approach speed.[3]

To limit disturbance of vulnerable guillemots, the permit holder will have to take into account the presence of groups of these birds. Regulation 4.5 stipulates that the permit holder must maintain a distance of at least 500 metres from groups of guillemots in the months of July to October. By keeping a distance of 500 metres, the disturbance of the guillemot is greatly limited.[4] In addition, there will be sufficient room to manoeuvre between the wind turbines for the ships. If this distance cannot be maintained due to necessary maintenance in the vicinity of groups of guillemots, the permit holder approaches the maintenance location at a sailing speed of up to 10 knots to allow guillemots to swim away undisturbed.[5] The permit holder is expected to make an effort to keep a distance of 500 metres from groups of guillemots with the ships in question. This best-efforts obligation means that the permit holder must take reasonable measures to recognise groups of guillemots in good time and to maintain the aforementioned distance. For example, the permit holder is expected to be extra alert during the moulting period from July to October and to actively steer towards maintaining the aforementioned distance in the event of concentrations of seabirds on the water.

In this way, year-round maintenance of the wind turbines is ensured. The impact of disturbance by the wind farm at Nederwiek Site I-B for the guillemot population will be reduced. At the same time, by maximising the required distance to groups of guillemots at 500 metres for a limited period of time, and allowing approach under certain conditions, the consequences for the permit holder are kept as limited as reasonably possible.

7.8.4 Reducing bat collisions

Section 7.3.2 sets out the effects of the wind farm at Site NW I-B on bats. It indicates that some bats, mainly pipistrelle bats, also cross the Southern North Sea during the autumn migration, from Scandinavia, the Baltic States and Russia to places in Europe such as the British Isles. Due to existing knowledge gaps with regard to population size, origin and the behaviour of different species of bats in relation to wind farms, the EIA is based on a worst-case scenario when assessing the effects of the wind farm. The main impact of a wind farm at Nederwiek Site I-B on bats

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[2] Fliessbach KL, Borkenhagen K, Guse N, Markones N, Schwemmer P, Garthe S (2019) A ship traffic disturbance vulnerability index for Northwest European seabirds as a tool for marine spatial planning. Front Mar Sci 6:192.

[3] Wageningen Marine Research, at the request of the Ministry of LVVN, Seabirds in the Dutch North Sea - Background document for a protection plan for seabirds potentially vulnerable to offshore wind farms, 2025; Fliessbach KL, Borkenhagen K, Guse N, Markones N, Schwemmer P and Garthe S, A Ship Traffic Disturbance Vulnerability Index for Northwest European Seabirds as a Tool for Marine Spatial Planning, 2019; Ronconi R.A. & Clair C.C.S., Management options to reduce boat disturbance on foraging black guillemots (Cepphus grylle) in the Bay of Fundy, 2002.

[4] Fliessbach KL, Borkenhagen K, Guse N, Markones N, Schwemmer P, Garthe S (2019) A ship traffic disturbance vulnerability index for northwest European seabirds as a tool for marine spatial planning. Front Mar Sci 6:192.

[5] The speed of 10 knots is in line with the speed usually used for bird counts, see for example HELCOM, Guidelines for monitoring seabirds at sea, 2021.

concerns the risk of collisions between the pipistrelle and the rotor blades during this autumn migration.

The EIA concluded that the conservation status of the pipistrelle would not be compromised by the wind farm in Site NW I-B. However, a significant negative impact on the species' conservation status, when considered cumulatively with other wind farms, cannot be ruled out. For this reason, it was decided to include a shutdown provision in Regulation 4.4 (a to d) to limit the number of bat collisions. In addition, in the light of existing knowledge gaps and the associated effectiveness of the curtailment measure, a monitoring obligation has been included in Regulation 4 (e to o).

Research into bat activity in the Dutch North Sea shows that most Nathusius' pipistrelle activity takes place in the autumn and that factors such as wind force and wind direction may also be important.[6]

Based on measurements from mining platforms, a turbine curtailment measure has been designed that reduces the number of (theoretical) casualties during the autumn migration by 40 percent. This tailor-made approach has been applied to the wind farms in the Borssele and Hollandse Kust Wind Farm Zones and has also been proposed for subsequent wind farms in, among other things, the EIA for the North Sea Programme 2022-2027. The measure prescribed for wind farms further offshore than Borssele and Hollandse Kust has been adapted to the conditions and turbine types prevailing there.

