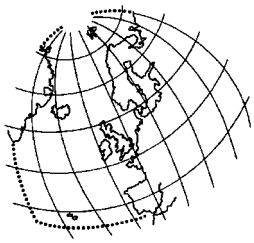
OSPAR CONVENTION FOR THE PROTECTION OF THE MARINE ENVIRONMENT OF THE NORTH-EAST ATLANTIC



OSPAR Guidance on Environmental Considerations for Offshore Wind Farm Development

(Reference number: 2008-3)[1]

Table of contents

[1] This agreement replaces agreement numbers , 2003-16, 2005-2, 2006-5, 2007-9.

Introduction

1. The OSPAR Quality Status Report 2000 for the North-East Atlantic refers to a conclusion by the Intergovernmental Panel on Climate Change (IPCC) that increases in greenhouse gases are contributing to global warming. It notes that such changes may lead to major climate-system changes with resulting impacts on the ocean and its biota. In response to global warming, OSPAR Contracting Parties have signed and ratified, approved or acceded to the Kyoto Protocol to the United Nations Framework Convention on Climate Change, thereby committing themselves to reduce, by 2008-2012, overall emissions of greenhouse gases to 5% below the 1990 emission levels.

2. In March 2007 the European Council backed Commission proposals on energy and climate change, agreeing on an action plan to further develop energy policy by 2009. Key aspects of the agreement include a binding target to reduce EU emissions by 20% by 2020, (increased to 30% should other industrialised nations take similar steps). For renewable energies a binding target is set to achieve 20% of the EU's overall energy consumption from renewable sources by 2020.

3. In this context, the use of energy from renewable resources plays an important role. Wind energy can contribute considerably to the national and international goals of CO_2 reduction and seems indispensable in this respect due to its potential to avoid substantial amounts of CO_2 emissions every year. As a consequence, the use of wind energy is expanding within the OSPAR Region, including making use of offshore wind energy potential.

4. Whilst the associated reduction in CO_2 emissions from the use of wind turbines should be welcomed, the identification of suitable locations and the utilisation of suitable construction, operation, maintenance and removal techniques to ensure that adverse impacts to the marine environment are minimised, plays an important role for its expansion. The OSPAR Background Document on Problems and Benefits Associated with the Development of Offshore Wind Farms (OSPAR 2004) identifies some of the potential advantages and disadvantages of offshore wind farms. The OSPAR Review of the Current State of Knowledge on the Environmental Impacts of the Location, Operation and Removal/Disposal of Offshore Wind-Farms (OSPAR 2006) seeks to clarify between where information and understanding is good and where it is lacking. These two documents should be read alongside this guidance to assist in the determination of what does and does not constitute an environmental impact within the specific parameters of the potential sites under investigation.

Purpose of the OSPAR Guidance

5. The purpose of this guidance note is to assist OSPAR contracting parties, developers, consultants, regulators or any other interested parties or individuals in the identification and consideration of some of the issues associated with determining the environmental effects of offshore wind farm developments. As guidance it is not a definitive set of instructions and should be read in conjunction with the other available guidance. **The potential impacts discussed within this document are not an exhaustive list nor will every potential impact need to be assessed in every location.**

6. The guidance has been structured to consider the main stages of the life history of an offshore wind farm, namely:

- Location
- Licensing
- Monitoring
- Construction and Operation
- Removal/Decommissioning

7. The Environmental Impact Assessment Directive 85/337/EEC, as amended by directives 97/11/EC and 2003/35/EC, requires an EIA to be carried out in support of an application for development consent for certain types of project as listed in the Directive at Annexes I and II. Offshore wind farm developments are listed in Annex II as *"installations for the harnessing of wind power for energy production (wind farms)"*. Whether or not Annex II projects require an EIA to be undertaken is determined on a case-by-case

examination or by criteria set by the Member State. It is, however, likely that national and international legislation will require that all offshore wind farm developments require an EIA to be undertaken. Progression through the EIA process will determine whether or not the issues identified within this OSPAR guidance are applicable or if the site(s) in question require further issues to be addressed. The EIA should cover all four aspects of the offshore wind farms life history, although given the timeframe between construction and decommissioning national regulations may require a further EIA for the removal phase.

8. EIA is essentially a predictive tool involving the systematic assessment of a project's likely significant environmental effects. The purpose of the EIA process is to ensure that all the likely effects of a development are fully understood and taken into account before a development is permitted to go ahead. The approach to EIA should be to:

(i) provide a complete and objective description of the development.

(ii) provide as complete as is possible description of the existing environment.

(iii) provide as systematic and objective an account as is possible of the environmental effects to which the project is likely to give rise.

(iv) describe and present the data gathering and interpretation that underpins the assessment of the identified environmental impacts.

(v) formulate evidence based conclusions supported by the information gathered in the EIA process in line with a precautionary approach.

(vi) provide an overview of knowledge gaps and clearly state what effect these might have on the certainty by which environmental effects can be predicted.

9. All these steps should be reported in an Environmental Statement to a level of detail sufficient to provide the public and competent authorities with a proper understanding of the importance of the predicted effects and the scope for reducing them.

Other relevant Guidance

10. Guidance on environmental impact assessment (EIA) procedures and requirements can be found at:

http://ec.europa.eu/environment/eia/eia-support.htm

These Internet pages provide guidance on:

- Screening – ISBN 92-894-1334-4 (2001)
- Scoping – ISBN 92-894-1335-2 (2001)
- Environmental Impact Statement Review – ISBN 92-894-1336-0 (2001)

Links to other relevant documents, reports and websites can be found at:

http://www.environmentalexchange.info/index.asp

11. National environmental regulatory authorities should also be consulted for EIA guidance: aligned to the national legislation in the country in which the proposed development is located; either specifically developed for offshore wind farms or produced for developments in the marine environment.

