

# Offshore Windfarm development and the issue of maritime safety

Case Study „Kriegers Flak” I, II and III

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## Preface/ Acknowledgements

Wind power in general can contribute significantly to achieve the EU goals of a 21 per cent share of renewable electricity by 2010, to water down global warming and to reduce our dependence on coal, oil and gas.

Compared to onshore wind energy, offshore farms have numerous advantages. Located at sufficient distance, noise and visual impacts are alleviated. Wind patterns at sea are more constant and wind speeds are higher.

Interference with maritime traffic is generally being seen as the most important issue regarding potential conflicts of interest when siting offshore-wind farms.

The purpose of this Case Study is to gather and evaluate experiences from siting the three offshore wind farms in Germany, Denmark and Sweden with a special focus on the maritime safety aspect.

*"The issue of maritime safety is of high priority within the Baltic Sea region since the Baltic Sea is relatively small, with many rocky shallows and narrow straits as well as harsh winter ice conditions. It is criss-crossed by some of the busiest shipping lanes of the world. The intensity of shipping activities in the Baltic has been growing very rapidly during the last decade, and there is no sign of this process slowing down. There are around 2,000 ships at sea at any time, accounting for 15 % of the world's cargo transportation. All kinds of cargo are being shipped in and out of the Baltic Sea countries, including oil and hazardous substances. Everyday 150-200 large tankers are filled with oil in about 20 ports around the Baltic."*[1]

According to this fact, major ship lanes are in principle excluded from considerations for the use for offshore wind farms. Other excluded areas are areas used or preserved for oil & gas pipelines, cable routes, raw material deposits, areas restricted to military use and areas of importance in relation to the *Wild Birds Directive* and the *Flora-Fauna-Habitat Directive*.

To clarify, which specific issues concerning offshore windfarm development should finally be considered when implementing the maritime safety perspective into marine area spatial planning, the objective of this study is, to make a comparative analysis of the applied steering approaches, pre-selection processes and the different approval procedures in Sweden, Denmark and Germany with focus on the navigational issues.

The research work of this case study is based on internet research, as well as on interviews with experts and developers and the outcome of a workshop with representative stakeholders from the three countries held in June 2006 in Trelleborg.

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# Chapter 1 Offshore Windfarm development on Kriegers Flak

## 1.1 Plans in the border triangle

The area of the three planned and approved wind farms “Kriegers Flak” I, II and III is situated on the borderline of the Exclusive Economic Zones (EEZs) of the three countries Sweden, Denmark and Germany in the southern part of the Baltic Sea.

Kriegers Flak is a submarine bank occupying an area that is about 18 km (east -west) by 7 km (north-south). On the central parts of Kriegers Flak, the water depth is between 16 and 17 meters while on the outskirts of the area, the depth is 20 - 25 meters and thereafter it quickly increases to more than 40 meters. The nearest landmass in Sweden is Trelleborg (about 30 km), in Denmark Mön (about 34 km) and in Germany Rügen (about 35 km).

Once built, the grids of the offshore wind parks are presumably going to be connected, making it possible for electricity to be traded between the three countries and enabling the transmission of electricity.



Pict. 1 Three Windfarms at Kriegers Flak  
Source: Vattenfall, 2006

The developers estimate Kriegers Flak to be a very suitable area from a localisation point of view due to its relatively shallow depths and adequate distance from shore. The wind conditions are favourable and shipping lanes in the area are a sufficient distance away. The seabed is basically without vegetation. It is no vulnerable Bird Area and the structure is expected to benefit commercial fishing as feeding ground even if individual fishermen may be deprived. There are no special environmental

interests in the area and industrial impact already exists on the Danish side of Kriegers Flak through sediment extraction.<sup>1</sup>

## 1.2 Site selection - three different approaches

All three countries have defined some areas that are restricted for the development of offshore wind energy.

The restrictions for wind energy development that the competent authorities impose on some sea areas are by and large the same in the countries concerned. Generally, these restrictions are based on safety and environmental parameters and other uses of and activities in certain sea areas, such as main ports, navigation, military and flight patterns to and from airports.

Only Germany and Denmark have pre-selected preferred areas for offshore wind energy development by carrying out a Strategic Environment Assessment (SEA).

### Sweden

In Sweden developers can apply for wind energy development basically anywhere in the Swedish Sea, as no areas have been actually designated as preferential.

Both the Swedish National Board of Housing, Building and Planning and the Swedish Energy Agency have designated some areas within the territorial waters, which are of national interest for wind energy production.

One of the designated areas is Kriegers Flak. For the pre-selection process (*Förutsättningar*) in the EEZ the National Board of Housing, Building and Planning has a directive to account for the general prerequisites for building wind power at the sea. As part of this process a GIS system "VindGis"<sup>2</sup> has been developed [2].

In Sweden there is no need for wind projects to be built in designated areas. The purpose of these designations is to put wind power on the same level of importance as other activities of national interest in these areas before decisions on permits according to the environmental code are made[3].

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<sup>1</sup> As this area is held for marine sediment extraction there are unresolved conflicting interests at the Danish part of Kriegers Flak concerning the sediment extraction needed for Fehmarn-Belt bridge and the planned Windfarm KF III.

<sup>2</sup> Representatives from Vattenfall, the Swedish Maritime Institute (Sjöfartsverket), the Swedish Energy Agency (Energimynigheten) and SSPA are forming a reference group which is currently (2006) developing a common approach for ship collision risk analyses. Results from this project will be included in the VindGIS- update.

## Germany

The political background for the determination of preferred areas for offshore wind farm development is the “*Strategy by the federal government for offshore windenergy*” (2002) in the framework of the strategy of sustainable development. After the designation of preferred areas for offshore wind farm development has become mandatory the German Federal Maritime and Hydrographic Agency (BSH) has designated three particularly suitable areas for offshore wind farms in Germany’s EEZ in 2005 in accordance with Art. 3a Offshore Installation Ordinance (*SeeAnlagenVerordnung*).

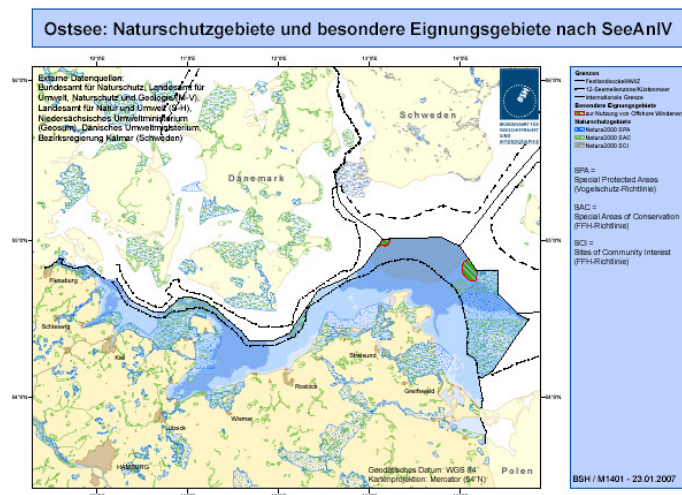
The aim is a well directed development on offshore wind farms. Within the approval procedure the effect of these designations matches an anticipated expert opinion with regard to the choice of locations for wind farms.

Two of the designated areas are situated in the Baltic Sea: Kriegers Flak and “Westlich Adlergrund” (s. pic. 2). An important matter of the investigation was that windfarm development in this area impairs neither the safety of navigation nor the marine environment.<sup>3</sup>

Up to the predefinition in December 2005 already eleven offshore windfarms in the German EEZ have been approved by the BSH. Only half of them are situated in the preferred areas.

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<sup>3</sup> With hindsight it has to be recognised, that the objective to enhance a well directed development of offshore windfarms through a pre-definition of areas in Germany partly failed, because there is no preclusive effect of these designated preferred areas and approvals were already granted beforehand.



Pict. 2 particularly suitable areas for offshore windfarms, BSH 2007

In the summer of 2004 the Federal Regional Planning Act (Raumordnungsgesetz) has been amended to implement a marine area spatial planning in the EEZ to enable a more comprehensive spatial coordination of marine uses for the future. Within this ongoing planning procedure the preferred areas will be taken over as priority areas [3].

### Denmark

By 1995 Denmark had already mapped out designated areas for offshore wind power. These designated areas compete obviously with other area interests. In 2003 and 2004 a screening of a certain number of the previously mapped areas was undertaken to update the current area interest. The screening was undertaken as a preparation for the 2 \* 200 MW tender.

In 2003 and later in 2004 the Danish Energy Authority published a report in which it described a screening of areas for the purpose of offering them in the tendering procedure. Such screenings were considered necessary as technical expertise had changed considerably since the 1997 action plan. The following areas were screened: the area near Horns Rev, south of Laesø (Kattegat), around Lysegrund, around Kriegers Flak (Baltic Sea), at Omo Staalgrunde, and around Rødsand (Baltic Sea). The aim of the screening procedure was to find out, which of the areas were best suited for wind energy production and thus could be included in the tendering procedure. The 2003 screening report was roughly drafted on the basis of the principles of the SEA

For interested parties the screening document for suitable areas is public and provides them with an indication of which investigations need to be made and the requirements for a subsequent EIA. Within the period of validity of the permit for preliminary survey an applicant will have to carry out an EIA. The EIA directive



requires an EIA for the construction of wind turbines and the internal cables connected to them, if it appears that these facilities have a considerable impact on the environment [3].