Monitoring data from bat measurement locations in the vicinity of the Nederwiek Wind Farm Zone have been studied. It follows that most bat activity can be expected in the period from mid-August to the end of October. The majority of bat activity is measured in nights with wind speeds of up to 8 m/s.[7]

So far, only a shutdown provision in which the so-called cut-in wind speed[8] is increased has proven effective in reducing the number of collision victims.[9] This means that the cut-in wind speed, the minimum speed at which the wind turbine starts generating electricity, will be adjusted upwards. At a wind speed below the adjusted cut-in wind speed, the number of rotations of the wind turbine will be reduced to one rotation per minute.

Regulation 4.4 has therefore been included, whereby the permit holder is obliged to adjust the cut-in wind speed of the wind turbines between sunset and sunrise to the wind speeds as stated in Regulation 4.4 (a). The aim is to reduce the rotation speed of the wind turbines during periods of increased bat activity, namely at low wind speeds between sunset and sunrise during the autumn migration. In this way, the risk of collisions is limited.

To measure the effectiveness of the bandwidth of the prescribed curtailment measure, Regulation 4.4 states that the permit holder must monitor the presence of bats. This mainly concerns acoustic monitoring by means of monitoring equipment at three points of a wind turbine, spread over approximately 15 percent of the wind turbines in the site. To be able to determine at which locations and under what conditions bat activity has taken place, the permit holder must also measure other variables, such as wind speed, temperature and time of day, and link these to the monitoring data. To ensure the data is representative, the permit holder must also monitor for at least five consecutive years, all year round. This monitoring takes place day and night and under all weather conditions.

Given the way data is collected within the permit holder's systems, combined with the permit holder's specific knowledge of the wind farm's operation and layout, it is efficient for this party to filter the data for noise and perform species-level identification. To ensure that monitoring is

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[6] Lagerveld *et al*. (2014) Monitoring bat activity in offshore wind farms OWEZ and PAWP in 2013. IMARES Report C165/14; Jonge Poerink et al. (2012) Pilot study Bat activity in the Dutch offshore wind farm OWEZ and PAWP. IMARES report number C026/13 / tFC report number 20120402. Lagerveld et al. (2017) Spatial and temporal occurrence of bats in the Southern North Sea area. Wageningen University & Research Report C090/17.

[7] The report was originally drawn up for the Site Decisions for the IJmuiden Ver wind farm zone, but because of the research locations, it is also representative of the Nederwiek Wind Farm Zone. See: Bureau Waardenburg, at the request of Rijkswaterstaat Zee & Delta, Bat curtailment IJmuiden Ver, Reducing bat mortality in offshore wind farms, ref. 22-227, 2022.

[8] The cut-in wind speed is the given wind speed at which the wind turbine starts to generate electricity. Below this speed, the turbine rotates in free run. The cut-in wind speed varies per turbine type, but is usually around 3.5 m/s. With a procedure, the cut-in-windspeed can be increased.

[9] EUROBATS Resolution 8.4, Wind Turbines and Bat Populations, 2018.

conducted correctly and the data is representative, the permit holder must submit a monitoring plan to the Minister of Climate Policy and Green Growth prior to the construction of the wind farm.

Through the WOZEP programme, the Government is investigating the ecological impacts of offshore wind energy in a generic sense. It is important that location-specific research by the permit holder aligns with the generic research of the Government. The monitoring equipment must therefore comply with the standards and working methods of WOZEP and MIVSP. To ensure this alignment as effectively as possible, the monitoring equipment will be supplied by MIVSP. The purpose of the delivery of the monitoring equipment and preconditions for the installation by MIVSP is to ensure that the research and monitoring takes place effectively and in a complementary manner to sensors already planned under MIVSP. The monitoring equipment is installed and maintained by the permit holder without financial compensation. The permit holder shall ensure that the risk of technical malfunctions and measurement errors is minimised through proper management and maintenance. The permit holder is expected to make an effort to repair monitoring equipment so that replacement of the monitoring equipment is avoided as much as possible.