Location

12. The first stage in developing an offshore wind farm is to find a suitable location for the turbines and the associated power cables. The choice of location strongly influences both the potential environmental impacts and economic considerations. For example, a wind farm located outside bird migration routes would generally have less potential for bird collision incidents than one located within such routes. If a wind farm is due to be constructed in deeper waters far from the coast, higher costs will be incurred for the installation of foundations and the power cables to shore. Therefore, careful selection of the location is important.

What can be done to find a suitable location?

13. From the offshore wind farm developer's perspective, areas with a high wind resource, in shallower waters, with easy access to the shore and grid connections are the key drivers in site selection. However, in

coastal and marine areas there may already be a number of uses and users within areas suitable for offshore wind farm development. Tools, such as constraints mapping, are useful to build a picture of the nature and scale of use at potential offshore wind farm locations. Where in place, Strategic Environmental Assessment (under the SEA for Plans and Programmes, Directive 2001/42/EC) and/or Marine Spatial Planning can assist in identifying the nature, location and extent of these other uses, to aid in the process of selection of a suitable site and in conflict management. Besides the more common uses like navigation, fisheries, oil and gas production, telecommunications cables and sand and gravel extraction, novel uses like offshore renewable energy (wave and tidal devices) are growing in importance. Marine Protected Areas, or areas of nature conservation importance, may conflict or compete with offshore wind developments for space and should be considered when selecting a wind farm location (as should any synergies). All available tools should be used to undertake such assessments, e.g. nautical charts, Geographical Information Systems (GIS), web-based information systems, local knowledge, consultation with statutory bodies, consultation with local user groups, public exhibitions etc. In general, areas of low use and low environmental sensitivity are likely to have fewer conflicts than those of high use and high environmental sensitivity.

How can conflicts be avoided or minimised?

14. The location of a wind farm may be in conflict with a variety of interests as listed in the Table 1 below, which also includes considerations for possible minimisation measures. The table should be regarded as an overview, which does not claim to be exhaustive. Acknowledging such conflicts at the project design phase of any development can be a useful framework within which environmental considerations and design of the development can interact and any environmental assessment may identify project modifications that avoid adverse effects. Conflicts should be solved as far as possible by involving all relevant authorities and stakeholders.

Table 1. Overview of potential conflicts and considerations for minimising conflicts that may arise from an unconsidered location of an offshore wind farm.

Issue	Potential conflict	Considerations for minimisation of conflicts
Nature conservation areas including OSPAR Marine Protected Areas, Special Protected Areas or Special Areas of Conservation	Loss of area or function of area, or disturbance of biota in the protected areas	Avoid sensitive areas or ensure that the wind farm project is in line with the relevant protection and conservation targets. Decisions based on adequate temporal and spatial data.
Areas of biological or ecological interest or value (e.g. habitats of rare or threatened species)	Loss of area or function of area, or disturbance of biota in the sensitive or ecologically valuable area	Avoid sensitive and ecologically valuable areas or ensure that the wind farm project does not negatively affect the respective area and its biota
Areas of archaeological interest	Loss of areas of archaeological interest; destruction of or damage to archaeological sites	Adjust planned locations of foundations and cables; hydroacoustic/seismic surveys and evaluation of historical records in the planning phase
Navigation	Interference with free passage	As necessary avoid established shipping lanes and anchoring sites (roads); Where appropriate, make provisions for shipping within and around wind farms, subject to the agreement of the relevant safety of navigation regulatory authorities
Recreational craft (e.g. sailing boats)	Shipping restrictions	Where appropriate, make provisions for shipping within and around wind farms, subject to the agreement of the relevant safety of navigation regulatory authorities

Issue	Potential conflict	Considerations for minimisation of conflicts
Civil air traffic	Obstacle to air navigation in particular for low flying aircraft (e.g. helicopters)	As necessary avoid entry lanes
Fisheries	Loss of fishing grounds. Increased steaming time. Increased costs to fishermen. Loss of income.	Potential benefit for fish (refuge); sustainable mariculture in the area of the wind farm as a possibility; access permitted?; safety considerations for fishing vessels other users
Military practice areas (ships, submarines, aircraft)	Loss or restriction of areas	As necessary avoid areas, look for solutions at political level
Submarine gas and oil pipelines	Loss or restriction of areas available for routes; obstruction of maintenance and repairs; damage to existing pipelines	As necessary avoid pipeline routes; ensure sufficient space for maintenance or repair vessels
Submarine power and communication cables	Loss or restriction of areas available for routes; obstruction of maintenance and repairs; damage to existing cables	As necessary avoid cable routes; ensure sufficient space for maintenance or repair vessels; careful planning and performance of crossings of new and existing cables
Sediment extraction	Temporary loss or restriction of areas; disturbance of extraction	As necessary avoid licensed extraction areas; possibly temporary use of "non-active" parts of extraction site
Offshore oil and gas activities	Temporary exclusion or restriction of exploitation or exploration activities	As necessary avoid licensed areas; enable sufficient space for exploitation or exploration activities
Disposal sites for dredged material	Loss of disposal sites; obstruction of disposal activities	As necessary avoid disposal sites; use available information on disposal sites
Past disposal sites for munitions	Disturbance of past disposal sites (risk of detonation and remobilisation)	Avoid past disposal sites; use available information on sites; carry out appropriate consultation and surveys in the planning phase
Seascape	Visual impact; perception	Select location sufficient distances from shore, avoid sensitive vistas
Tourism	Restrictions to recreation	Select appropriate location
Scientific research	Restrictions for scientific research	As necessary avoid areas where long-term scientific research takes place; ensure where adequate the possibility to carry out scientific research

15. In cases where competing or conflicting uses are identified within an area, this does not mean that this area is automatically unsuitable for the construction of an offshore wind farm. Where such conflicts arise attempts should be made to find reasonable solutions allowing a combination of both uses or to assess the relative importance/value of each use. National regulatory frameworks will determine how such conflicts can be resolved but a useful guide will be to ensure an open dialogue between all stakeholders, throughout the

site selection process, to ensure that all potential conflicts are identified and discussed early in the process. Socio-economic studies may also be required to assist the national regulatory bodies to reach a decision.

