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STRATEGIC ENVIRONMENTAL ASSESSMENT IN CONNECTION WITH LICENSING ROUNDS WEST OF 6° 15' E IN THE DANISH PART OF THE NORTH SEA FOR EXPLORATION AND PRODUCTION OF HYDROCARBONS, AND LICENSING OF PERMITS FOR INJECTION OF CO<sub>2</sub> IN EXISTING OIL FIELDS FOR THE PURPOSE OF EOR.

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APPENDIX 2. PRELIMINARY NATURE IMPACT ASSESSMENT,  
ACCORDING TO THE EU HABITATS DIRECTIVE

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## **1. IMPACT ASSESSMENT, ACCORDING TO THE EU HABITATS DIRECTIVE**

The Danish Energy Agency (DEA) has compiled an environmental report entitled "Strategic environmental assessment in connection with licensing rounds west of 6° 15' east in the Danish part of the North Sea for exploration and production of hydrocarbons, and licensing of permits for injection of CO<sub>2</sub> in existing oil fields for the purpose of EOR", July 2012.

In accordance with the Danish Act on Environmental Assessment of Plans and Programmes, see Consolidated Act No. 939 of 3 July 2013/6/, public authorities' plans and programmes laying down frameworks for future installations or area uses must be environmentally assessed whenever the authority considers that the plan or programme may have a significant impact on the environment. To comply with this, the DEA must produce a strategic environmental assessment in connection with licensing rounds west of 6 minutes 15 degrees east in the Danish part of the North Sea for exploration and production of hydrocarbons, and licensing of permits for injection of CO<sub>2</sub> in existing oil fields for the purpose of EOR.

Since the plan for licensing rounds for exploration and production of oil and gas, as well as separate licensing rounds for permits for injection of CO<sub>2</sub> in existing oil fields for the purpose of EOR is not covered by the Danish Executive Order on Habitats /1/, it has been chosen to conduct a preliminary impact assessment with reference to the EU Habitats Directive, Article 6(3) /2/, which deals with all plans (and projects) that are not necessary or directly linked to the management of Natura 2000 areas.

When drawing up a plan for licensing rounds west of 6 degrees 15 minutes east in the Danish part of the North Sea for exploration and production of hydrocarbons, and licensing of permits for injection of CO<sub>2</sub> in existing oil fields for the purpose of EOR, a preliminary nature impact assessment will therefore be conducted on the basis of the EU Habitats Directive in order to assess whether the plan may result in significant impacts on the designation basis in Natura 2000 areas.

If a preliminary assessment does indeed show that there is a risk of one or more Natura 2000 areas being significantly affected, under the EU Habitats Directive a more comprehensive nature impact assessment must be prepared, including an assessment of the impact on the integrity of the areas /2/.

Under Article 12 of the EU Habitats Directive /2/ there is an obligation to introduce and safeguard a strict protection scheme in respect of Appendix IV species. The potential effects in connection with the plan for licensing rounds west of 6 degrees 15 minutes east in the Danish part of the North Sea for exploration and production of hydrocarbons, and licensing of permits for injection of CO<sub>2</sub> in existing oil fields for the purpose of EOR have therefore been assessed at an overall level as well.

### **1.1. Method and scoping**

The various activities connected with the exploratory surveys, exploration and production of oil and gas, and decommissioning of installations, as well as activities connected with injection of CO<sub>2</sub> in existing oil fields with a view to EOR are examined below. For more in-depth descriptions, please refer to the environmental assessment (Appendix 1). This is the basis used to describe the potential impacts on Appendix IV species and Natura 2000 areas.