The distribution of the sensors across the wind farm and the other installation specifications, including the direction in which the sensors will be installed, will be discussed with the permit holder after the permit has been awarded. Because measuring equipment is installed at three different heights, more insight will be gained into the height at which bat activity takes place and how this relates to the rotor blades. This is important information for assessing the vulnerability of bats.

Based on this new monitoring data, the curtailment measure can be further optimised. It can be determined more precisely in which period and at what wind speeds the measure should be applied in order to achieve the most effective implementation of the measure.[10] This amendment to the regulation requires an amending decision pursuant to Article 11(1b) of the Offshore Wind Energy Act. An ex officio amendment decision can be taken if the monitoring data provides sufficient reason to do so or based on a substantiated request from the permit holder. Given the statutory requirements governing any potential amendment to the site decision—and the associated need for high-quality, representative research data—it is advisable for the permit holder to consult the competent authority in good time regarding any bat monitoring study to be conducted. This allows for agreements to be reached on the research methodology, study duration, spatial coverage of monitoring equipment, and quality assurance.

The purpose of this regulation is to limit the number of collision casualties among bats − in particular the pipistrelle bat. The monitoring regulations that are part of the regulation have been included to expand knowledge about the presence and behaviour of bats in and around the wind farm in Site I-B. This knowledge building is of essential ecological importance to ensure protection of bats, both within this wind farm and in future projects. The implementation of the regulation entails efforts for the permit holder, including temporarily reducing the rotation speed of the turbines and making provisions for monitoring. The shutdown provision is aimed at the period from mid-August to October during the period between sunset and sunrise, in which the migration intensity of bats is greatest. In addition, the necessary equipment will be supplied by MIVSP and will only need to be installed on approximately 15 percent of the wind turbines, which further reduces the implementation burden for the permit holder.

7.8.5 Reducing disturbance from underwater noise

The KEC indicates that noise-reducing measures can reduce the effects on the harbour porpoise population. That is why a regulation (Regulation 4.2) is included in each Site Decision to limit noise level during foundation installation activities. The regulation focuses on the harbour porpoise as the most sensitive to pile driving noise and the most strictly protected marine mammal species, but also offers protection to other marine mammals. Setting a performance-based requirement rather than a prescriptive one encourages innovation in the tools and techniques used to protect underwater life.

[10] Boonman, M. 2018. Mitigating measures for bats in offshore wind farms. Evaluation and improvement of downtime provision. Bureau Waardenburg Report no. 18-278. Bureau Waardenburg, Culemborg.

Sound standards and possible deviations
The EIA concluded that if a sound standard of 164 dB re 1 μPa2s SELss (at 750 metres from the sound source) is applied in Nederwiek Site I-B, the population target for the harbour porpoise (and seals) described in the KEC 5.0 will be comfortably achieved. In the EIA, a bandwidth of 160 to 164 dB re 1 μPa2s SELss (at 750 metres from the noise source) was used for underwater noise during foundation work. In determining this bandwidth, the starting point of the North Sea Programme 2022-2027 to minimise the impact of underwater noise and to achieve the sound standard of 160 dB re 1 μPa2s SELss (750 metres from the sound source) was taken into account as soon as possible.[11] For this reason, when each Site Decision is taken, the noise standard for the installation of wind turbine foundations within the intended site is reconsidered.

In 2023, after consultation with experts in the field, it was concluded that there is a real risk of exceeding a sound standard of 160 dB re 1 μPa2s SELss (750 metres from the sound source) due to technical limitations.[12] However, based on more recent experiences with piling offshore wind turbine foundations, it can be concluded that uncertainties surrounding the installation of foundations for 15 MW turbines appear to be more limited than assumed in 2023. In 2026, foundations for 15 MW wind turbines will be installed in the Dutch North Sea using pile driving, with a noise sound level of less than 160 dB re 1 μPa2s SELss (750 metres from the noise source). The following measures were used:

- a source measure consisting of a noise-dampening system integrated into the pile-driving hammer;
- a 'near field' measure, involving the installation of a net structure around the foundation pile, fitted with elements designed to reflect and absorb underwater sound;
- a 'far field' measure, consisting of a double bubble curtain around the foundation location.