Assessment of the suitability of a location for offshore wind farms with regard to environmental factors

16. For the assessment of potential environmental impacts, biotic and abiotic information on the "natural" (pre-construction) environment is essential. The Environmental Statement produced through the EIA process is the information base on which national regulatory bodies will make a decision on whether or not to permit an offshore wind farm, through considering issues like the suitability of the location(s) assessed. Where a planned project, either individually or in combination with other plans, is likely to have a significant effect on Special Areas of Conservation (SAC) under the Habitats Directive (92/43/EEC) or Special Protection Areas (SPA) under the Birds Directive (79/409/EEC) an appropriate assessment of its implications is necessary in the light of the site`s conservation objectives. If it is likely that a project will have significant effects on the environment of another state, this state should be notified about the planned activity and where required the state of origin shall enter into consultations with the affected state (Article 7 of Directive 97/11/EC amending the EIA Directive).

Biotic factors

17. In order to assess the suitability of an offshore wind farm location with respect to the biological features to be protected, the relevant basic information (e.g. spatial distribution and temporal variability) should be made available for benthos (epifauna, infauna, macrophytobenthos), fish, mammals (e.g. harbour porpoise) as well as resident, migratory, resting or feeding birds (including any combination of these parameters).

18. Through extensive preliminary surveying and/or the use of existing data (if of relevance) for a location, the site characterisation in terms of spatial and temporal distribution of habitats and species, especially Red List species, can be identified and mapped. Information on critical habitats, such as spawning grounds, breeding, moulting and feeding habitats, and migration routes also needs to be gathered.

19. Such surveys and data gathering should follow certain guidance/standards with regards to gear, frequency, methods etc. in order to ensure harmonised and comparable data sets for authorities and industry. Some examples of such guidance/standards include:

- Surveys and monitoring at the Danish demonstration offshore wind farms Horns Rev and Nysted, www.hornsrev.dk and www.nystedhavmoellepark.dk
- Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the UK. Report COWRIE-BAM-02-2002, April 2004

  http://www.offshorewind.co.uk/Downloads/1352_bird_survey_phase1_final_04_05_06.pdf

  Standard Investigation of the Impacts of Offshore Wind Turbines on the Marine Environment (StUK 3), February 2007 (Germany)

  http://www.bsh.de/en/Products/Books/Other_publications/Stuk-eng.pdf
- Offshore Wind Farms – Guidance note for Environmental Impact Assessment In respect of FEPA and CPA requirements. Version 2 – June 2004 (UK)

  http://www.cefas.co.uk/publications/files/windfarm-guidance.pdf
- Nature Conservation Guidance on Offshore Windfarm Development – A guidance note on the implications of the EC Wild Birds and Habitats Directives for developers undertaking offshore windfarm developments. March 2005. Defra (UK)

  http://www.defra.gov.uk/wildlife-countryside/ewd/windfarms/windfarmguidance.pdf
- Investigation into Best Practice Guidance for the Use of Remote Techniques for Observing Bird Behaviour in Relation to Offshore Windfarms (UK)

  http://www.offshorewindfarms.co.uk/Research/ResearchAreas/RemoteTechniques.aspx

20. However the national regulatory authorities within the country in which the development is proposed should be contacted for specific guidance in survey design. The use of some survey techniques, e.g. side scan sonar or sub-bottom profilers may have effects on marine organisms so guidance should be sought from the regulatory authorities on the appropriate and safe operation of these prior to their use.

21. The preliminary surveys should in particular provide information on spatial and temporal distribution and habitat use of:

- marine mammals (seals and cetaceans) nursery grounds, haul-out areas etc;
- sea birds, wintering, resting, feeding and moulting areas;
- migrating birds (especially species with high conservation status), migration routes and areas of high migration activity;
- bats, e.g. migration routes and areas of high migration activity;
- fish species (commercial and non-commercial), e.g. nursery grounds and spawning areas and protected and Red List species;
- macrozoobenthos and phytobenthos with special focus on protected habitats (e.g. reefs and sandbanks and other habitat types according to the Habitats Directive) and protected and Red List species.

22. It is recommended that the preliminary survey for a location is set out in a way which will ensure that the collected data can be used as a baseline for subsequent monitoring of the effects of the construction, operation and removal phases of the offshore wind farm. However, depending on the timeframe between the date of such surveys and the construction, sample replication, the spatial and temporal coverage and the results of the characterisation surveys, additional baseline data for monitoring purposes may be required. The approach to all monitoring should be to define a clear rationale on which the survey can be designed and to follow the Before and After / Control and Impact Analysis (BACI) approach. In this regard setting up and surveying reference or control areas is recommended.

Abiotic factors

23. Abiotic properties of a site for the assessment of environmental impacts and for engineering considerations in respect of the prospective location include, but are not limited to,:

- the sediment characteristics (structure, topography, mobility, sediment transport) of a prospective location should be established since this is important basic information for characterisation and baseline surveys (e.g. planning of benthos investigations). The sediment characteristics can be ascertained by grab sampling and hydroacoustic methods (e.g. side scan sonar);
- bathymetry and geomorphology need to be taken into account;
- information on the geological/geophysical structure at the site is important for an assessment of the general suitability of the location in the planning phase. The soil property data should be available well in advance of the beginning of turbine installation. Information on the soil properties is a technical prerequisite for the stable construction of the foundations of offshore wind turbines, thus ensuring the structural integrity and safety of the installation;
- for safety and environmental reasons information on the prevailing wind speeds, hydrographic conditions (e.g. currents, wave heights) and if applicable ice conditions should be assessed.