The restrictions for wind energy development that authorities impose on some sea areas are nearly the same in all three countries. Generally, these restrictions are based on safety and environmental parameters and other uses of and activities in certain sea areas, especially such as main ports and navigation.

## **Chapter 2 Site specific parameters**

### **2.1 Marine traffic survey in the area of Kriegers Flak**

The area of Kriegers Flak is situated in the north of the heavily frequented main shipping route Kadetrende - Bornholmsgat. Data concerning the traffic vary between 40.000 und 65.000 ship movements per year. One third of these ships are oil tankers with rising tendency in numbers.

The shipping around Kriegers Flak could be described as five main shipping lanes through the southern Baltic Sea. The main flow of traffic has two distinct shipping lanes. One directed towards the Belts and German ports west of Rügen and another directed towards Öresund. The lane towards the Belts passes south of Kriegers Flak and the planned German wind farm whilst the lane towards Öresund is passing the Swedish south coast. Apart from these two lanes, there are three others mainly used by ferries between Trelleborg and Travemünde/Rostock, Trelleborg and Sassnitz/Swinoujście and Öresund and Sassnitz / Swinoujście [6].

Big shipping lanes pass to the east, south and west of Kriegers Flak at a safe distance from the wind farm. Single ships may, however, always navigate outside of the shipping lanes and thereby pass Kriegers Flak at a closer distance. Collisions between ships and wind turbines may be caused by bad navigations, fatigue, engine failure or damaged navigational equipment.

A collision may lead to oil spills and ships may also spill chemical cargoes. Oil spills can cause impact over larger areas and drift away with the wind. 18 % of all goods transported in the Baltic Sea is regarded as dangerous. Therefore a collision could cause great consequences for the marine environment.



Pict. 3 AIS data for the 3rd of October 2004 - Assessment of the traffic in the Baltic Sea West

## 2.2 Meteorology and Oceanography

The area at and around Kriegers Flak is hydrologically well documented. The Swedish Meteorological and Hydrological Institute (SMHI) for instance operates a measuring station in the Arcona basin east of Kriegers Flak since 1958 measuring temperature, salination and oxygen content once or twice a month.

### 2.2.1 Ice Conditions

The risk of ice formation around Kriegers Flak depends on the wind direction, salinity of the water, currents and depth. Westerly winds bring in mild air from the Atlantic into the Baltic area but if the wind comes in from east, the Baltic is cooled down, which could lead to ice formations. During very severe winters the ice will cover the whole of the Baltic east of Bornholm.

According to observations made by the ice department of the German BSH during a span of 40 years, the water freezes west of Bornholm about 10-15% of all winters. During these years drifting ice (classified as thick ice, 30-40 cm, to very thick ice, 50-70 cm) may, depending on wind direction, in a few days move between the German, Swedish and Danish coasts. The ice periods last between January and the middle of March. The maximum thickness of ice around Kriegers Flak has been estimated by BSH to 60 cm. Formations of very thick drifting ice can occur in the Baltic Sea. This is however very rare. At Kriegers Flak, the German BSH estimates the thickness of this drifting ice walls to more than one metre.

### 2.2.2 Wind conditions

During summer time the winds at Kriegers Flak are predominantly westerly, whilst during winter, easterly winds are quite common. The wind direction is between southwest and northwest just over 50 % of time.

Based on wind data from SMHI during 1980-89 from the high mast at Maglarp, the average wind speed has been calculated to an annual average wind speed of around 7.2 m/s. Sweden Offshore is planning to erect up to three 100 metre tall measuring masts to verify the performance of the farm. In August 2007 Germany starts to operate the meteorological research station FINO II at Kriegers Flak, which will establish very accurately the wind resource in the area.

### 2.2.3 Visibility Conditions

The German Meteorological Office has carried out a study regarding visibility conditions and the visibility of the wind farm. The statistics shows that visibility above 40 km is rare. On average this is the case in only 8.3% of the hours in a year. Best visibility is in May and September. Similar statistics from Rügen show that visibility out over the Baltic Sea is only 30 km., i.e. the same distance as from Trelleborg towards the nearest wind turbine during less than 10% of the hours in a year [6].

### 2.2.4 Effects of climate change

The Baltic Sea basin belongs to those regions in the World with a large north-south gradient in hydro-meteorological characteristics, which makes this region unique among European water basins, creating specific demands on models and scientific concepts. Climate change scenarios predict an increased risk of extreme weather events. Ongoing sea-level rise and a sinking coast as well as changes in precipitation in the catchment, with subsequent changes in river discharge, will increase the flooding risk in the river basin and at the coast. Along the Baltic Sea coast, an increased risk of storms and storm surges will have immediate negative effects on coastal erosion, protection measures and shipping. Recent floods and devastating storms hitting the basin<sup>4</sup> have increased the public and political awareness of the risks climate and climate change may imply in Northern Europe.

The impact of climate change plays an important role in the spatial and economic development of the Baltic region.

- The economical losses caused by natural hazards are rising continuously.
- Climate change has potential long-term effects on the living environment, sea level rise and coastal protection.

Positive responses towards these impacts on development are mid- to long term strategies that are supported by decision makers and other stakeholders, including regional and local planners [4].

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<sup>4</sup> The exceptional storm named Gudrun of January 2005 highlighted an inadequate awareness of extreme wave properties and of the height and spatial extent of extreme water level conditions under existing climat conditions.

## 2.3 Cumulative effects

Because of the mobility of the marine environment, there will definitely be pressure for cumulative impacts of offshore wind farms to be studied especially where individual sites are close together like on the area of Kriegers Flak. Cumulative impact refers to the combined impact of two or more wind farms in combination with other uses like e.g. shipping on the surrounding seascape.

A common definition of cumulative effects or impacts has not been identified yet. One approach is to define it as “combinations of offshore wind farm impacts against the background level of already existing adverse impacts, e.g. pollution, disturbance by ship traffic, and effects of other projects like sand and gravel quarrying.” This definition comprises both direct impacts and additional impacts from the project itself, e.g. increased shipping in the unimproved areas or a higher collision-probability in the area of wind farms with constricted intervention possibilities by salvage tugs at the same time.

Another definition of cumulative impacts does look rather at the effects of several wind farms and which impacts they have altogether. For example, building several wind farms next to each other would lead to a corridor effect for ships. This could result in additional disturbances, which would not have occurred if a single wind farm was considered in isolation. A distinction could be made between cumulative or additional effects and combination effects. The follow-up effects (consecutive effects) caused by grid connection at sea should also be taken into account. The planned wind farms are outside any navigable channels, but they might also have an impact on shipping traffic by affecting various navigation aids.

The consideration of different kinds of cumulative impacts is an issue in spatial planning processes and SEA-like assessments. All three countries have pre-selected preferred or suitable areas, some selected under consideration of avoidance of cumulative effects. For selection of sites, approaches of strategic environmental assessments have been applied. This may indicate that in view of the prevailing cumulative effects and problems evoked by follow-up effects it has become evident, that impacts of offshore wind cannot sufficiently be handled on project level.

Cumulative effects and follow-up effects appear to be a major problem. Exchange of knowledge and information has successfully been started. The need for trans-national approaches seems to be obvious [5]

## Chapter 3 Planning in open Sea area - obligations and regulations

### 3.1 Maritime safety issues

#### 3.1.1 UNCLOS

The UN Convention on the Law of the Sea (1982) (known as UNCLOS) is the "umbrella" Convention beneath which a legal order for seas and oceans can be established for certain general objectives, including safety of navigation and protection of the marine environment.

UNCLOS allows, under Part V Art. 76, Coastal states to declare an Exclusive Economic Zone (EEZ) for a variety of economic purposes.

##### 3.1.1.1 Rights and duties in the Exclusive Economic Zone.

Wind farms in the EEZ have to compete with other sea uses, including navigation. In the EEZ the coastal state has sovereign rights. These rights, jurisdiction and duties of the coastal state in the EEZ are defined as follows:

Sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the waters superjacent to the sea-bed and of the sea-bed and its subsoil, and with regard to other activities for the economic exploitation and exploration of the zone, such as the production of energy from the water, currents and winds.

On the one hand wind farms beyond territorial waters must be erected and operated with 'due regard' for third States' freedoms there.<sup>5</sup> On the other hand, the coastal state has in its EEZ, the exclusive rights, to exploit its renewable resources and to construct and to authorise and regulate the construction, operation and use of artificial islands and of installation and structures to exploit those resources. It also has exclusive jurisdiction over those platforms. (*Art 60 (1) and (2) UNCLOS*).