## 2. ACTIVITIES

Activity	Description
<b>Seismic surveys and other exploratory surveys</b>	<p>Seismic surveys will be carried out to obtain knowledge about the geological structures under the seabed. They will be used for both exploratory purposes and during the production phase (3D/4D seismics) to monitor developments in the oil-producing reservoir, to allow production to be optimized.</p> <p>Seismic surveys in the oil and gas industry offshore are conducted with the aid of air guns fitted to the exploratory vessel or drawn behind it. The air guns emit regular sonic pulses, which are reflected off the seabed and from geological strata beneath the seabed. The reflected pulses are picked up by a large array of microphones drawn behind the exploratory vessel in a series of parallel cables. In some cases the cables can also be laid on the seabed. The sound reflections are recorded and can then be analyzed to form a "picture" of the geology beneath the seabed.</p> <p>For research purposes, seismic surveys of the deeper-lying soil strata are sometimes conducted with the aid of detonations. Explosives are not currently used in the oil and gas industry, where there is mounting interest in the soil strata accessible down to a depth of 6,000 m, and here air guns are sufficient.</p> <p>The exploratory surveys (drilling site studies) are conducted to ensure that drilling operations can be carried out safely. They can include 2D and 3D seismics of the top strata below the drilling site, seabed penetration testing, side-scan sonar and magnetometer/gradiometer studies; collecting small seabed samples may also be involved in some situations. The exploratory surveys are conducted with a view to enhancing our knowledge of the seabed and the top strata beneath the seabed at the drilling site, to make sure that the drilling rig can be positioned properly and drilling carried out safely. The exploratory surveys of this kind affect only a smallish area of the seabed and are not considered to entail significant environmental impacts.</p>
<b>Exploration wells</b>	<p>Exploration wells will be drilled to demonstrate the presence of hydrocarbons based on the data about the geological structures collected via the seismic surveys etc. If hydrocarbons do prove to be present, samples can be taken or, in a best-case scenario, production tests conducted.</p> <p>In the plan area, where sea depths typically range from 30 to 70 m, wells can be drilled from a jack-up drilling rig resting on three or four legs on the seabed.</p> <p>The environmentally relevant aspects of the drilling operation are:</p> <ul style="list-style-type: none"> <li>• Physical presence of the drilling rig (emissions to air/water from the well, energy production and accommodation, physical pressure from the legs on the seabed, any spillage of chemicals from the rig, including lubricants on the rig's legs).</li> <li>• Discharge of materials from the drilling operation: drill cuttings, drilling mud, excess cement and completion fluids, emissions to air and water, evaporation of volatiles from oil-based drilling mud and hydrocarbons from the well.</li> <li>• Noise associated with the drilling operation and well testing as well as derived shipping and helicopter traffic. Prior to test drilling, a site survey is conducted, which is an acoustic survey of the top stratum of the seabed.</li> </ul>

	<p>Albeit not nearly as intense as the seismic surveys, the noise level involved is considered sufficient to impact on the environment.</p> <p>With the exception of the physical effects on the seabed, other types of drilling equipment (semi-submersibles, drill ships etc.) will produce varying levels of noise, but the same forms of environmental impacts.</p>
<p><b>Drilling wells for production and production support</b></p>	<p>In order to initiate production from a hydrocarbon accumulation, a number of wells are drilled, from which the output fluids are piped to a production installation. Wells may also need to be drilled to inject water or gas for production support, as the pressure in the reservoir drops as production continues. Consideration is currently being given to using CO<sub>2</sub> for production support, since – in addition to increasing pressure – CO<sub>2</sub> also reduces oil viscosity, thus increasing the inflow to the production well.</p> <p>In principle, production wells are drilled using the same method as for exploration wells, with the following differences:</p> <ul style="list-style-type: none"> <li>• Production wells typically have a longer and more deviated well profile than exploration wells. A production well can deviate in a horizontal direction and sometimes also upwards, and at its final depth can extend for up to 10 km from its starting point, so that production from one installation can derive from several wells and in some instances from several accumulations within the accessible area.</li> <li>• In production wells, oil-based drilling mud is often used to optimize drilling output and maximize well length. In some cases wells can be used to dispose of oil-coated drill cuttings or mud residues, which are then pumped down into the well, once comminuted, for disposal in the formation or transported ashore for processing.</li> <li>• In order to optimize the well's production characteristics, stimulation can also take place. During this process, highly pressurized fluids and chemicals are pumped down, fracturing the reservoir around the well for the purpose of increasing the flow of fluids towards the well. This form of completion can also be used for exploration wells.</li> </ul> <p>During the lifetime of the production wells, a need may arise for maintenance to maintain or optimize production. Deposits and wax precipitates must be removed. Damaged or worn equipment in the wells can be replaced, wells can be stimulated up to several times, or new sidetracks can be drilled off the main borehole in order to produce from new areas of the reservoir.</p>
<p><b>Establishing platforms etc. to process production</b></p>	<p>Production installations can comprise one or more platforms, possibly interconnected by catwalks. As well as emissions and discharges from the accommodation facilities, which are essentially no different to emissions from drilling rigs and ships in general, there will be emissions and discharges in connection with the production and processing of the hydrocarbons.</p> <p>The production discharges and emissions usually comprise:</p> <ul style="list-style-type: none"> <li>• Emissions from energy production (gas turbines, diesel engines)</li> <li>• Emissions from the flaring of hydrocarbons (flaring and cold venting)</li> </ul>