Licensing

24. Once possible location(s) for offshore wind farms have been identified the detailed process of identifying, predicting the level and assessing potential environmental impacts can begin. This section deals with the licensing process and decision-making on whether or not to consent an offshore wind farm development and what if any conditions may be required to minimise and/or mitigate effects and to monitor predictions.

25. As mentioned elsewhere in this guidance it is likely that an environmental impact assessment (EIA) is likely to be necessary for all offshore wind farm developments. However, contracting Parties should agree on characteristics or thresholds that help determine whether a project is to be subject to an EIA (screening), e.g. a specific number of turbines, area etc. The applicant should be required to investigate and assess the area of the planned project in accordance with the agreed standards of EIA. It is advisable that an EIA scoping request is circulated for consultation to engage stakeholders and to identify key issues and the availability of relevant data sets. The gathering of environmental data for an EIA could take at least 2 years. General guidance on EIA Screening can be found in – ISBN 92-894-1334-4 (2001) and EIA Scoping at ISBN 92-894-1335-2 (2001). Much of the data collected and assessed at the site selection stages described in the preceding section on LOCATION will be of relevance and included in the environmental impact assessment.

Minimum criteria to be considered in environmental impact assessments (EIA)

Objectives

26. The objectives of an environmental impact assessment is to give the approval authority an information base for determining the consequences that a project might have for the environment, which have to be considered in granting an approval. EIA is a process and the outputs are reported in an Environmental Statement (ES) and Non-Technical Summary. It is the purpose of the ES to provide for a proper understanding by the public and competent authorities of the importance of the predicted effects, and the scope for reducing them. The ES should assist the promoter to define the construction that is to be preferred, identify and assess the associated environmental impacts and inform the public in order to facilitate their contribution to the decision-making process. The environmental features that may be affected are flora (sea grass, macroalgae etc) and fauna (fish, benthos, birds and mammals), water, soil (sea bed, sediment and associated features such as sandbanks), landscape, human-beings and cultural heritage. Therefore the applicant should investigate the area in order to:

a) determine and assess the spatial distribution of such features, their temporal variability (where applicable) and their condition (characterisation studies);

b) describe the effects that the construction, operation and eventual decommissioning of the wind turbines, cables, scour protection and all infrastructure might have on these features;

c) investigate and assess the actual utilisation/exploitation of the area and any conflicts that may arise;

d) investigate and assess the sensitivity of the natural resources of the area;

e) assess any cumulative effects and any impact interactions a project might have with other projects, whether wind farms or other types of construction or activity, that have been, or will definitely be, carried out in the near future;

f) consider alternative locations for the placement of the wind farm (or individual turbines) and cables.

27. Preparation of an ES in parallel to project design can be a useful framework within which environmental considerations and design of the offshore wind farm construction programme can interact and the environmental assessment may identify project modifications that avoid adverse effects.

28. If an appropriate assessment is due under the Birds Directive (79/409/EEC) or the Habitats Directive (92/43/EEC) the EIA should contain sufficient information for this to be completed by the competent authority. If not additional data may be required to undertake the appropriate assessment.

Potential adverse impacts

29. Concerning the possible impacts of offshore wind farms on the marine environment, various risks during the construction and operation phases are relevant, e.g. bird collision, loss of habitat, disturbance of benthos, fish and sea mammals. The OSPAR 2004 and 2006 publications provide a detailed overview of these potential effects.

30. Examples of potential impacts include:

- **Sediment dynamics**

  The interaction of the foundation and hydrodynamics may lead to modifications in seabed morphology, sediment dispersion and movements.

- **Impacts on infauna, epifauna and vegetation**

  The subsurface structures and the scour protection can increase the habitat heterogeneity and change the native benthic communities at the turbine sites, e.g. from typical 'soft' sediment infauna communities to hard bottom communities and the benthic community may furthermore change in abundance and biomass, which in turn may create possible effects further up the food chain.. The construction and operation of an offshore wind farm can create noise that may impact benthic organisms.

- **Impacts on fish**

  The establishment of an offshore wind farm can lead to changes of natural habitat for fish communities by the introduction of artificial physical structures. The new structures (*e.g.* foundations and scour protection), can also attract fish species, the precise reasons are unclear but could include: food or shelter against predators and strong water currents. This can have long-term effects on the distribution and composition of the fish communities and the abundance and diversity of different fish populations within and around the wind farm.

  The power from the offshore wind farms is transported from each turbine by an array of cables and to the shore through a series of power cables, whilst the shielding for such cables prevents any losses the operational cables do emit magnetic induced electric fields. These electromagnetic fields are sensed by some fish species (notably the elasmobranchs), and as such the power cables may have an impact on the behaviour and migration of the fish fauna in the areas traversed with cables.

  The construction and operation of an offshore wind farm can create noise that may impact marine fish, of particular concern are pile driving noise effects on fish spawning and other sensitive life cycle stages.

- **Impacts on marine mammals**
  The construction and operation of an offshore wind farm can create noise that may impact marine mammals. Important parameters are peak pressure, received energy (received sound pressure level), signal duration, spectral type, frequency (range), duty cycle, directionality, and signal rise times. Possible effects on marine mammals can be divided into behavioural disturbance (including displacement), masking, and injury either as temporary threshold shift (TTS), permanent threshold shift (PTS), or other injuries such as tissue damage and, in extreme cases, death if the animal very close to pile-driving activities.

- **Impacts on birds and bats**

  The potential for offshore wind farms on birds and bats are broadly synonymous. Offshore wind farms may present hazards to birds at sea. They may represent a barrier to movement of migrating or feeding birds and may potentially result in displacement of migration routes and displacement of feeding birds. Such displacements may incur heavier energetic costs, which may ultimately affect survival or breeding success. The behavioural avoidance of the wind farm area could also potentially result in effective habitat loss.

  The risk of bird mortality through collision with turbines needs to be assessed at a site and species-specific level.