In view of the ambition of the North Sea Programme 2022-2027 to lower the noise sound standard to 160 dB re 1 μPa2s SELss (750 metres from the noise source) as soon as possible, it has been decided to use a noise sound standard of 160 dB re 1 μPa2s SELss (750 metres from the noise source) in this Site Decision. This sound standard is included in Regulation 4.2 (a). However, it remains uncertain to what extent the recent experiences described above relate to the situation in which foundations for larger turbines of, for example, 20 MW are placed or to the situation in which foundations are placed in other seabed conditions.

For the above reasons, a derogation option has been included in Regulation 4.2 (b). Based on that, it is permitted, under certain conditions, to deviate from the noise sound standard of 160 dB re 1 μPa2s SELss (at 750 metres from the noise source) to a maximum of 164 dB dB re 1 μPa2s SELss (at 750 metres from the noise source) at a maximum of 57 turbine positions. This derogation option provides more certainty that the underwater noise level will remain within the permitted limit if a wind turbine type with a higher capacity, larger pile diameter and heavier foundation construction is chosen. The number of 57 turbine positions, for which the derogation applies, corresponds to the maximum number of wind turbines that can be installed if 20 MW wind turbine types are chosen. The possibility of derogation for a maximum of 57 turbine positions also applies to the foundations for other permitted turbine types, although in many cases more than 57 of these will have to be installed. For the foundations for lower capacity turbines, this also takes into account the situation in which the limit of 160 dB re 1 μPa^{2s} SELss (at 750 metres from the noise source) could be unintentionally exceeded during pile driving as a result of, for example, local seabed conditions.

Although the regulation does not differentiate between different turbine types, it is estimated that the risk of deviations from the noise sound standard of 160 dB re 1 μPa2s SELss (at 750 metres from the noise source) is lower for foundations for 15-16 MW wind turbines than for 17-20 MW wind turbine foundations. The provision allowing for deviations explicitly does not grant the permit holder the option to implement fewer noise-reduction measures than is reasonably feasible. The regulation has been included to account for remaining technical uncertainties regarding the ability to consistently achieve a noise standard of 160 dB re 1 μPa2s SELss (at 750 metres from the noise

[11] This is a consequence of the commitment in the North Sea Agreement to include 'the experiences of neighbouring countries Germany and Belgium with a noise level of 160 DB' in Site Decisions. The method of standardisation in Germany and Belgium is different from the aspired SELss standard from the North Sea Programme 2022-2027, which means that 'a noise level of 160 dB' is not an unambiguous term. The standard applicable in Germany, measured at a distance of 750 metres, is as follows: unweighted broadband single event level (SEL05) 160 dB re 1μPa2s, peak level (Lp,hp) 190 dB re 1μPa. In Belgium, measured at a distance of 750 metres, 185 dB re 1 μPa (zero to maximum SPL, L0-hp).
[12] Pondera, in collaboration with TNO and HWE, Construction of wind farms in IJmuiden Ver and Nederwiek I, Limiting underwater noise and feasibility of noise standards, 2023.

source). This implies that the permit holder must apply reasonably available mitigation measures to prevent the limit from being exceeded in the first place and, should an exceedance occur, to keep it to a minimum.[13] In practice, this means that when installing any foundation with a pile-driving technique (impulsive noise), at least a combination of a source measure, a near field measure and a far field measure will have to be applied, as outlined above in the example of Hollandse Kust (west) Site VI. These techniques are available on the market and in combination have proven effective in limiting underwater noise.

Regulation 4.2 (c) also provides for a limited possibility of derogation for research and testing purposes. The offshore sector is undergoing rapid change, also with regard to the development of new foundation techniques and means to reduce noise levels associated with existing techniques. From the perspective of knowledge development and the ability to test innovations, there may be good reasons to temporarily exceed the underwater noise level of 164 dB re 1 µPa2s SELss (at 750 meters from the noise source). For this reason, a (further) exceedance of the noise standard is permitted at a maximum of three wind turbine positions (of the 57 positions referred to in Regulation 4.2 (b). The permit holder is obliged not to generate more noise than is strictly necessary in the context of the trial. Pile driving without any mitigating measures, for example to establish a reference value, is therefore only permissible to a limited extent. Pile driving without mitigation measures is permitted, if necessary, for a maximum of 25 minutes per turbine position (and for a maximum of three turbine positions). In addition, the permit holder must demonstrate that the maximum number of harbour porpoise disturbance days during the construction of the wind farm, including these tests, will not exceed 57,100 days. An appropriate, public research interest must be served [14] when a temporary exceedance of the underwater noise sound standard, with a noise level higher than 164 dB re 1 µPa2s SELss (750 metres from the noise source), occurs. This may involve testing new technologies and pile driving hammers where development is in the final stage, and for which, on the basis of previous test results (onshore), there are strong indications of a good mitigating effect with regard to underwater noise and other environmental effects. Tests to validate a publicly usable underwater noise model can also provide valuable knowledge.