The coastal state shall give due notice of offshore wind installations, as a warning to others of their presence at sea (*Art. 60, 3, UNCLOS*). Notification must also be given with respect to their related safety zones. (see chapter 3.1.3)

##### 3.1.1.2 Navigation

The regime of transit passage retains the international status of the straits and gives the naval powers the right to unimpeded navigation and overflight. Ships and vessels in transit passage, however, must observe international regulations on

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<sup>5</sup> Within EEZs these are essentially communication freedoms, notably navigation, overflight and laying submarine cables and pipelines.

navigational safety, civilian air-traffic control and prohibition of vessel-source pollution and the conditions that ships and aircraft proceed without delay and without stopping except in distress. In all matters other than such transient navigation, straits are to be considered part of the territorial sea of the coastal State.

The potential of wind farms to interfere with navigation is greater in the EEZ than in territorial waters because wind farms there are likely to be both larger and erected in deeper waters. The freedom of navigation enjoyed by ships of third states extends to submerged navigation and is a broad freedom in fact. A ship is free, for example to move, stop or anchor at will as long as she does so with reasonable regard for third states' communications rights and for the coastal states' economic and other rights. Her freedom comprehends, indeed, other internationally lawful uses of the sea related to it, such as those associated with the operation of the ships. She remains, moreover, subject to the jurisdiction of her flag State, with the exception of limited coastal State jurisdiction over merchant vessel- source pollution [8].

#### 3.1.1.3 Safety zones

According to the UNCLOS, the coastal state may in its EEZ or above its continental shelf, where necessary, establish reasonable safety zones around the artificial islands, installations and structures, in which it may take appropriate measures to ensure the safety of navigation and of the artificial islands, installations and structures. The breadth of these safety zones shall be determined by the coastal state, taking into account applicable international standards. The designation of such zones must be reasonably related to the nature and function of the artificial islands, installations or structures

Furthermore, they are not to exceed a distance of 500 metres around them, measured from each point of their outer edge, except where authorised by generally accepted international standards or where recommended by the IMO [9].

#### 3.1.1.4 Removal of Offshore Installations

Once the offshore wind energy production has ceased, the installations must be removed from the seabed (art. 60, 3, UNCLOS). Article 60 UNCLOS allows for partial removal as far as the safety of navigation and of fishing is ensured. However, to ensure safety of navigation the IMO is empowered by article 60 to establish generally accepted standards in relation to removal requirements.

The issue of toppling off and removal for the purpose of safety of navigation is regulated by IMO Resolution A.672 (16) of 6 December 1989 "Guidelines and Standards for the Removal of Offshore Installations on the Continental Shelf and in the Exclusive Economic Zone".

New installations, placed in the EEZ after 1 January 1998, should be completely removed after use or abandonment [9]

### 3.1.2 IMO Conventions on Maritime Safety

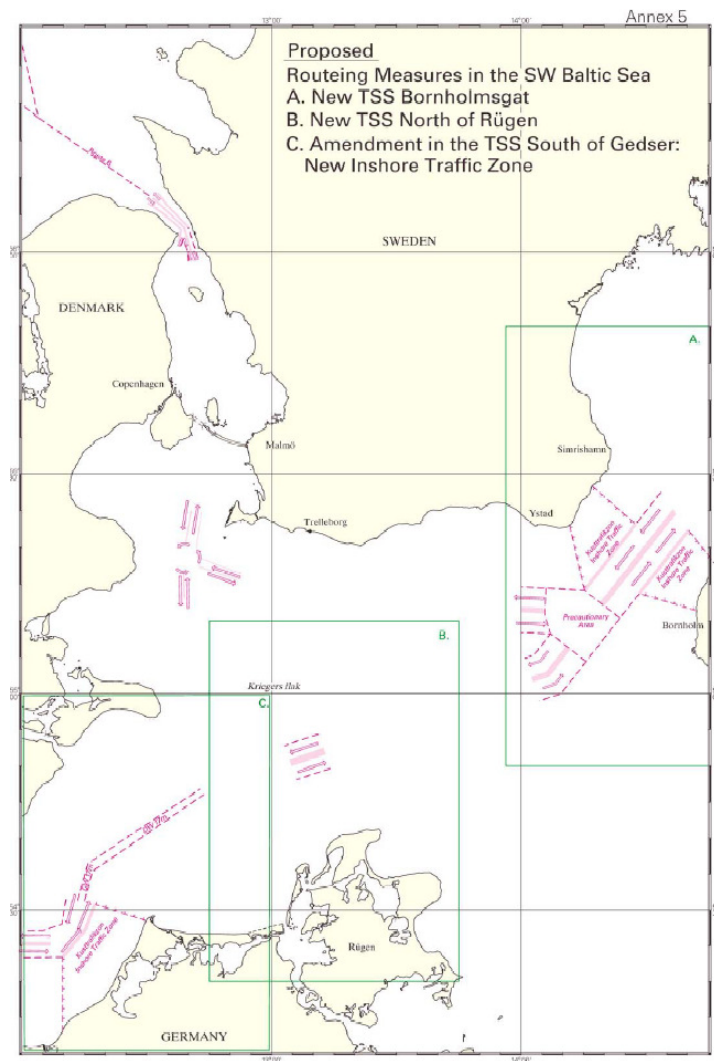
#### 3.1.2.1 Convention on the International Regulations for Preventing Collisions at Sea (COLREG)

This is the main convention for regulating international maritime traffic. It specifies the "rules of the road" for particular traffic situations and organises the traffic flow by means of "traffic separation schemes" (TSS) (Rule 10), the aim of which is to separate opposite-going traffic in high traffic density areas such as the Kadet Trench, etc. The area between land and a traffic separation scheme is called an "inshore traffic zone". A vessel of more than 20 meters in length, except fishing vessels, shall not use an "inshore traffic zone" when it can safely use a traffic lane within the adjacent traffic separation scheme, except when on route to or from a port.

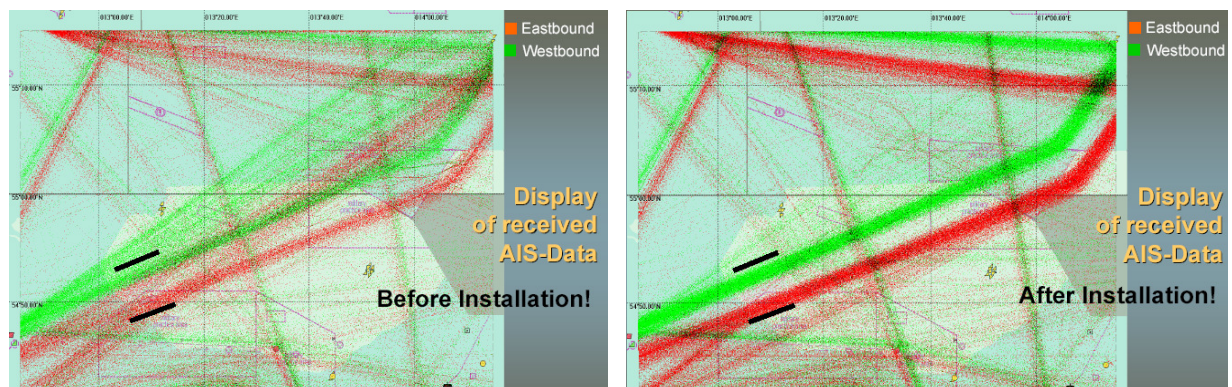
The delineation of shipping routes is important for ensuring the safety of marine traffic. In straits used for international navigation between one part of the EEZ and another part of the EEZ, all ships enjoy the right of transit passage. Bordering states designating sea-lanes and prescribing traffic separation schemes in those straits shall submit their proposal to the IMO with a view to their adoption. In the EEZ, all ships enjoy the freedom of navigation. Proposed traffic lanes have to be adopted within the IMO.

*"In the course of the designation of the Baltic Sea area, (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden) in 2005 as a PSSA by the IMO the countries concerned proposed inter alia the traffic separation scheme "North of Rügen" that is located 10 nautical miles south of Kriegers Flak and 12 nautical miles north of Rügen. The separation scheme will guide and structure the traffic at a safe distance off the coast of Rügen and the environmental reservation area. Furthermore, the traffic separation scheme will also give a better chance for anti pollution fighting in case of accidents and keep the traffic at a safe distance off the planned large wind farms at Kriegers Flak."* [10]





Pict. 4 Proposed Routing Measures in the SW Baltic Sea [10]



Pict. 5 The Traffic Situation at the T.S.S. „North of Rügen“, [11]



### 3.1.2.2 International Convention for the Safety of Life at Sea (SOLAS)

The SOLAS Convention introduces (*Chapter V, regulation 8*) the possibility to establish “areas to be avoided” and other routing measures. These ships’ routing systems contribute to the safety of life, safety and efficiency of navigation and/or the protection of the marine environment. *“Ships’ routing systems are recommended for use by, and may be made mandatory for, all ships, certain categories of ships or ships carrying certain cargoes, when adopted and implemented in accordance with the guidelines and criteria developed by the IMO. An “area to be avoided” is a routing measure comprising an area with defined limits in which navigation is particularly hazardous or it is exceptionally important to avoid casualties and which should be avoided by all ships or certain classes of ships.”*

## 3.2 Marine environmental issues

### 3.2.1 Environmental considerations

Offshore wind farm development must satisfy two ‘assessment’ processes required under EC law: An Environmental Impact Assessment (EIA) and in addition the Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment (SEA Directive) require the governments to conduct strategic environmental assessment at the *planning and programme level* of offshore wind farm development.