  Shipping and aircraft traffic (in particular helicopters) and operational noise associated with offshore wind farm activities has the potential to disturb roosting, moulting and foraging birds. Irregular sailing routes, flying routes and flying heights have the potential to cause a greater disturbance on birds than regular sailing routes, flying routes and heights.

- **Impacts on other users**

  Offshore wind farms may have adverse impacts or interfere with other legitimate uses of the sea, *e.g.* recreational beaches, human divers, sailing, navigation routes, fishing, military activities *etc*. It is therefore essential that the type, scale, frequency and location of such activities are identified in the EIA procedures and that the impacts on these from all aspects of the construction and operation of the offshore wind farm are assessed.

  The ES should consider mitigation measures that will prevent, reduce or compensate possible adverse impacts.

Precautionary approach

31. In order to enable prediction of effects and to avoid large-scale substantial impacts, the results of monitoring should provide a rapid feedback if effects are detected.

Landscape and risk analysis

32. A visualisation of the impact of the wind farm on the landscape should be prepared for projects planned within a range visible from the coast (e.g. by computer simulation or photomontage). Experience has shown that offshore wind farms can be visible over 20 miles away but that such visibility is wholly dependant on weather and light conditions.

33. A risk-analysis assessing the probability of a ship collision with a wind farm, both with and without accidental pollution (worst case scenario), should be carried out and presented to the approval authorities as part of the ES. This would only be necessary where, due to specific conditions (*e.g.* navigable water depth, usage), there may be a risk of such an incident.

Main requirements to be fulfilled by an offshore wind farm

34. Once completed the application(s) to construct and operate an offshore wind farm along with all supporting information (including the Environmental Statement and all supporting technical reports if required by the national regulations) will be submitted to the approval authorities for consideration. When considering an application to construct an offshore wind farm the approval authority should pay due regard to the following:

No endangerment and obstruction of shipping and aviation

35. The safety of shipping and aviation should not be compromised by wind farms and the impact of wind farms on the efficiency of shipping and aviation should be minimised. Therefore the approval authority should develop requirements to be met by, and measures to be applied to, the project, such as regulations or guidance on lighting requirements for wind farms, safety distances to shipping routes, safety zones around the turbines / wind farm, activities permitted within wind farms etc., that are appropriate to reduce the risk of possible collisions of vessels with wind turbines as well as the risk of other possible damage.

No hazards to marine environment

36. The erection, operation and removal of wind turbines should not endanger the quality of the water and air or the conservation of the species using the impacted area as their habitat. This also includes cumulative effects and any impact interactions a development might have with other projects. Disturbances of sedimentary or hydrodynamic processes that have a significant impact should be prevented.

37. The threat of marine pollution that might be caused by any hazardous substances originating from the construction or operation of wind turbines should be prevented. The risk of the release of pollutants caused by the collision of a ship with a wind turbine should be reduced to an acceptable minimum. Provision, therefore, has to be made to prevent collisions and for minimising the impact of pollutants on the sea and coastline.

No hazards to birds

38. The construction and operation of a wind farm should not endanger birds. Birds may be affected by loss of habitat, *e.g.* in connection with resting and foraging, in areas where wind farms have been constructed. They may also be killed or injured by collisions with the installations. Wind farms may be a barrier for birds on their long-distance migrations or on their flight from feeding grounds to resting or

breeding grounds. The EIA provides the basis to evaluate the impact of the specific project on birds. The impact on the population level of a species of the specific wind farm as well as the impact on the number of birds and the characteristics of the species should be investigated and considered.

Other interests/uses of the sea

39. Other interests or uses of the sea and seabed that are likely to be affected by the project (e.g. tourism, military activities, commercial fisheries, landscape, conservation) should be considered in the procedure.

Aspects of licensing procedures for offshore wind farms

40. It is advisable that licensing procedures for offshore wind farms include the following items:

Involvement of other authorities

41. The approval authority should forward the application and supporting documents to the full range of other authorities who, by reason of their specific responsibilities, are likely to be concerned by the project (*e.g.* local authorities, authorities responsible for safety of navigation, nature conservation, cables and pipelines, military, fisheries, submarine exploitation of the seabed *etc)* and should ask them for their comments within a reasonable timeframe.

Involvement of the public/stakeholders

42. The approval authority should make the application documents available for public consultation for a reasonable period of time and should ensure that this fact is published in regional and national newspapers. The public should be given the opportunity to comment in writing on the planned project within a reasonable timeframe, including the public affected or likely to be affected by, or having an interest in, the planned project and relevant non-governmental organisations, such as those promoting environmental protection, commercial or recreational shipping, fishing, energy from renewable sources or any other interested individuals.

Involvement of the authorities of a neighbour state

43. Where the approval authority considers that the implementation of a project is likely to have significant effects on the environment of the territory of another state (including maritime areas under the jurisdiction of that state) the latter should be notified of the project. The potentially affected state should respond to the approval authority acknowledging receipt of the notification and indicate whether it intends to participate in the procedure. If the potentially affected state desires to participate in the procedure or in transboundary consultations, the approval authority should forward the application documents to the competent authority in that state and ask for its comments within a reasonable period of time.

Licensing decision

44. The approval authority will need to review and evaluate the application and all supporting environmental information in order to reach a decision on whether or not to licence an offshore wind farm. In reaching this decision consideration should be given to the effects associated with the construction and operational phases of the development and how these impact the physical and biological parameters identified in the ES. If the approval authority considers that insufficient evidence is provided within the ES it should notify the applicant of the deficiencies and request that further information be provided. Where a potential adverse effect is identified possible mitigation and compensation measures should be considered. Decisions on whether or not to consent could have the following outcomes:

- Refuse consent (impacts deemed to be unacceptable)
- Issue consent (impact or impacts deemed to be acceptable)
- Issue consent with conditions (impacts deemed acceptable if appropriate mitigation measures utilised)

45. When setting conditions the approval authority should ensure that these are proportionate, achievable and enforceable. Due consideration should also be given to the removal phase.