	<ul style="list-style-type: none"> <li>• Discharges from separating hydrocarbons and subsoil water (produced water) and injected seawater</li> <li>• Occasional discharges (either directly or via the production system) of excess stimulation fluids etc. when re-stimulated wells are brought back on stream.</li> </ul> <p>As an alternative to being discharged, production water can be pumped back into the subsoil, either to the productive formation or to some other suitable geological structure, if available. However, in some of the Danish chalk fields (e.g. the Dan Field) it is not possible to reinject the water using present-day technology owing to the reservoir's lack of porosity. In such cases discharge is the only practical option.</p> <p>When establishing the production installations, crane barges and other vessels are used. The installation is typically sailed out to the location and lifted into position, and the platform legs then affixed firmly to the seabed using metal spikes up to 2 m in diameter. This operation entails possible noise nuisances for any marine animals in the vicinity.</p> <p>The physical presence of fixed installations will also mean that there is a risk of bird collisions, e.g. because the birds are drawn to lights or they see the platform as a possible "stepping stone" for their migration.</p>
<p><b>Injecting CO<sub>2</sub> in existing oil fields (EOR)</b></p>	<p>CO<sub>2</sub> may be injected in existing oil fields with two reasons in mind: to increase the production of hydrocarbons or to dispose of CO<sub>2</sub>. As long as the field is productive, a proportion of the injected CO<sub>2</sub> must be expected to be co-produced with the hydrocarbons. This CO<sub>2</sub> will be separated from the hydrocarbons before their further transport, and the CO<sub>2</sub> will be reinjected into the reservoir. When production ceases, the field will thus contain a certain amount of CO<sub>2</sub>. Provided the field's wells are properly sealed and the field's hydrocarbon trap is still intact, the volume of CO<sub>2</sub> will be retained, in principle for an unlimited time.</p> <p>Apart from the activities associated with transporting liquid CO<sub>2</sub> to (and possibly from) the field, there are not seen to be any environmental impacts, based on the above assumptions, associated with CO<sub>2</sub> injection other than those arising in connection with exploration and production of hydrocarbons. Risks associated with accidents and subsequent large-scale CO<sub>2</sub> escapes are considered more safety-related (i.e. risk to human life) than environmental. It has been chosen to ignore any impact on the national CO<sub>2</sub> emission accounts, as the plan's impacts on air quality are deemed to be insignificant.</p> <p>If concrete projects relating to CO<sub>2</sub> EOR are presented in the future, the risk of formation water outflow will have to be treated in an EIA report. The possible effect of a specific project on the ecosystem will also have to be included in the EIA report. Furthermore, any possible impact on marine mammals and other fauna will also have to be dealt with in an impact assessment, if relevant to the project in question.</p>
<p><b>Laying pipelines etc. for export of hydrocarbons</b></p>	<p>The production installations are connected to satellite platforms and to the mainland using steel pipes buried or laid in the seabed. Apart from oil and gas pipelines, this includes pipelines for transporting injection water, lift gas etc., or hydraulic lines. Oil products can also be piped to a loading buoy (or a floating production, storage and offloading vessel - FPSO) and from there to</p>