Environmental Assessment generally seen is a procedure that ensures that the environmental implications of decisions are taken into account before the decisions are made. The process involves an analysis of the likely effects on the environment, recording those effects in a report, undertaking a public consultation exercise on the report, taking into account the comments and the report when making the final decision and informing the public about that decision afterwards. In principle, environmental assessment can be undertaken for individual projects or for plans, programmes and policies.

#### 3.2.1.1 Environmental Impact Assessment

The EC-EIA Directive on Environmental Impact Assessment of the effects of projects on the environment was introduced in 1985 and amended in 1997. The EIA procedure ensures that environmental consequences of projects such as offshore wind projects are identified and assessed before authorisation is given. Wind farms are listed in Annex 2 to the EIA Directive as a type of project for which EIAs will be required if they are likely to have a ‘significant effect’ on the environment.

The developer’s Environmental statement should cover the impact of the whole development, including the cabling and on-shore site, and consider all possible

effects including the effects on (shipping) safety, the effects on radar (shipping, air traffic, military) and the overall expected environmental impact.

The environmental information must be made available to authorities with environmental responsibilities and to other involved authorities like maritime administrations and the general public for review. They must be given an opportunity to comment on the project and its environmental effects before a decision is made on development consent. The public is informed of the decision afterwards [12].

Collision risk analyses are to be carried out as part of the EIA and are moreover of great use for choosing risk mitigation measures. The phenomenon of ship collisions with offshore wind farms is more or less comparable to other ship collision issues, such as with ship/ship collisions, collisions with offshore oil/gas platforms, or collisions with large bridges [13]

As the consequences of collisions may be very serious mitigating measures are called for in order to minimise collision risks, collision damage and potential environmental impact: Collision risks can be reduced by passive measures, such as careful siting procedures, proper marking of the wind farm and the individual wind turbines or by active measures such radar based ship detection in combination with emergency towing capacities. Collision damage can be reduced by classical fendering techniques and damage reduction design optimisation. Environmental impact can be reduced by proper oil spill contingency and mitigation planning. An overall risk management approach is to be followed to develop a cost effective balanced package of measures. Such an approach combines risk assessment, design measures and active risk control measures.

According to international shipping conventions all ships have the right of innocent passage through territorial waters, and beyond this 12 nautical-mile limit shipping enjoys freedom of navigation. Where required for safety reasons sea-lanes and traffic separation schemes are designated or prescribed for the regulation and passage of ships. International shipping activities are regulated within the IMO, a specialised organisation of the United Nations.

According to international law (s. chapter 3.1.1.1) countries have the right to construct renewable offshore projects within a 200-mile renewable energy production zone. It is possible to establish safety zones up to a distance of 500 m around such installations, however offshore renewable installations and safety zones are not permissible if they interfere with recognised sea-lanes.

### 3.2.1.2 Strategic Environmental Impact Assessment

Strategic Environmental Assessment (SEA) is a process of evaluation of environmental effects during the preparation of policies, plans, programmes and legislation (including executive regulations). It should be early, high-level,



comprehensive, and participatory. The purpose of SEA is to consider environmental factors alongside social, economic, and other matters in strategic decisions.

In September 2001 the Committee on Environmental Policy of the UN ECE made a decision to develop a Protocol on Strategic Environmental Assessment under the Espoo EIA Convention because the Espoo EIA Convention was already in force at that time, and the Aarhus Convention was not. Further work on public participation in such decision making under the Aarhus Convention was suspended until the conclusion of negotiations on the proposed SEA Protocol.

Strategic Environmental Assessment can make sure that environmental factors are taken into account in all government planning and policy-making. Public participation before the stage of concrete projects allows the public to express its views in the planning process before certain types of concrete becomes inevitable. This early stage is when public comments can actually make a difference – before plans set in motion a train of events with inevitable and unavoidable results. The participation of the public in strategic decision-making builds on the Convention on Environmental Impact Assessment in a transboundary context (the Espoo Convention) and the convention on Access to Information, Public Participation in decision-making and access to Justice in environmental matters (the Aarhus Convention) [12].

### 3.2.2 Participation

When it comes to maritime safety in the context of offshore wind farms, the public is usually very concerned about the possible effects on the environment in the case of a collision between ship and wind turbine. Therefore public participation plays a central role in the development process of offshore wind farms.

Public participation above the project level is required by two international legal instruments: Articles 7 and 8 of the Aarhus Convention and the Protocol on Strategic Environmental Assessment under the Espoo EIA Convention.

#### 3.2.2.1 Aarhus Convention

The Aarhus Convention is a new kind of environmental agreement. It links environmental rights and human rights and acknowledges that people owe an obligation to future generations. It establishes that sustainable development can be achieved only through the involvement of all stakeholders. It links government accountability and environmental protection. It goes to the heart of the relationship between people and governments. The Convention is therefore not only an environmental agreement; it is also a Convention about government accountability, transparency and responsiveness [15].

Articles 7 and 8 of the Aarhus Convention demand even more in terms of public participation than the SEA Protocol, and apply also to matters not covered by the SEA Protocol. Therefore it is useful to compare them to see what is covered in terms

of public participation in strategic decisions. The scope of the SEA Protocol is narrower than Articles 7 and 8 of the Aarhus Convention.

Article 7 of the Aarhus Convention requires:

*“each Party shall make appropriate practical and/or other provisions for the public to participate during the preparation of plans and programs relating to the environment, within a transparent and fair framework, having provided the necessary information to the public... To the extent appropriate, each Party shall endeavour to provide opportunities for public participation in the preparation of policies relating to the environment.”*

Article 7 of the Aarhus Convention covers all plans and programs “relating to the environment.” These might be plans or programs having either adverse or positive affect on environment. Article 7 is not limited to ones with “significant” effects [16].

### 3.2.2.2 Espoo-Convention

This convention obliges parties to assess, at an early stage of planning, the environmental impact of certain projects entailing possible transboundary impacts. It also lays down the general obligation of states to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact on a transboundary level.<sup>6</sup>

To those activities listed in Appendix I to the convention, parties must establish EIA procedures that permit public participation. The assessment documentation must be prepared as set out in Appendix II to the convention. The list of activities in Appendix I includes major installations for the harnessing of wind power for energy production (wind farms)<sup>7</sup>.

Even where a wind farm development is not deemed a ‘major installation’ it still may be subject to an EIA by virtue of its size, location or effect.<sup>8</sup> For the purposes of this analysis, the proximity of a project to an international border should be taken into consideration.<sup>9</sup> While environmental impact assessments are to be applied at the project level, parties should endeavour to apply the same measures to policies, plans and programmes [17].

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<sup>6</sup> For interest other than environmental, like e.g shipping there is no Espoo responsibility

<sup>7</sup> Appendix I, item 22.

<sup>8</sup> art 2.5 and Appendix III.

<sup>9</sup> Appendix III.

## Chapter 4 Effects on navigational safety

### 4.1 Maritime traffic and offshore wind farm development

Large and exclusive spatial users, such as offshore wind farms are expected soon to experience accelerated growth and to require wider use of marine space respectively as a result of compliance with Kyoto Protocol commitments in response to climate change [18]. In turn, this new use has to be developed carefully to avoid that it elbows out navigation.

#### 4.1.1 Collision Risk ship / wind turbine

Even where careful planning is carried out, and the farm is not placed near major navigation routes, or routes have been altered in order to minimise collision risk, there will still exist a risk of significant environmental damage in case of ship collisions with wind turbines [19].

As stated earlier collision risk analyses are to be carried out as part of the EIA and are moreover of great use for choosing risk mitigation measures. The analysis has to take into account the data of the wind farm and of the sea region (in particular the environmental conditions, sea traffic and cargo). The phenomenon of ship collisions with wind turbines is more or less comparable to other ship collision issues, such as with ship/ship collisions, collisions with offshore oil/gas platforms, or collisions with large bridges.

On behalf of the developer of the two wind farms on Kriegers Flak, three studies have been carried out regarding the risks of a collision between a ship and the planned wind farm KF I and II and the consequences of such a collision. Two risk analyses in the Swedish and in the German EEZ were conducted by the Germanischer Lloyd (GL). GL has calculated a so called basic collision risk, i.e. the risk of a ship colliding with the wind farms without regard for safety increasing measures. In this scenario, all collisions are considered, including those where a ship only touches a wind turbine without causing damage. The basic collision risk has been calculated to a statistical interval of 251 years in the Swedish EEZ and 158 years in the German EEZ. If safety increasing measures are taken into consideration, the statistical interval between two accidents increases to over 1.000 years in the Swedish case. These numbers are considerably lower than for the German case due to the fact, that the German Risk analysis takes only AIS and the traffic separation scheme "North of Rügen" as a risk minimising factor and estimates AIS only with a quite small factor due to a lack of experience so the interval between two collisions was calculated to be 207 years for the German wind farm.