Monitoring

46. Monitoring programmes should be developed for those impacts identified through the EIA and national licensing procedures as requiring further study. In the most part such monitoring will be required to validate predictions on impacts made through the EIA process and to review the impacts of a specific activity or development with regards to the need for mitigation.

47. It is recommended that the surveys undertaken for the EIA are set out in a way which will ensure that the collected data can be used as a baseline for subsequent monitoring of the effects of the construction and operational phases of the offshore wind farm. However, depending on the timeframe between the date of such surveys and the construction, sample replication, the spatial and temporal coverage and the results of the characterisation surveys - additional baseline data for monitoring purposes may be required. The approach to all monitoring should be to define a clear rationale on which the survey can be designed and to follow the Before and After / Control and Impact Analysis (BACI) approach.

48. The monitoring area should comprise the planning or construction area, including the inter-array and export cables, and the reference area. The individual environmental features that may be affected require different areas in terms of size and location. Reference areas should be used for comparison, where applicable, to document the development of the environmental features that may be affected without the impact of wind turbines. The reference areas should, as far as possible be located outside the planning area and their natural ambient conditions should correspond to those of the planning area.

49. Comprehensive monitoring programmes during construction and operation will provide information on effects and thereby help future developers minimise potential impacts. However, it is important that all such monitoring has a clear purpose in order to provide answers to specific questions where significant environmental impacts have been identified. Such questions are most likely to derive from the environmental impact assessment. Once sufficient evidence is available, either from the site in question or from other sites, it will not be necessary to continue monitoring that issue. This should assist an efficient use of resources to only target those issues of concern. The data requirements for any monitoring programme should be agreed with the competent authority. The collection of data should provide the competent authorities with the information necessary to carry out an appropriate level of assessment. Monitoring should follow clear standards with regard to parameters, methods etc. and testable hypotheses in order to generate comparable sets of data for both authorities and industry.

Construction and Operation

Introduction

50. If the decision is taken to licence the development of an offshore wind farm, as long as appropriate conditions are added, then this is under the premise that the impacts associated with the construction and operation are deemed acceptable if appropriate mitigation measures are utilised.

51. Such conditions should be used to manage the construction activities and operation to limit any potential impacts to within the acceptable limits determined at the EIA and licensing stage. Mitigation measures could include: applying noise mitigation measures (*e.g.* bubble curtains, insulation piles), scheduling construction and maintenance works to avoid sensitive life-cycle stages (*e.g.* fish spawning); defined routes for vessels involved in construction and maintenance to avoid important bird habitats; recovery of any debris or lost material associated with the construction and operation; notices to mariners on the timing and position of the construction, maintenance and monitoring activities; using cable laying techniques that minimise seabed disturbance and therefore any increases to turbidity; burying cables to sufficient depths to avoid re-emergence; basing the need and type of scour protection on local conditions etc.

Guidance on construction and operation of offshore wind farms

52. This document provides high-level guidance to identify the types of issues that require consideration. The remainder of this section considers the construction and operation phases separately. The scale and scope of any monitoring, mitigation and compensation measures will be dependent on the site-specific requirements as identified by the environmental impact assessment. Fewer or additional issues, than those described in this guidance, may require investigation dependant on the outputs of the environmental impact assessment process and the national regulations. The scope of any monitoring programme should be agreed

with the competent authority. Where the environmental impact assessment and permit conditions dictate, the issues to consider may include the following:

Construction

53. Potential effects and mitigation measures associated with the construction of an offshore wind farm could include:

Disturbance from construction vessels and equipment

54. Movements of vehicles, vessels, machinery and personnel during construction could have a disturbing effect on the resident biota (*e.g.* wintering/roosting, moulting and foraging birds; marine mammals) or human population. If the level of disturbance is likely to have a significant effect on birds or marine mammals, management rules should be considered to schedule the timing and routes to avoid sensitive locations and times. Helicopters, in particular, can have a large disturbing effect on biota and if used special rules on their operations should be agreed with the regulatory authorities.

55. Shipping and aircraft traffic associated with the construction works also has the potential to interfere with ordinary shipping and aircraft routes. Therefore, accident and collision risks with ordinary shipping and aircraft traffic during the removal phase should also be considered.

56. To avoid accidents/collisions with ordinary shipping, the position and co-ordinates of the construction area should be announced officially in good time before taking up the work. In addition, during construction and activities, the area should be made safe, e.g. by means of illumination at night. Keeping a permanent watch on shipping in the vicinity of the wind farm area (both visually and by radar) can reduce collision risks. This may be done (for example) by using a traffic-security vessel (standby vessel) throughout the entire construction phase.

Chemical pollutants

57. All chemicals, paints, coverings etc used in the construction should be approved for use in the marine environment and their ecotoxicological properties known. It is important that all storage areas for chemicals (whether on land, vessels or other structures) are appropriately bunded (such bunds should be a minimum 10% greater than the volume of all chemicals to be stored). All vessels and equipment should be checked and maintained to an approved standard and where necessary certified for the task to which they are employed. Such measures are required to reduce the risk of chemical pollution incidents. It is advisable that pollution control and remediation measures are described in a plan.

Construction noise impacts

58. Aspects of the construction works are known to be noisy (*e.g.* pile driving) and at levels detectable by certain species of fish and marine mammals. In order to protect the populations of species that may be adversely affected by such noise certain activities should be scheduled to avoid these sensitive times, e.g. fish spawning, seal pupping etc.