A plan for a field trial, in which a maximum of three wind turbine positions are subject to a further exceedance of standards, is included in the foundation plan that is submitted to the competent authority for assessment no later than four weeks prior to the start of construction. To this end, the foundation plan contains a description of the innovation to be tested and a substantiation of, among other things, the usefulness and necessity of the research, the expected noise sound level, the total number of harbour porpoise disturbance days and the duration of the distinctive phases of the trial. This information is used by the competent authority to ensure that the effects remain within the scope of the impact assessment in the EIA. The research results are also shared with the competent authority. The competent authority may make the results public. The findings can provide new insights for subsequent Site Decisions and identify further research opportunities.

With the chosen noise sound standard, and the associated conditional deviation options, there remains an incentive to invest in the development of low-noise foundation techniques, but operational uncertainties for permit holders are limited as much as possible, while negative effects on the harbour porpoise can be reduced and population effects can be ruled out.

Foundation plan
The permit holder draws up a foundation plan and submits it to the Minister of Climate Policy and Green Growth no later than four weeks prior to the start of construction. This is laid down in Regulation 4.2 (e). The foundation plan must, as a minimum, include:

- a description of the installation process, consisting of a description of the foundation, the equipment and vessels to be used, the installation method and the process steps;
- a communication plan describing how communication will take place—before, during, and after the foundation works—with the competent authority, relevant government agencies, and other stakeholders identified in the plan;
- a noise forecast, with substantiation, taking into account site-specific conditions;
- a description of mitigation measures to be taken, such as the use of an acoustic deterrent (if applicable), soft/slow start and other noise-reducing measures;
- a description of the design and technical characteristics of noise measurement systems.

[13] The principle of complying with Regulation 4. 2 (a) for each turbine foundation entails that the turbine positions do not have to be selected in advance in the foundation plan, with the exception of the positions where a deviation is provided for in the context of Regulation 4. 2 (c).
[14] This ensures that the effects on harbour porpoises and seals are no more negative than was investigated in the EIA.

The EIA study focuses primarily on assessing the environmental effects of pile-driving activities (impulsive noise). However, the EIA also describes techniques that are a source of non-impulsive noise, namely vibration, screwing and *blue piling*. These techniques are expected to cause fewer impacts on marine mammals due to expected lower noise levels. If a foundation technique is (also) chosen that does not involve impulsive noise but continuous noise, the permit holder demonstrates in the foundation plan, by means of a calculation[15] by an expert in the field, that the number of harbour porpoise disturbance days does not exceed 57,100. This number is equal to the maximum number of harbour porpoise disturbance days calculated in the EIA for the scenario where a pile-driving technique is used.

Noise measurements and foundation report
The noise sound level must be continuously measured by the permit holder during the foundation work. This is stipulated in Regulation 4.2 (i). These measurements must take place at two directly opposite positions, 750 metres from the foundation, ensuring a consistent measurement methodology. The results of the noise sound measurements must be shared with the Minister in a foundation report for each foundation, no later than 48 hours after the completion of the installation of the foundation, in order to enable supervision and enforcement. In addition, the foundation report is shared with the Minister of Climate Policy and Green Growth and the Minister of Infrastructure and Water Management to support the updating of the cumulative impact analyses (in the KEC and EIAs) and international reporting obligations with regard to environmental protection. This environmental information is used—in cooperation with other countries in the marine region—to assess the state of the North Sea. The data is used in the framework of the Convention for the Protection of the Marine Environment of the North-East Atlantic (known as the OSPAR Convention) and the European Marine Strategy Framework Directive (MSFD) to formulate policies and marine strategies aimed at reducing environmental pressures, protecting and restoring Europe's seas and oceans and their sustainable use. This environmental information is reported in abstract form once every six years in an international context and made public.[16]

Each foundation report contains at least the following information:
- foundation ID, location, length and diameter of the foundation;
- the maximum amount of hammer energy;
- a description of the mitigation measures applied to reduce the noise sound level as much as possible;
- the start and end time of the installation of the foundation;
- the start and end times of the use of an acoustic deterrent (if applicable);
- the start and end times of the measures applied to reduce the noise sound level as much as possible;
- the results of the noise measurements, in SELss (in the case of impulsive noise) or SPL[17] (in the case of continuous noise).