The second Swedish risk analysis was carried out by SSPA. The analysis of GL mentioned above and the analysis that GL has made for the wind farm planned in the German EEZ, has been used as important basis for the SSPA study. SSPA has

focused on the risk of an accident that causes danger to nature or humans, for example through an oil spill. The risk of a collision that causes an oil spill has been calculated about 1.700 years between two collisions.

The average oil spill has been estimated to be 3.400 tons. With safety increasing measures, such as standby tugs, the risk is reduced to 6.700 years between collisions.

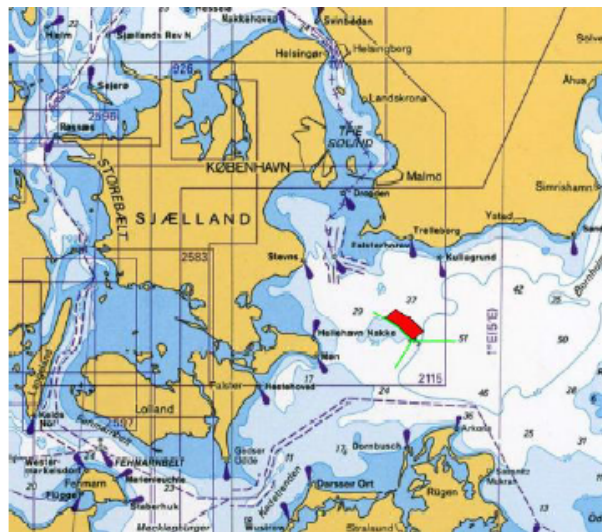
#### 4.1.2 Risk- and consequence mitigating measures

As the consequences of collisions may be very serious mitigating measures are required in order to minimise collision risks, collision damage and potential environmental impact.

Collision risks can be reduced by passive measures, such as careful siting procedures, proper marking of the wind farm in accordance with national or international guidelines (IALA) or by active measures such radar based ship detection in combination with emergency towing capacities. Collision damage can be reduced by fendering techniques and damage reduction design optimisation. Environmental impact can be reduced by proper oil spill contingency and mitigation planning. [20].

## Chapter 5 National approaches

### 5.1 Sweden – Kriegers Flak II



Pict. 6: Åke Larsson, Vattenfall

For the Swedish side of Kriegers Flak, the Sweden Offshore Wind AB, a joint subsidiary of WPD and Wind Project GmbH, has submitted an application for approval of the Kriegers Flak II project with 128 plants generating 640 MW. The construction permit for Kriegers Flak II was granted in June 2006. It is located 30 km



from Trelleborg outside the Swedish territorial waters in the EEZ with water depth between 16 to 42 metres.

The project rights were sold to the Vattenfall Power Supply Company in May of 2005.

#### 5.1.1 National policy, legal framework and administrative procedures

The Swedish wind power planning goal is pursuant to a number of energy policy decisions and governmental bills directed towards an increased use of renewable energy. In 1997, the Swedish Parliament adopted a program for adjustment towards a sustainable energy system. The program comprises guidelines to promote an efficient use of energy and to increase the share of renewable energy resources in the Swedish energy system. In 2002, the Government laid down a proposal concerning environmentally friendly electricity supply including a new system of rules aiming to promote the production of renewable electricity, there amongst wind power.

In 2002 the Swedish Government adopted a national planning goal of a yearly wind power generation of 10 TWh by 2015, which implies a substantial increase from the current 0.6 TWh level.

In March 2002, the Swedish government presented its “*Energy Policy Bill Cooperation for a Secure, Efficient and Environmentally-Friendly Energy Supply*” (2001/02:143). This report, approved by Parliament, re-affirmed the country's established energy policy objectives. The energy policy decision contained measures designed to encourage more efficient energy consumption through the rationalisation of existing policy measures and the dissemination of knowledge at the national and regional levels. The decision also announced a new method to promote environmentally-friendly and renewable electricity production through a quota-based trading programme for green electricity certificates.

The legal basis for erecting offshore wind farms in the Swedish EEZ is the United Nations Convention on the Law of the Sea of 10 December 1982, the Swedish Exclusive Economic Zone Act (*Lag om Sveriges ekonomiska zon 1992:1140*) and the Act on the Continental Shelf (*Lag om kontinentalsöcklen*).

Within EEZ, 2 permits required:

- 1) government permit for exploration (also for cabling)
- 2) permit according to Swedish Exclusive Economic Zone Act

According to the Swedish EEZ Act, governmental permission must be obtained for construction projects (with a commercial purpose) located within the Swedish EEZ. The evaluation of the project for which permission is sought is based, a.o., on paragraphs from the Environmental code (*Miljöbalken*) referred to in the EEZ Act. Certain chapters of the code are emphasised in the common guidelines issued by the planning and environmental authorities. Accordingly, a statement on EIA must be

included in the application. The Department of Environment (*Miljödepartementet*) is the authority designated to administrate this part of the law. Applications must be sent to the department.

According to paragraph 3 in the Act on the Continental Shelf (*Lag om kontinentalsocklen*) government permission is required for exploration relating to the establishment of construction projects, such as wind turbines (geotechnical measurements, drilling etc). This is administrated by Ministry of Industry, Employment and Communications (*Näringsdepartementet*). Concessions for access to the grid, according to the Act on electricity (*Ellagen*), are administered by the Swedish Energy Agency (*Energimyndigheten*).

The associated environmental aspects must be evaluated by an environmental court according to the Environmental Act (*Miljöbalken*). Applications are sent to the Court.

For cables passing through privately-owned land or sea territory, the rules in the Utilities Easement Act (*Ledningsrättslagen*) apply [9].

The main competent authorities involved in the procedure for swedish offshore wind developments are:

- Ministry of Industry, Employment and Communications (*Näringsdepartementet*), which is responsible for the energy policy
- The National Board of Housing, Building and Planning (*Boverket*), the central agency of the Swedish government for planning, urban development, building and housing
- The Swedish Energy Agency (*Energimyndigheten*)
- National Judicial Board for Public Lands and Funds, which represents the public interests in decisions on use of water areas, particularly inside the territorial Sea.
- The regional state authority (*Länsstyrelsen*) for the region in question
- The environmental Court, set up according to the Environmental Code
- The municipality

The licensing procedure in the Swedish EEZ is planned around the applications for and issuing of required licences, and around the obliged actions based on the environmental code. As the activity is considered to have significant environmental impact an EIA is always necessary in the EEZ:

- Initial contacts with concerned authorities and local interested parties for e.g. analysis of alternative locations are made.



- An application must be made for a permit for sea bottom explorations in accordance with the Act on the Continental Shelf.
- An early consultation round according to the environmental code is organised.
- The county administrations' decision concerning whether the activity shall be considered of significant environmental impact is adopted (for offshore wind project this is always the case, which means an EIA has to be carried out).
- An application is to be made for the right of disposition of public waters.
- If necessary: A notice is published in accordance with the Espoo Convention, if significant environmental impact in a neighbouring country is to be expected.
- An extended consultation round is held in accordance with the environmental code for projects with significant environmental impact (all offshore wind farms).
- An application is submitted for a permit according to the environmental code (collision risk analyses for offshore wind projects is a mandatory part of the EIA)
- An application is submitted for a building permit, for the concession for cabling and access to the grid and for a permit for water activities according to chapter 11 of the environmental code.

Sweden does not apply a pre-phase for the application process for offshore wind energy development. However, before applications are submitted, suitable areas have to be designated and some preparations for the EIA have to be made, which include the early consultation round according to the environmental code.

Exclusive rights are granted to wind farm operators, which excludes the possibility for others to develop a competing wind farm on the same location. The initial permit is turned into a water lease agreement with the government. During the permit process other interests such as fishery, shipping, navigation are weighed on their merits [9]. So far Sweden has not carried out an SEA for their territorial or EEZ sea areas or offshore wind energy development in those areas.

#### 5.1.2 Participation process

The legal foundation for the participation process within the licensing procedure of KF II is the EIA-Directive. In Sweden the EIA Directive is mainly implemented by Chapter 6 of the Swedish environmental Code, which was adopted in 1998 and entered into force on 1. January 1999, and a supporting Ordinance on EIA (1998:905).

During the period December 2002 up and to including April 2003, Sweden Offshore has carried out early consultation with the Skåne County Council, relevant authorities



and communities and with the general public of those communities. Early consultation has also been carried out with the commercial fishermen that use Kriegers Flak, with the Swedish Fishermen's Federation and with the Central Organisation for the West Coast Fishermen. Before the meetings with the authorities and the communities, the participants received written information about the company and the project.

Early consultation was carried out with the following authorities: The Swedish National Board of Fisheries, the Swedish Maritime Administration and the Civil Aviation Authority. In November 2002, Sweden Offshore sent basic information to the National Board of Fisheries and the Maritime Administration. Both authorities provided written statements.

From November 2003 to November 2004 the extended consultation process was carried out. The consultation information packs, including attachments, were sent to 60 different parties. Consultation meetings were held with 17 parties and the remaining 43 were invited to send written comments and viewpoints to the company. 30 of those choose to participate in the written consultation process.