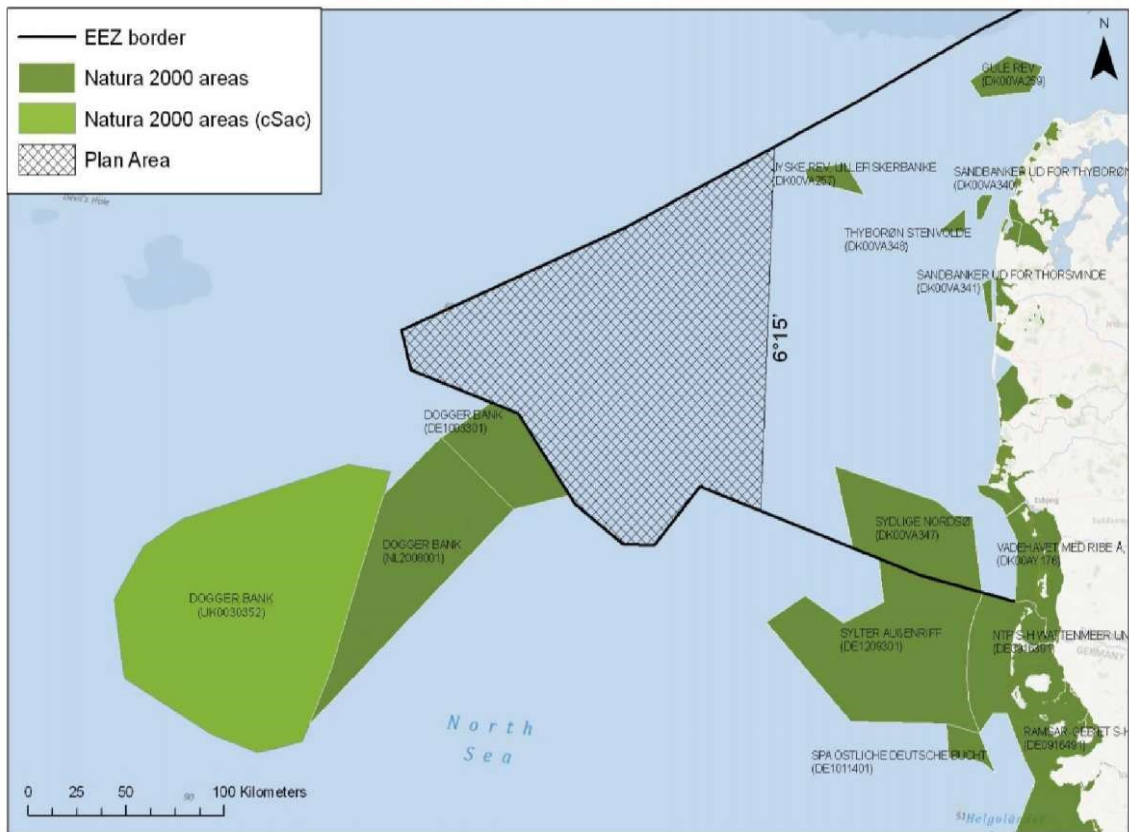
	<p>a tanker.</p> <p>Before laying oil pipelines etc., a seabed survey will normally be carried out, usually by side-scan sonar. Laying oil pipelines involves excavation on the seabed, and it can be necessary to weight the pipeline by means of rock dumping to stabilize and protect it.</p> <p>When applying for a licence or approval for the production of hydrocarbons and pipeline installation in Danish territorial waters and the continental shelf area, a report will usually have to be prepared to assess the effects on the environment (EIA).</p>
<b>Decommissioning the installation (removal)</b>	<p>New wells may have to be drilled or other maintenance measures initiated to allow operations to be maintained. Once the installation is no longer operational, fixed installations will be removed, while the actual wells will be sealed with concrete plugs placed at specified depths according to a programme approved by the DEA.</p> <p>Based on our present knowledge, it is estimated that removing fixed installations will have very limited environmental effects. At this point in time, however, it is difficult to predict the exact circumstances regarding removal. For example, it is hard to assess the extent to which fixed installations will have any positive reef-like effect.</p> <p>The effects of removal should therefore be evaluated in accordance with the regulations in force at the time such dismantling is carried out.</p>
<b>Unforeseen events/major accidents</b>	<p>Major accidents can include loss of chemicals in transit to/from an installation, uncontrolled spillage from a well (blowout), and fire and explosion on a drilling rig or production installation. Finally, an oil or gas export pipeline may be subject to damage/corrosion, resulting in spillage.</p> <p>For specific projects relating to offshore production of hydrocarbons, a complete report will always have to be drawn up to assess the environmental impact, including emergency plans to provide for unforeseen events. Insofar as a project can be assumed to affect designated international nature protection areas, the award of a licence must be preceded by an impact assessment of the project's impact on the site, taking into account the conservation objectives for this site, and the impact assessment must show that the project will not damage the area.</p>