Deterring marine mammals
In addition to the standards for underwater noise sound levels and the permitted number of harbour porpoise disturbance days, the Site Decision includes measures for the timely deterrence of any animals present (Regulation 4.1). The implementation of these measures must be described in the foundation plan referred to in Regulation 4.2 (e). If a pile-driving technique is used, Regulation 4.1 (a) provides for the mandatory application of a slow and soft start during pile driving. The pile driving energy and strike frequency are slowly increased to deter harbour porpoises (and possibly other marine mammals). This ensures that harbour porpoises move to a safe location in good time.[18]

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[15] The permit holder must use the calculation method for the number of harbour porpoise disturbance days as used in the KEC 5.0 and the underlying underwater noise sound report. However, in the calculations in the KEC 5.0, pile driving (impulsive noise) is the starting point. For this reason, the calculation must be made to measure the (alternative) installation technology used. Adjusted assumptions must be justified in the calculation. A memo has been published as an instruction, see: TNO, at the request of RWS ZD, Memo-Calculation of the number of harbour porpoises potentially disturbed by offshore vibropiling noise, 2024.
[16] In the weighing of interests to make environmental information public in abstract form, the starting point of the Aarhus Convention is that environmental information must be accessible to the public. Article 19.1a, first paragraph, part b, of the Environmental Management Act qualifies the pile driving data as environmental information.
[17] SPL=sound pressure level.
[18] Incidentally, according to the EIA, it is observed in practice that the presence of porpoises at a project location has already decreased before the actual pile-driving work begins. One explanation is that this is a result of the noise caused by ship propellers, anchor chains, the lowering of the legs of the jack-up vessel, etc.

Applying a slow and soft start is not necessarily possible with a technique that involves continuous noise, such as vibration. That is why the use of an acoustic deterrent can play a role in effectively deterring harbour porpoises and to limit disturbance as much as possible. This is stipulated in Regulation 4.1 (b). However, whether it makes sense to use an acoustic deterrent depends on the noise level of the technology to be used and its frequency range. It is important to avoid the use of a deterrent device resulting in unnecessary additional noise exposure. This applies, for instance, if the chosen installation technique produces less noise at the relevant frequencies than the acoustic deterrent itself. The permit holder may dispense with the use of an acoustic deterrent if it produces more noise at the relevant frequencies than the installation technique being used, or if a qualified expert justifies in the foundation plan that the measure does not contribute to preventing permanent hearing damage in harbour porpoises. This option of derogation is included in Regulation 4.1 (c).

7.8.6 Promoting biodiversity through nature-inclusive construction

Wind farms can provide opportunities for strengthening (native) species and habitats. Nature-inclusive construction can contribute to nature restoration in the North Sea. For example, certain organisms can benefit from the materials used, which can create a semi-natural reef.

In view of the North Sea Agreement and the North Sea Programme 2022-2027, specifically the policy objective of strengthening and restoring the marine ecosystem, as well as the European Nature Restoration Regulation, this Site Decision includes a regulation for nature-inclusive construction (Regulation 4.6). If the permit holder uses stones or other materials to for scour protection around the foundations of wind turbines and when cable or pipeline crossings are constructed, this regulation obliges the permit holder to take measures at at least 50 percent of the turbine positions and crossings to increase habitat opportunities for species native to the North Sea. By using a narrow range of stones in the scour protection around turbine foundations (part d), as well as ensuring the stability of stones around turbine foundations and cable and pipeline crossings (part c), it is expected that nature will have the space to develop here. Benthic organisms can attach themselves to stable stones and a diverse community can develop. Working with one of the narrow stone grades listed in Section 6.4 of the Deltares Handbook of Scour and Cable Protection Methods (2023) prevents the use of too great a variety of rock sizes. This ensures that spaces are created between the stones with the aim that fish, crabs, lobsters and other benthic species can settle or retreat between these stones.[19]

The measures taken may contribute to the restoration of relevant marine habitat types or habitats of species referred to in Article 5(2) or Article 5(5) of the Nature Restoration Regulation. Promising EUNIS habitat types from groups 3 and 5 of Annex II of the Nature Restoration Regulation include bivalve reefs in the circalittoral zone (MC223), mussel beds on circalittoral sediment (MC2235) and faunal communities on circalittoral rock (MC121).