Within the context of the Espoo Convention, the National Environmental Protection Agency informed Denmark and Germany. The scope and the layout of the information material, was decided directly between the two countries and the Agency. [6].

## **5.2 Germany - Kriegers Flak I**

For the German site of "Kriegers Flak", Offshore Ostsee Wind AG, a joint subsidiary of Offshore Ostsee Wind AG a subsidiary company of the German WPD Offshore Ltd and the Wind -Project Ltd, has submitted an application for approval of the Kriegers Flak I project with 80 turbines generating 330 MW in May 2001. The construction permit for Kriegers Flak I was granted in April 2005.

As the planning instruments for marine spatial planning in the Exclusive Economic Zone are now available and the determination of preferred areas for offshore wind farm development has become mandatory, it will be possible in future to approve the construction of larger numbers of wind turbines in preferred areas for wind farm development, which implies that other, more sensitive areas can be kept free from such installations [7].



Pict. 7 Wind farm Kriegers Flak I German EEZ  
Source: Offshore Ostsee wind AG

### 5.2.1 National policy, legal framework and administrative procedures

The goal the Federal government set itself is to double the share of renewables in the energy supply by 2010. The goal is for 4.2% of primary energy consumption to be covered by renewable energy sources. The share in gross electricity consumption is to be increased to 12.5%. The medium-term objective for the Federal government is to increase the share of renewable energy in the electricity provision to at least 20% by 2020. In the long run, i.e. by 2050, at least half of the energy supply is to be met by renewable energy.

The Strategy of the German Government on the use of offshore Wind Energy sets the goal to install 2,000 MW of offshore wind energy capacity by 2010.

The period in which high feed in taxes are guaranteed to offshore developers has been prolonged by the Erneuerbare-Energien-Gesetz (EEG) in 2004. Another law that should help to speed up the process of adequately extending the electricity grid for the purpose of a further growth of mainly offshore wind power, the 'Infrastrukturplanungs-beschleunigungsgesetz', has been adopted in 2006.

The legal basis for the erection of wind farms in the German EEZ is the United Nations Convention on the Law of the Sea of 10 December 1982 and the German Federal Maritime Responsibilities Act (*Seeaufgabengesetz*), implemented by the Marine Facilities Ordinance (*Seeanlagenverordnung*), which is the basis for the

approval procedure. It requires that a wind farm project has to be approved provided that

- a) it does not impair the safety and efficiency of navigation, and
- b) it is not detrimental to the marine environment [21].

The EU Directive on Environmental Impact Assessment 97/11/EG, 85/337/EEG has been implemented into German national law as of 3 August 2001 with Act on the implementation of the directive to change the EIA, the IPPC directive and other EU directives aimed at environmental protection (*Gesetz zur Umsetzung der UVP Änderungsrichtlinie, der IVU-Richtlinie und weiterer EU-Richtlinien zum Umweltschutz*) (3 August 2001). All installations and operations of technical buildings are covered within the scope of this law. For wind parks of more than 20 wind turbines, the law requires a full environmental impact assessment. The Marine Facilities Ordinance states that the Federal Act on Environmental Impact Assessment will apply for offshore wind parks in the EEZ.

The licensing procedure in the German EEZ according to the Marine Facilities Ordinance consists of several phases:

Upon receipt of a planning application, it is first checked for completeness. If that is not the case, the applicant has the opportunity to correct and complete it. At the same time, in the first round of participation, the competent authorities (including the regional Waterways and Shipping Directorates, mining authority, Federal Environmental Agency, Federal Agency for Nature Conservation) are informed about the project application and asked to comment.

After evaluation of the first comments, a larger number of stakeholders took part in the second round of participation. It also involves associations (e.g. nature protection, commercial and small craft shipping, fisheries, wind energy associations) and the public, which has the opportunity to inspect the planning documents.

An important aspect of the approval procedure is an early involvement of the German coastal states, which have to approve the laying of land feeder cables through the territorial sea for the transport of electricity to onshore substations. Offshore wind farms normally have to be connected to the onshore grid through feeder cables. Cables to be laid on the seabed in the territorial sea have to be approved by the competent German coastal state.

Subsequent to the second round of participation, an application conference is held during which the applicant has the opportunity to give a presentation on the project. Conflicting interests and uses are discussed, and the scope of investigations required to study possible effects on the marine environment is determined. On the basis of

the environmental studies, the applicant prepares an EIA. A risk analysis dealing with the probability of vessels colliding with wind farm installations is also mandatory.

After having received the documentation from the applicant, the BSH passes it on to the competent authorities and associations, asking them to comment. This is followed by a discussion, during which the comments and information concerning the marine environmental features to be protected, the subject of navigational safety, and other interests and uses are discussed with all stakeholders. Parallel to this, the documents are once more available for public inspection and comment at the BSH.

Then, the BSH reviews whether the requirements for granting approval have been met. At the same time, the competent regional Waterways and Shipping Directorate reviews whether consent can be granted with a view to the safety and efficiency of navigation.

In case the BSH has received several applications for the same site, Art. 5 of the Marine Facilities Ordinance requires that the application which first meets all requirements for approval is decided first. An application is considered to meet all requirements for approval when all documents needed for the decision are available to the approval authority.

After both authorities have consented to the application and approval has been granted, a notification of approval is issued. An important part of each approval granted by the BSH for an offshore wind farm is the incidental provisions, which are issued in a largely standardised form. They include, among others, a limitation of the approval to a 25-year period, the requirement to start building the installations within 2.5 years after receiving the notification of approval, as well as requirements concerning

- safety in the construction phase,
- a state-of-the-art geotechnical study,
- use of state-of-the-art methods in the construction of wind turbines, prior to start-up,
- presentation of a safety concept,
- installation of lights, radar, and the automatic identification system (AIS) on the turbines,
- use of environmentally compatible materials and non-glare paint,
- foundation design minimising collision impact,
- noise reduction during turbine construction and low-noise operation,
- presentation of a bank guarantee covering the cost of decommissioning.

The decision on the development application is published in the German notices to mariners (NfS) and in two national papers and is available at the BSH for public inspection. It is sent to all authorities and associations involved in the approval procedure [22].

### 5.2.2 Participation process

In the case of Kriegers Flak I, Sweden and Denmark were considered as possible affected Parties and the transboundary cooperation with them was realised according to the Espoo Convention. Both were notified in December 2001 and were invited to a Scoping Conference in February 2002 in Germany but did not participate. The Swedish Environmental Protection Agency (SEPA) has the responsibility for the procedure in Sweden and sent the documents for comments to central and regional authorities and to organisations. The comments were sent to BSH in February 2004. In January 2004 Sweden and Denmark received EIA documents in English and a nontechnical summary in Swedish and Danish. SEPA published the display of the German EIA documents on its homepage and sent the documents for comments to authorities and organisations. All comments were sent to BSH in Swedish with a summary in English. The public had the possibility to send comments directly to BSH but it did not receive any such comments.

In September 2004 there was a hearing on the amended application documents where the Swedish Maritime Administration and Danish Maritime Authority participated. The project was approved on 6 April 2005 and the decision in German was sent to Sweden and Denmark, including a translation of the terms and conditions in English and Danish language. The SEPA distributed these documents to those in Sweden who had submitted comments. The decision on the cable will probably be taken in December 2005 [23].

### 5.3 Plans in the Danish part of Kriegers Flak

In August 2006 Danish Offshore Wind A/S has filed an open door application in Denmark to investigate an offshore windfarm of 91 turbines at the Danish side of Kriegers Flak (Kriegers Flak III), 25 km east of Mon. The company is a joint venture between WPD and Wind-projekt, and has also developed offshore wind farms on the German and Swedish side of Kriegers Flak.

*“If also the Danish side of “Kriegers Flak” would be used for wind power, the total complex could be the largest offshore wind farm in the world with up to 299 turbines and an output of up to 1,5 GW. It would also be the first international wind farm area with projects from three countries meeting each other.”<sup>10</sup>*

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<sup>10</sup> Danish Offshore Wind A/S (08/30/2006)



### 5.3.1 National policy, legal framework and administrative procedures

The utilization of renewable energy has played an important role in Danish energy policy over the last decades. Over the last fifteen years significant work has been conducted in the Danish offshore wind energy sector. A number of studies concerning the environmental impact assessment and siting of offshore wind turbines have been carried out. Between 1992 and 1995 the Offshore Wind Turbine Committee of the former Ministry of Environment and Energy conducted a mapping project in order to identify possible locations for offshore wind farms in Danish waters.

The mapping project tended to take into account all known interests in Danish waters, such as nature preservation areas, main shipping lanes and military areas etc.

As part of the *Danish Government's 2025 Energy Strategy* submitted on 17 June 2005 it was decided that the Offshore Wind Turbine Action Plan of 1997 should be updated.

In January 2007, the Government submitted its proposal "A Visionary Danish Energy Policy", the long-term visions of which include "*the share of renewable energy must be increased to at least 30% of gross energy demand by 2025*" and obtaining "*the least costs development of renewable energy*".