59. Appropriate noise mitigation measures should be applied, *i.e.* if there is likely to be a significant environmental impact arising from the construction works best available techniques for avoiding noise and, where noise is unavoidable, best available techniques and/or best environmental practice for noise reduction (*e.g.,* for reducing the propagation of noise) should be employed, so that critical levels would not be exceeded. In particular, explosives should, not be used unless other options are not possible. The use of soft start/ramp up procedures for pile driving may reduce the risk of fatalities and physical injury. It may be necessary to employ trained marine mammal observers and/or acoustic monitoring devices (e.g. hydrophones) to track the presence of mammals in the vicinity of the construction works to advise on start up to minimise disturbances.

60. In addition, before carrying out activities resulting in sound levels likely to be harmful to marine mammals, appropriate measures should be taken to minimise any effects on marine mammals that may be present in the work area. 'Pingers' and 'seal scarers' may be used for a certain period of time before starting the noisy operations, if they are proven to be effective and safe, however, the use of such devices will need to be agreed with the national competent authorities.

61. When carrying out construction works resulting in intensive sound levels, acoustic monitoring (measurement of the underwater background noise and construction noise) should be carried out systematically during the construction phase. Where it is necessary to measure noise, internationally recognised standards should be used for the configuration of measurement devices and for the parameters to be measured.

Increased turbidity

62. Some aspects of the construction works, e.g. cable burial, drilling, ground preparation works for Gravity-base foundations etc, have the potential to disturb sediments and in turn increase turbidity. Where there are sensitivities, e.g. adjacent shellfish beds, fish spawning grounds, feeding grounds for birds (e.g. visual hunters like terns) etc it may be necessary utilise techniques that reduces this risk. Possible options include: controlling the use of jetting, use of bubble curtains, sediment traps, undertaking such activities in slack water (or on a tide that moves material away from the sensitive location) etc.

63. Monitoring of the turbidity during construction may be required depending on the background levels of turbidity and the construction techniques being used. In this regard, the ICES Guidelines for the Management of Marine Sediment Extraction should be taken into account. Furthermore, monitoring of the effectiveness of the techniques utilised should be considered, especially at the beginning of the construction phase, so that the techniques used can be modified if necessary. Monitoring should follow clear standards with regard to parameters, methods etc. in order to generate comparable sets of data for both authorities and industry.

Safety to mariners

64. It is important that mariners are given sufficient notice and warned of the timing and locations of all construction works. To prevent the risk of snagging cables should be appropriately fixed to the seabed or buried so as to prevent re-emergence and hazards to vessels. Optimum cable burial depths should be determined by appropriate geophysical surveys and an assessment of anchor and gear penetration depths. The use of cable protection wherever cables are on the surface of the seabed should be designed and the materials chosen so as to minimise risks to mariners' vessels. Installations should be appropriately marked and lit in line with national and international maritime standards.

Procedure in case of emergencies

65. Contingency plans should be drawn up in order to permit rapid and adequate responses if there is a breakdown, accident or other emergency during the construction phase. Such contingency plans should be drawn up in consultation with those who are responsible for national responses to shipping accidents. The website of the Bonn Agreement (www.bonnagreement.org) is a potentially useful source of information in this field.

66. In particular, response teams should be notified of crucial phases of the construction work to ensure that they are appropriately equipped and prepared for immediate response to emergencies such as hydrocarbon spills.

67. If a release of a pollutant takes place as a result of an emergency, the relevant national authority should be informed immediately. The contingency plans should identify which national authorities are relevant.

Visual effects

68. No mitigation measures currently available.

Loss or change of habitat

69. Consideration could be given to designing foundations, scour protection etc that may either enhance or maintain marine habitats depending on national management objectives. Where possible the construction should be designed and planned to reduce the footprint of disturbance on the sea bed, *e.g.* only install scour protection if the structural integrity of the foundations are at risk.

Waste and debris

70. Waste will be generated during the construction activities. The OSPAR Convention bans the dumping at sea of such waste (except dredged material and inert material of natural origin). The waste should be properly disposed of on land, taking into account the waste management hierarchy of avoidance, reduction, re-use, recycling, recovery, and residue disposal.

71. A "Hazardous and Noxious Substances List" should be drawn up of the different fluids and other soluble substances to be used in the construction or integral to the operation of the structures. This should describe their physical, chemical and ecotoxicological properties and the quantities used.

72. Arrangements should be made so that, if any pollutant is released, the relevant national authority is informed immediately.

73. Any floating or sunken objects which are accidentally introduced into the sea during construction should be removed.

74. After completion of the constructional operation, the wind farm site should be surveyed in order to identify any debris located on the sea-bed. Debris should be recovered and disposed of on land.

Illumination

75. Lighting will be required both for carrying out construction work and for safeguarding the "work site". Potential effects of lighting on bird movements should be considered and appropriate mitigation measures should be taken.

Timing of construction works

76. If the work area is of ecological significance, schedules for construction work should, if they are likely to have a significant environmental impact, avoid sensitive periods such as bird migration, breeding and nursing of marine mammals and spawning of fish to the extent possible.

Effectiveness of good practice

77. Monitoring the effectiveness of the techniques utilised should be considered, especially at the beginning of the construction phase, so that the used techniques may be modified if necessary. Monitoring should follow clear standards with regard to parameters, methods *etc.* in order to generate comparable set of data for both authorities and industry.

Operation

78. Potential effects and mitigation measures associated with the operation of an offshore wind farm could include:

Disturbance from maintenance vessels and equipment

79. Movements of vehicles, vessels, machinery and personnel during maintenance and repair operations could have a disturbing effect on the resident biota or human population. It may therefore be necessary to schedule the timing and routes to avoid sensitive locations and times.

Scouring and scour protection

80. No mitigation measures are currently available for the effects of scouring. Any material used for scour protection should be free of chemical contaminants with minimal fines content. The need, type and grade of material should be assessed based on local conditions.