### 3. POTENTIAL IMPACT ON NATURA 2000 AND APPENDIX IV SPECIES

#### 3.1. Natura 2000 areas

There are no Natura 2000 areas within the area of activity. The closest Natura 2000 area is the German area Dogger Bank (DE 1003-301), which borders on the project area to the south; see figure 3.1. The Dogger Bank area extends into the Dutch sector of the North Sea (NL 2008-001 Dogger Bank). Part of Dogger Bank is also located in the British sector of the North Sea; this area has been designated a potential Natura 2000 area. An application for the designation was submitted to the European Commission in August 2011 (JNCC) /5/.





**Figure 3.1.** Map of the plan area with adjacent Natura 2000 areas.

Dogger Bank is a sandbank, designated a special protection area (SPA) in Germany and the Netherlands, and a potential special protection area in Great Britain. The designation basis for the Natura 2000 area is natural habitat type 1110 (Sandbanks which are slightly covered by seawater all the time) and the species Harbour porpoise (1351), Harbour seal (1365) and Grey seal (1364, only in the Dutch sector) (EIA, Mærsk Olie og Gas, 2011 /7/).

Across Dogger Bank the water column is agitated all year round. The body of water consists of relatively warm water from the English Channel mixed with freshwater. North of the bank, relatively cold Atlantic water dominates and an oceanographic front arises where cold, high-salinity Atlantic water meets warm freshwater-influenced water from the Channel. Phytoplankton production takes place all year round; this supports a high biomass of species at higher trophic levels (JNCC, 2011 /5/).

Another Natura 2000 area nearby is the Danish sector of the “Southern North Sea” (DK00VA347) and the German “Sylter Aussenriff” [Sylt Outer Reef] (DE1209301), located approx. 50 km from the southeastern corner of the area of activity. The designation basis is natural habitat type 1110 (Sandbanks which are slightly covered by seawater all the time) and the species Harbour porpoise and Harbour seal. In addition to habitat areas, the Natura 2000 area also includes an EU bird protection area. The designation basis is the red-throated diver, the black-throated diver and the little gull.

Northeast of the area of activity (about 25 km) is the Natura 2000 area of Jyske Rev [Jyske Reef], Lillefiskerbanke (DK00VA257), where the designation basis is natural habitat type 1170 (Reefs).

### 3.1.1. Impacts resulting from the plan

Overall, it is fair to assume that the plan will not lead to increased activities within the Natura 2000 areas of the North Sea and that the increase in activities within the plan area is expected to be small in relation to the present level, as also set out in section 4.2.11 of the summary report.

Within the plan area there are activities that will result in increased sediment dispersal. It has been estimated that the area heavily affected by the sediment dispersal as a result of these activities will be restricted to a maximum zone of 100 m from the work area (EIA, DONG Energy, 2011 /3/). Further away from the work area the impact will be slight.