The appropriate form of scour protection must be applied for at least 50 percent of the turbine positions (part a) and cable or pipe crossings (part b). However, the regulation leaves room for an alternative interpretation of the nature-inclusive construction of the wind farm. If the permit holder opts for a measure other than modifying the rock deposits and cable or pipeline crossings, the permit holder must substantiate how the alternative measure contributes to the enhancement of habitat types or habitats of species. The permit holder must also substantiate that the surface area of the alternative measure is equal to or greater than the surface area of the standard measure and the permit holder must provide a monitoring programme to determine and evaluate its effectiveness. Finally, the permit holder must be aware that additional permits may be required for the implementation of the alternative measure. If installations or structures are placed separately from the wind turbines, foundations, scour protection and cabling, and therefore there is no functional relationship with the wind farm, an environmental permit must be applied for. The application will then be assessed against the applicable rules and assessment frameworks.

For nature-inclusive construction, the permit holder submits an action plan before the start of construction of the wind farm. This focuses on the motivation for the choice and effectiveness of the measure, with the permit holder paying attention to limiting sedimentation, stability, stone grading and preventing potential leaching. With regard to the scour protection of turbine

[19] The use of one of the 'narrow' standard grades also prevents the openings from being filled with a smaller material.

foundations, it is important to justify that, in view of the circumstances of the location, the choice of grading as referred to in part d can meet the requirements of part c. The inclusion of a grading on the list in the Deltares manual, referred to in section c, is not in itself a guarantee that the stones at the location in question will remain stable under storm conditions with an average exceedance frequency of once every five years, that sedimentation will be limited and that contamination by leaching will be prevented. In view of the requirements of part c, the permit holder is required to make a careful and motivated selection of a standard grading taking into account local conditions.

The effectiveness of the measures taken can be part of monitoring commissioned by the Government. In relation to (cooperating with) monitoring by the Government, see Sections 6.18 and 7.8.7.

7.8.7 Monitoring and evaluation

The EIA, Appropriate Assessment and KEC address knowledge gaps with regard to ecological impacts during the construction, operation and removal of the wind farm. For this reason, the regulations impose various monitoring tasks on the permit holder. In addition, ecological research, monitoring and evaluation will take place by the Government. The monitoring and evaluation programme (WOZEP) explicitly pays attention to bottlenecks that have been raised in EIA research, with priority given to species with a protected status. The knowledge that follows from the programme will be used to optimise the regulations in (future) Site Decisions. The monitoring and evaluation programme is financed and adopted by the Minister.[20] WOZEP's research agenda has been broadly elaborated in the WOZEP Multi-Year Programme 2024-2030 and is further elaborated in annual plans. Components in the monitoring and evaluation programme concern:

Birds
The bird research within WOZEP mainly focuses on gaining more knowledge about the possible number of casualties as a result of collisions with offshore wind turbines and the potential impacts on birds that avoid the wind farms (habitat loss). With the help of advanced radar systems, high definition images, field observations, tagged birds and model development, relevant knowledge is gathered.

This data is used, among other things, to improve the collision-risk model, which predicts the number of collision casualties. In addition, WOZEP is working to make a large part of the international bird count data more available. All this data will be used as input to validate and improve the assumptions made within the collision, habitat use and population models. These models provide better insight into the effects of offshore wind farms on birds.

As a result of the large-scale roll-out of offshore wind, changes in the ecosystem can also occur. These changes may have consequences for the availability and accessibility of food for seabirds. New models should visualise this effect.