In 2005, the Danish Energy Authority began the work on a new plan for location of future offshore wind farms in the period from 2010 to 2025. The process builds on the Danish Action Plan on Offshore from 1997 as well as on experience from the Horns Rev and Nysted demonstration offshore wind farms and follows the principles of a SEA.

As a result of the Government's decision to find suitable sites for the future construction of offshore wind farms, at the end of 2005 the Ministry of Energy and Transport requested the Danish Energy Authority to appoint a committee with associated reference group<sup>11</sup>.

The committee has assessed society's interests in relation to grid transmission conditions, navigation, nature, landscape, raw material exploitation etc. and has examined in detail 23 specific possible sites each of 44 square kilometres to an overall area of 1012 square kilometres divided between 7 offshore areas (see map below).

Recommendations concerning navigational safety are given to each possible site.

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<sup>11</sup> The composition of the committee enfolded i.a. the Danish Maritime Authority with responsibility for navigational safety and safety at sea.

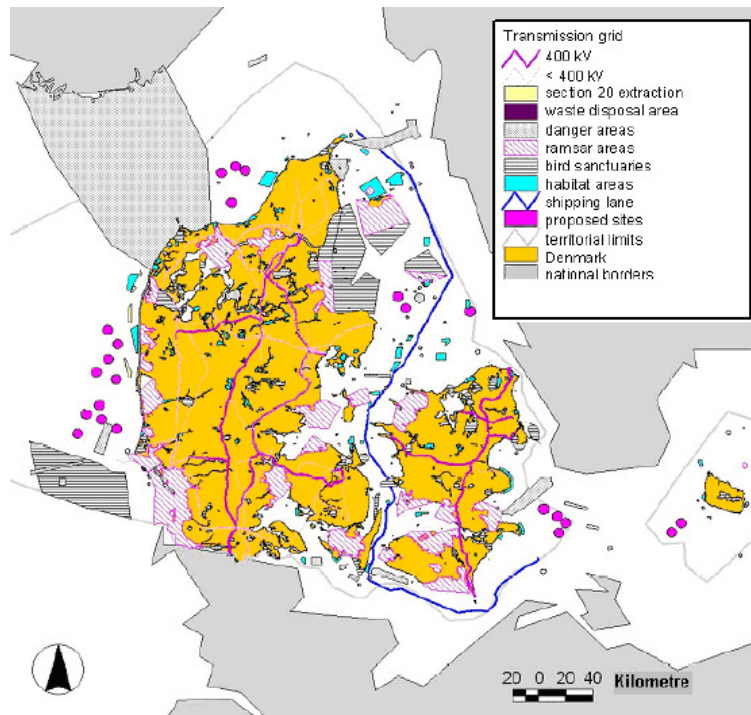


Fig. 1 Recommended Offshore Wind Power Sites [24]

The committee recommends that the first farms be constructed at Djursland-Anholt in the Kattegat and Horns Rev in the North Sea. Finally, the committee recommends sites at Store Middelgrund in the Kattegat and Kriegers Flak and Rønne Banke in the Baltic Sea.

In the area of Kriegers Flak the committee recommends 4 locations for windfarm of each 200 MW. On short time two windfarms on the shallow areas and in the long term two further ones in the deeper parts of this area. (see map below).



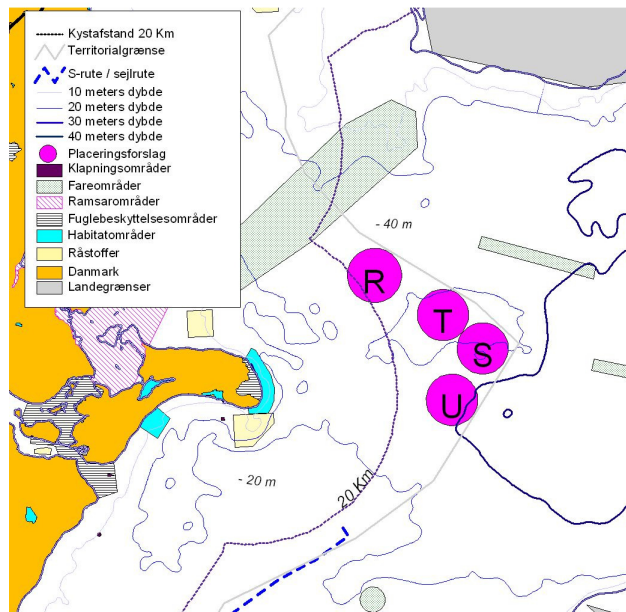


Fig. 2: Recommended 4 locations in the area of Kriegers Flak [24]

In the frame of the Energistyrelsens screening 2003-2004 it was recommended, that impacts on navigational safety should be handled through transnational coordinated considerations between Sweden and Denmark and cumulative risk assessments, as both windparks will have consequences on navigational safety in the same sea area.

When planning the detail location and design of offshore wind farms it is assumed that navigation safety, options for fishing, raw material extraction and nature conservation interests etc will be specifically evaluated. For example, it may be expected that in general a ship collision risk analysis will be required as part of the EIA report. In the preceding planning stage, area and time coordination must be carried out so as to combine pre-investigation activities in the best possible way and so that one interest/activity does not automatically exclude the other.

The committee has assessed opportunities for prioritising the suitability of potential areas relative to each other [24].

The procedure for establishing offshore wind farms has been gradually developed as experience has been gained with the first eight Danish offshore wind power projects. The Danish Energy Authority functions as a one-stop-shop in relationship to the many, often opposing, interests connected to the establishment of offshore wind power projects.

Permissions for preliminary studies and for exploitation of wind energy at sea may only be given either after applications have been requested in connection with a call

for tenders, or in an open door procedure after an application has been made public and other interested parties have been given the opportunity to apply [30].

Offshore windfarms in Denmark are subject to specific regulations which imply that the operator must make a request for the right to exploit the wind energy offshore (*el-produktionsanlæg på havet 2000:815* (28 August 2000), *Lov om elforsyning, 1999:375* (2 June 1999)) as well as apply for a permit to install the windfarm. The Government, represented by the Ministry of Transport and Energy, is responsible for the authorization. The environmental impacts assessments of offshore wind turbine installations are made by the Danish Energy Board and include almost the same assessment criteria as the EIA:s for land-based installations.

The public is involved in the planning process for wind turbine installations in several stages: Firstly, before the drafting of regional plans and once more before the regional plan is adopted, secondly, prior to the proposal for a new municipal plan and previous to its announcement and thirdly, in connection with the announcement of a local plan [29].

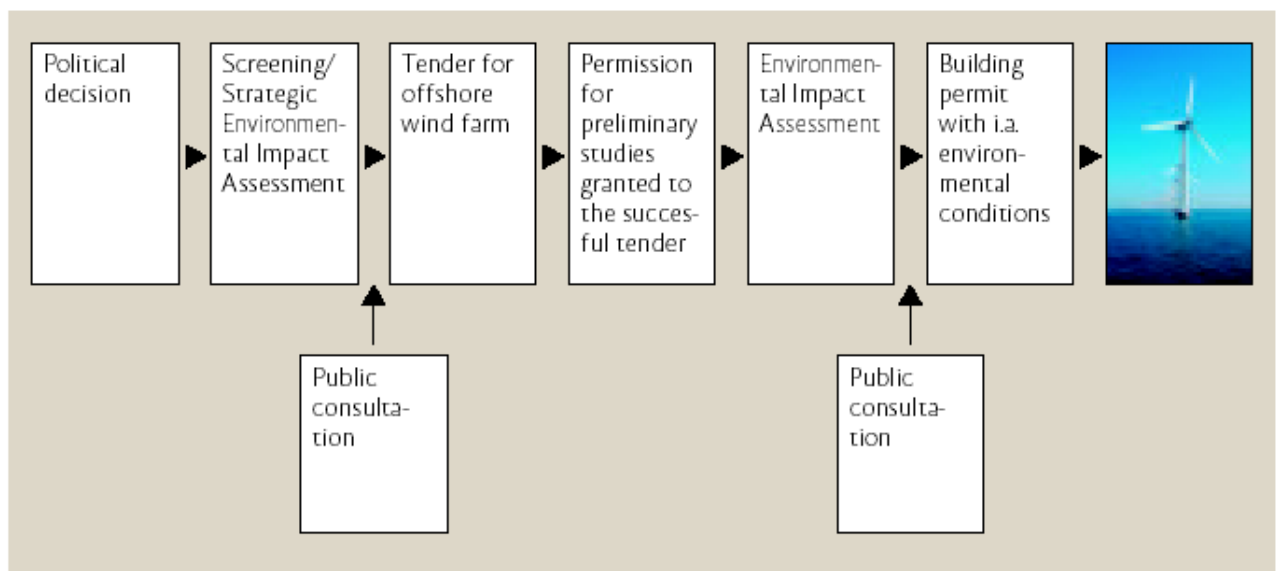


Fig. 3: The authorisation procedure for establishing offshore wind farms in Denmark following a tender procedure, source: Danish Energy Authority [30]

The Danish planning regime for offshore wind turbines includes a number of laws and statutory orders.