Given the above and the view expressed in the environmental report that potential impacts from chemicals or oil residues from production water or oil spillage will have no significant impact, and that, in the event of any oil spillage, emergency response procedures etc. will be available to contain the oil spill, the DEA considers the scope of the investigative activities and construction work entailed by the plan within the plan area to be too small to potentially cause sediment dispersal or other impacts that may affect the conservation status for the natural habitat types (like reefs, for example) located within the North Sea's Natura 2000 areas. It is unlikely, therefore, that the plan will lead to any significant impacts on the Natura 2000 areas nearby.

One possible activity connected with the plan which may possibly result in an impact on Natura 2000 areas is the laying of pipelines to export hydrocarbons from the area. The existing connections from the licence area to the coast of Jutland do not cross Natura 2000 areas, however, and there is probably no particular need to construct a new connection. New pipelines may also be built in conjunction with smaller projects in the licence area. These will be subject to the body of regulations in force; see sections 4.2.2.4 and 4.2.2.6 of the summary report.

Loud noise from activities in the plan area can potentially affect nearby Natura 2000 areas in Danish, German and British waters, but this is unlikely to have any significant impact on the conservation status of those natural habitat types and species protected. Projects assumed to potentially impact on protected species will have to be subjected to an impact assessment to show that there are no lasting effects. In the case of specific projects, the requisite preventive measures will have to be taken to avoid damage to the species of animals mentioned in the EU Habitats Directive.

### 3.1.2. Appendix IV species

The plan may involve an increased level of activity, which may translate into a general rise in the level of noise being emitted from platforms, vessels, helicopters and seismic survey activity. The noise level from platforms is estimated to be low (Mærsk Olie og Gas, 2011 /7/). The increase in traffic is expected to be small compared with the present level, but since the present level can be considerable, it is difficult to gauge the importance of probable future changes in relation to the environmental baseline and the size of the impact on marine mammals produced by a small increase in noise levels.

#### Increased noise levels from platform and vessels etc.

Positive or negative	Impact	Duration	Geographical impact
Negative	Minor	Lasting	Local for platforms, regional for vessels

Another type of noise is the noise emitted by pile-driving for exploration and production wells and foundations during the construction of platforms, and noise emitted during seismic surveys. The noise from these sources is rather loud, but relatively short-lived.

It has been shown that noise from seismic surveys and pile-driving and foundation work can potentially cause physical damage (such as permanent damage to hearing (H. Gray and K.V. Warebeek, 2011 /4/) or death) and that such noise can be disruptive. A number of stipulations will therefore be made to prevent damage to marine mammals.

Marine mammals generally return to the affected area a few hours after the noise-generating activities have ceased. Since there is nothing to indicate that the plan area is more important for marine mammals than other areas nearby, the impact of an isolated pile-driving event is considered of minor importance.

Seismic surveys can scare the animals away from larger areas for many weeks or months. The major impact of such seismic surveys is not the harmful physical effects, which may impinge on few individuals, but the behavioural impact which the diminished communication options, the possible increase in stress levels and the surveys can cause in animals.

Seismic surveys will take place continually throughout the production period, and although such activities are short-term they will presumably create more frequent disturbances as a result of the plan.

The individual-level impact is deemed to be moderate on account of the increased risk of harmful physical effects on marine mammals which such noise may cause. At population level there is not deemed to be any significant impact, when making allowance for the preventive measures set out in section 4.2.4. of the summary report.

#### Increased noise levels from pile-driving and seismic surveys

Positive or negative	Impact	Duration	Geographical impact
Negative	Minor as a result of disruption, moderate as a result of harmful physical effects	Short-term	Regional as a result of disruption, local as a result of harmful physical effects

If preventive measures are used to a sufficient extent, the increased noise and disruption levels entailed by the plan are not expected to have any significant impact on marine mammals which are part of the designation basis for Natura 2000 areas in the North Sea or are protected in Appendix IV of the EU Habitats Directive.

However, it should be mentioned that the preventive measures currently known can only reduce the risk of harmful physical effects; such measures cannot lessen the behavioural consequences caused by the noise at greater distances from the noise source. But since the duration of the noise-generating activities is temporary, it is considered that the plan will not result in any significant impact on the designation basis for Natura 2000 areas in the North Sea or Appendix IV species under the EU Habitats Directive.