Chemical pollutants

81. All chemicals, paints, coverings etc used in the maintenance and repair should be approved for use in the marine environment and their ecotoxicological properties known. It is important that all storage areas for chemicals (whether in the nacelles, substation or on land, vessels or other structures) are appropriately bunded (such bunds should be a minimum 10% greater than the volume of all chemicals to be stored). All vessels and equipment should be checked and maintained to an approved standard and where necessary certified for the task to which they are employed. Such measures are required to reduce the risk of chemical pollution incidents. It is advisable that pollution control and remediation measures are described in a plan.

Electric and magnetic fields

82. There is a possibility that the electric and magnetic fields associated with offshore wind farm power cables may affect some species of fish, *e.g.* elasmobranchs. Research into these effects is ongoing, current mitigation measures include appropriate choice of cable types, separation and burial depths.

Temperature

83. There is a possibility that the heat emission to the sediments associated with offshore wind farm power cables may affect some benthic species. Further investigation of this is required. Temperature rise, especially of the upper layers of seabed sediments, can be reduced to an acceptable level if cables are buried to sufficient depths.

Operational noise effects

84. No mitigation measures currently available.

Birds – collision

85. Site selection is important to minimise impacts, including avoidance of important bird habitats and migration routes. Consideration should be given to the operation, marking and lighting of the wind farm to reduce bird collisions (within navigational and operational safety limits). No other mitigation measures currently available.

Barrier effects on fauna

86. Site selection is important to avoid important habitats, and migration routes. No other mitigation measures currently available.

Visual impact and public perceptions

87. Stakeholder engagement and gauging public perceptions is an important part of the licensing process. No mitigation measures currently available.

Safety to mariners

88. Installations and all infrastructure should be appropriately marked and lit in line with national and international maritime standards.

Removal and Decommissioning

Introduction

89. The removal phase normally starts at the end of the lifetime of an offshore wind farm or offshore wind turbine (OWT). OWT may also have to be removed when they are no longer operational for example due to damage. Also the expiry or withdrawal of an approval or its premature termination (*e.g.* due to insolvency of the developer) may require the removal of a wind farm if no alternative operators are forthcoming. After the wind farm components have been removed, one has to care about their subsequent disposal (in the sense of re-use, recycling and final residue disposal on land) - so both phases are in close connection.

90. For removal and subsequent disposal of a wind-farm, the following main components should be addressed:

- wind installation comprised of rotor (with blades and hub), nacelle (containing e.g. rotor shaft, gear, generator, cooling units (containing oil)), tower and foundation (*e.g.* monopile, tripod, gravity based);
- scour protection materials;
- interconnecting power cables within the wind-farm;
- power cable to shore;
- converter stations with technical equipment and foundation.

International obligations for removal and disposal

91. The following paragraphs should be considered as general prerequisite for further considerations about removal and disposal.

92. In accordance with international obligations, abandoned or disused offshore installations have to be removed. The basis for this obligation is the principles given in Article 60 of the United Nations Convention on the Law of the Sea[2]. In this connection, the IMO adopted in 1989 "Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone". Furthermore, the OSPAR Commission adopted in 1998 a legally binding regulation for the disposal of disused offshore oil and gas installations (OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations).

93. In line with OSPAR's policy on waste disposal at sea, the removed components of a wind farm should generally be disposed of entirely on land taking into account the waste management hierarchy of avoidance, reduction, re-use, recycling, recovery, and residue disposal. If the competent national authority decides that a component of the wind farm should remain at site (*e.g.* parts of the piles in the sea-bed, scour protection materials), it should be ensured that they have no adverse impact on the environment, the safety of navigation and other uses of the sea. The status of remaining parts should be monitored and if necessary, appropriate measures should be taken.

94. In Germany, approvals specify for example:

> [...] the installation shall be removed and properly disposed of on land, for which evidence shall be provided. [...]Any components of the foundation placed in the seabed shall be cut at such a depth below the surface of the seabed that the remaining parts do not pose a danger for shipping or for fishing vessels, even if sediments should become relocated.[...].

95. If parts of the installations will remain in the sea-bed, they may pose a risk to e.g. navigation. The appropriate cutting depth depends on the prevailing natural sediment dynamics at site. In order to ensure that sediment movement does not bare such remaining foundation parts so that they protrude above the sea-bed, it is necessary to monitor the site, *e.g.* with side scan sonar.

96. In line with the polluter pays principle, the licensee or, if deemed appropriate, other suitable body should ensure that adequate financial reserves (*e.g.* bonds) are available to enable the appropriate removal and subsequent disposal on land (in the sense of the waste management hierarchy). Furthermore, the licensee should bear any costs for necessary monitoring of the status of components which remain at site and cost for any associated necessary measures.

Assessment of the environmental impact of the removal of offshore wind farms

97. The operation of offshore wind farms often has just started or is still in the planning phase and the operational life-span of a wind farm is estimated to be in the order of some decades. Therefore, one cannot expect concrete information on environmental impacts to be already available. However, it is assumed that many impacts that may occur in the removal phase are similar to those in the construction phase (see paragraphs 53 to 77).

98. Potential environmental impacts are strongly dependent on the removal techniques. It is expected that techniques to remove offshore installations will evolve over the coming decades, in particular in context with the removal of disused offshore oil and gas installations. The removal of offshore wind farms will certainly benefit from such experiences. In order to avoid or mitigate impacts on the environment, best available techniques should be used for the removal, taking into account research on potential impacts on the marine biota and research on mitigation measures. As a general rule, removal should be performed in such a way that adverse effects upon the marine environment as well as navigation and fishing do not occur.

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[2] Article 60 (3) of the United Nations Convention on the Law of the Sea, 1994:
[...] Any installation or structure which is abandoned or disused shall be removed to ensure safety of navigation, taking into account any generally accepted international standards establish in this regard by the competent international organization. Such removal shall also have due regard to fishing, the protection of the marine environment and the rights and duties of other States. Appropriate publicity should be given to depth, position and dimensions of any installation or structure not entirely removed.

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