Ultimately, one of the goals is to be able to estimate the combined effect of the impacts mentioned above for the populations of a particular species. To arrive at such an estimate, WOZEP is committed to a process of model development in which a (combination of) model(s) is worked towards with which all effects can be quantified. Subsequently, a population model can be used to see how this affects the population of a species. If there is further reason to do so, WOZEP will also investigate the mitigation options for the above impacts.

Specifically for migratory species (migratory birds), WOZEP conducts research into migratory patterns and conditions in which migration takes place. The KEC has a species-specific and quantitative approach. Therefore, the aim is to find out which migratory bird species are most vulnerable to collisions with offshore wind farms and how large this effect is compared to the effects of other activities. The focus of the follow-up research will be on the species that may be affected by offshore wind energy at the population level. Because a lot of detailed knowledge per species remains a challenge, research is also being done into options for mitigation of collision victims among migrating bird species.

Bats

[20] Parliamentary Papers II, 2015/16, 33 561, no. 26.

The bat research within WOZEP focuses mainly on gaining more knowledge about the specific circumstances relating to when and why bats are at sea and the behaviour of bats in offshore wind farms. To map the movement of bats along the coast and over the sea, research is being carried out within WOZEP using telemetry stations (receiver of radio signals) and Nathusius' pipistrelles fitted with transmitters. These transmitters emit a radio signal that is captured by the telemetry stations. In addition, research is carried out using acoustic observations (bat detectors), in which the echo signal, which a bat uses to orient itself and forage for food, is recorded.

Future research will focus on estimates of population size of the Nathusius' pipistrelle bat, the development of collision/population models for impact assessments, and the development and improvement of curtailment measures and additional forms of mitigation.

Marine mammals
The marine mammal research within WOZEP focuses mainly on gaining more knowledge about the direct impacts of the construction and operation of a wind farm on harbour porpoises and seals, and translating these findings to the population level. As projects scale up, it is becoming increasingly important to refine assumptions regarding population parameters and to improve population models through validation and further development, particularly concerning data on impact ranges and population recovery. At the same time, the industry is developing alternatives to standard pile driving techniques to install wind turbines in a quieter way. Current models for determining impacts on marine mammals do not yet take these techniques into account. These models will be adjusted based on WOZEP research. WOZEP also focuses on broadening knowledge about the impacts of operational offshore wind farms on existing populations of marine mammals. The central question here is whether a wind farm as a habitat will still be suitable for species, also in view of possible effects at the ecosystem level. WOZEP also pays attention to the impacts of the removal of offshore wind farms on marine mammals.

Ecosystem effects
The ecosystem research within WOZEP focuses on a better understanding of changes caused by offshore wind farms in the North Sea ecosystem. These changes can indirectly affect protected species. Ecosystem modelling is being developed to determine the effects of offshore wind farms. This involves looking at processes and interactions, such as abiotic processes (wind, waves, currents, sediment, light, temperature, salinity, nutrients) and the food web (phytoplankton, zooplankton, benthos, fish).

Fish
Fish research within WOZEP focuses mainly on gaining more knowledge about the distribution of fish species, the variation in the fish landscape and the impacts of wind farms on pelagic and demersal fish. Studies also focus on the strength and possible effects of electromagnetic fields around the electricity cables. Various related projects are looking at the influence of noise (both pile-driving noise and operational noise) on the behaviour of fish.

Benthos
The research into benthos within WOZEP focuses mainly on the change of benthic animal communities and the effects of wind farms on these systems. Research and data collection are carried out in existing wind farms, among other things, by means of benthic grab sampling and boxcore samples. Conducting hard substrate benthos research into growth on monopiles is also part of WOZEP.

The permit holder will cooperate in this monitoring and evaluation programme without financial compensation, which may include granting access to the wind farm and the wind turbines, and the seabed of the wind farm, attaching equipment (or having it attached) in, on or to (parts of) wind turbines, and providing cabling and making space available on data cables. In addition, the permit holder will have to provide access to the wind farm and the wind turbines (without financial compensation) for the purpose of research, management and maintenance of this equipment. Granting access also includes the (timely) provision of a vessel with associated crew, but also any deployment of own personnel for on-site guidance. To this end, Regulation 5.1 has been included. See Section 6.18.3 for further explanation.

The starting point is to efficiently align with the construction, management and maintenance schedule of the permit holder. The permit holder will be informed of the intended activities as soon as possible.

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