There is limited knowledge about the cumulative effects, and this issue will be followed up in connection with the Marine Strategy Directive.

#### **3.1.3. Preventive measures**

In order to minimize the risk of harmful physical effects on marine mammals, preventive measures must be taken when implementing the individual activities (see also Chapter 7 of the environmental report and section 4.2.4 of the summary report).

The preventive measures generally used for pile-driving in connection with exploration and production wells are:

Use of a soft-start procedure, ensuring that pile-driving only takes place at full power after a period at low power, which will not emit noise loud enough to harm marine mammals. Low-power pile-driving will cause the marine mammals to leave the area.

With regard to seismic surveys, preventive measures can include such initiatives as:

- The equipment used (air guns) should not be more powerful than needed to carry out the survey.
- The survey should be postponed if marine mammals are observed within a safety zone of at least 200 m from the equipment.
- A soft-start procedure should be adopted.

The safety zone depends on the relevant activity, i.e. the noise level, duration, time of year etc. The safety zone will always be a minimum of 200 m from the sound source, adhering to "best practice" in accordance with recommendations from the Danish Centre for Environment and Energy (DCE).

There can also be conditions where there must be trained observers of marine mammals aboard the exploratory vessel. The surveys should only be permitted to start once it has been ensured that there are no marine mammals in the area (minimum 200 m from the sound source).

Preventive measures are always considered necessary to some degree when pile-driving activity or seismic surveys are being conducted in the licence area. The scope and implementation of such preventive measures should be evaluated in relation to the specific projects.

#### **4. SUMMARY**

The plan for licensing rounds west of 6 degrees 15 minutes east in the Danish part of the North Sea for exploration and production of hydrocarbons, and licensing of permits for injection of CO<sub>2</sub> in existing oil fields for the purpose of EOR incorporates the following reservations:

- No significant impacts on Natura 2000 areas must occur as a result of the plan. It is therefore assumed that no initiatives will be taken that entail a major adverse effect on the designation basis for the area in question.
- Under the EU Habitats Directive and the Danish Executive Order on Habitats, licences or permits may not be granted or plans etc. adopted that can damage or destroy breeding and rest areas for certain species.

Overall, the plan for licensing rounds west of 6 degrees 15 minutes east in the Danish part of the North Sea for exploration and production of hydrocarbons, and licensing of permits for injection of CO<sub>2</sub> in existing oil fields for the purpose of EOR is not *per se* considered to give rise to impacts on Natura 2000 areas or Appendix IV species. Viewed in relation to international nature protection interests, therefore, no extended nature impact assessment or supplementary field surveys are considered necessary.

There may be a need for a nature impact assessment in connection with concrete activities; that will depend on the geographical spread of, for example, the seismic surveys, siting of the installation etc.

#### **5. REFERENCES**

/1/ Danish Executive Order on Designation and Management of International Nature Protection Areas and Protection of Certain Species (No. 408 of 1 May 2007).

/2/ Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora,

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31992L0043:DA:HTML>

/3/ DONG Energy, 2011 et al.: Hejre Development Project: Environmental Impact Assessment (EIA) for the Hejre Field – development and production.

- /4/ Gray, H. & Waerebeek, K.V. (2011) Postural instability and akinesia in a pantropical spotted dolphin, *Stenella attenuata*, in proximity to operating air guns of a geophysical seismic vessel. *Journal for Nature Conservation*.
- /5/ JNCC, 2011: Offshore Special Area of Conservation: Dogger Bank. SAC Selection Assessment Document. Joint Nature Conservation Committee (JNCC), 26 August 2011.
- /6/ Danish Act on Environmental Assessment of Plans and Programmes (Consolidated Act No. 939 of 3 July 2013) and guidance notes (no. 9664 of 18 June 2006).
- /7/ Mærsk Olie og Gas A/S, 2011: Assessment of the environmental impact of further oil and gas activities in the North Sea.