5 permits required:

1) a permit for preliminary survey with the obligation to carry out an EIA (the EIA is subject to public hearing)<sup>12</sup>

<sup>12</sup> vurdering af virkningerne på miljøet (VVM)

- 2) a permit to establish the installation: a building permit including cables (subject to public hearing)
- 3) a permit to exploit wind energy
- 4) an additional permit to produce electricity at installations with a capacity of more than 25 MW (not particularly wind energy; all existing electricity producing companies with power production larger than 25 MW must be awarded such a licence. Each enterprise will only need one permit – independent on the amount of power production installations.)
- 5) a permit for the construction of cables for a new electricity transmission grid in territorial waters and the EEZ (until now, the transmission companies have been responsible for, and have covered the costs of the installation of the grid connection of the Danish large scale offshore wind power plants).

The right to exploit wind energy within the Danish waters belongs to the State and permission to conduct preliminary studies and to exploit wind energy at sea is granted by the Danish Energy Authority.

The procedure for establishing offshore wind farms has been gradually developed as experience has been gained with the first eight Danish offshore wind power projects. The Danish Energy Authority functions as a one stop shop in relationship to the many, often opposing, interests connected to the establishment of offshore wind power projects.

Permissions for preliminary studies and for exploitation of wind energy at sea may only be given either after applications have been requested in connection with a call for tenders, or in an open door procedure after an application has been made public and other interested parties have been given the opportunity to apply [24].

Once the EIA procedure has been completed, the Danish Energy Authority prepares the final authorisation for the establishment of the offshore wind farm in question. This is done according to detailed conditions that reflect both the EIA report's conclusions and consultation responses from the general public and the authorities concerned. Public consultation of the EIA report is an open and flexible process that makes it possible for the Danish Energy Authority to clarify and prioritise the various - and often opposing - interests associated with the establishment of an offshore wind farm.

The authorisation issued by the Danish Energy Authority is made public. Any party with justified and individual interest in the decision has the right to register a complaint with the Energy Appeal Board regarding the decision's environmental aspects. The authorisation may not be acted upon before the appeal deadline has expired. Once authorised to carry out a project, the permit holder must provide the

Danish Energy Authority with documentation proving that the conditions in the permit issued have been fulfilled. This must be done in the form of a detailed project for the installation works. The permit holder may begin to install the offshore wind farm only after the Danish Energy Authority has determined that the documentation submitted is sufficient [25].

### 5.3.2 Participation Process

The establishment of offshore wind farms requires permission for preliminary surveys as well as an approval of the project – a building permit. Both of these permissions depend on a process of public consultation. When, on the basis of preliminary studies, an application (including an EIA report) has been submitted, the Danish Energy Authority submits this material for public consultation with a deadline of at least eight weeks [30].

Once the processing of the application for Kriegers Flak III has started, the Danish Energy Authority has announced in nationwide newspapers, that they have received the application.

This will also serve as a call for other applicants who might be interested in the area. The Danish Energy Authority will also call for input to what should be covered in the environmental assessment. According to the Espoo convention Germany and Sweden will be consulted in this process as well.

When the developer has created the draft environmental assessment the Danish Energy Authority will seek the assistance of other authorities in order to approve the project, or cancel it if necessary [27].

## Chapter 6 Offshore Windfarm development and Marine Spatial Planning

Particularly the location of large scale wind farms offshore has triggered a need to balance the different uses of the Sea. Therefore, finding new areas for the location of offshore wind farms underlines the need for a strategic planning at Sea.

The relationship between marine transportation and offshore wind farm development can be described as both, spatial and functional. Marine transportation use space in exclusive and non- exclusive ways. Marine transportation is spatially exclusive when issues of safety are concerned. There is an increased risk of collisions and accidents in confined and crowded spaces.

Most potential conflicts of interest between navigation and offshore wind farm development apply to areas already known in the planning phase, thus severe conflicts of interest can theoretically be avoided through careful, open planning across sectors and in a geographic context.

In consequence the *Copenhagen Strategy 2005 on European Offshore Wind Power Deployment* recommends the establishment and use of marine spatial planning instruments to arrive at optimal site selection.

As navigation is the most traditional use of the sea, adequate expanded and efficient and safe to sail shipping lanes form the basic grid of any spatial organisation in the territorial waters and the EEZ. Based on this priority Marine Spatial Planning applied in the EEZs is an effective tool to manage the patterns of marine uses and diminish conflicts between different marine uses.

The spatial planning process provides that environmental impact data and monitoring information are taken into account as well as the exchange of information and experience gained by already realised offshore wind farm projects like Horns Rev or Nysted.

Whilst recognising the benefits of sectoral SEA, Marine Spatial Planning offers additional benefits including integration of clearly articulated environmental objectives with economic and social objectives, reconciling conflict between different sectors of human activity as well as between the full range of human activities and the environment, and bringing more certainty to developers and others earlier in the decision making process.

First experience with MSP is currently gained in Germany, where the MSP initiatives started in December 2001.

One motive was the different competences for approval of activities (especially offshore wind farm development) in the EEZ and territorial waters in combination with more intense and diverse uses of oceans and coastal waters that create conflicts among different users.

In July 2004 an amendment of the Federal Regional/Spatial Planning Act entered into force that stated that the Federal Ministry of Transport, Building and Urban Affairs (BMVBS) shall make a statutory instrument setting out the objectives and principles of regional/spatial planning in the EEZ. The planning initiative for the EEZ started with the Federal Ministry setting up goals and principles for this spatial planning. Presumably these objectives and principles will be implemented as statutory ordinance in 2008.

## **Chapter 7 Conclusions – Lessons to be learned**

This Case Study clearly indicates that even though the national legal preconditions for wind power implementation differ considerably between Sweden, Denmark and Germany, the issue of maritime safety is included adequately in all three countries' offshore development efforts.

This is due to the facts, that all three countries made a pre-selection of preferred areas for offshore wind energy development and that international law like UNCLOS and IMO conventions like COLREG lead to Traffic Separation Schemes. . In addition preparing risk analysis concerning collision is an obligation in all three countries' application procedures.

From the perspective of shipping administration and industry offshore wind turbines are regarded predominantly as a new activity in competition with the traditional use of the Sea as shipping area. Therefore, and due to the present growth rates of ship traffic finding new areas for the location of offshore wind farms underlines the need for a strategic planning at Sea.

This need is highlighted by the draft proposal of an overall EU maritime strategy "Towards a future Maritime Policy for the Union: A European vision for the oceans and seas" and by the marine strategy "Towards a strategy to protect and conserve the marine environment". The latter suggests: *"the maritime sectors must arrange their activities with a view to achieving the objectives for good environmental conditions at sea by 2021"*.

Although only named as such in Denmark and Germany the pre-selection processes of preferred areas for offshore wind energy development belongs to a SEA. The involved parties get the opportunity to assess cumulative environmental consequences – risks and benefits of a programme for offshore wind in a national and in a transboundary context where necessary, and to identify mitigating measures and actions at an early stage. Furthermore performing an SEA gives a good indication of topics which need to be addressed in detail in the applicants' EIA.

While hereby explicitly no safety risk concerning the offshore wind industry and the presently applied planning procedures can be stated in the countries Denmark, Germany and Sweden the integrative approach of Marine Spatial Planning still is recommended for the following reasons:

As MSP provides a framework for regional or local projects, for example port development planning it ensures – above the participation and consultation procedures from EIA and SEA- a cross-sectoral debate and joined - up decision-making involving maritime authorities as well as transport departments or ministries at the planning stage rather than on the project stage.

Once MSP is established it brings information efficiencies - the information held in MSPs will not have to be repeatedly collected through sectoral SEA - and as the information resource is built up, it should be the case that less detailed mapping is required for specific EIAs.

An established transboundary system of MSP is very challenging considering the above mentioned reasons.





## Chapter 8 Recommendations

- To ensure long-term continuity, MSP will require a legal framework.
- Integration of planning and plans across international borders in the Baltic Sea still remains a challenge. Cumulative effects of offshore wind farm development should be assessed in a transboundary context. MSP, SEA and EIA are complementary tools in assessing and addressing cumulative effects.
- A commitment to MSP will give an impetus to tackle long standing issues such as providing clear environmental objectives at a broad scale.
- Provided that the agreed planning guideline is that shipping lanes define the basic structure of any marine spatial plan, new technologies like Automatic Identification System (AIS) and Global Positioning System (GPS)-based instrumentation should be applied to give information on existing traffic patterns. This may result in the adoption of Shipping Clearways<sup>13</sup> to prevent installations being located in recognised Sea lanes and navigational channels.
- Synergies are to be gained when e.g. AIS maps are being used by different governmental bodies or decision makers, which avoids a massive duplication of effort and resources.
- Next to the long term aligned MSP the active designation and adaptations of routing measures or Vessel Traffic Services (VTS), each conforming to IMO standards, will have an important role to play in reducing risks to all marine activities and to the environment.
- Necessarily experiences gained from extensive monitoring of the first offshore wind farms should be use for assessing the impact of offshore wind farms, and for giving a firm scientific basis for any Marine Spatial Planning.
- New routing regulations like traffic separation schemes could be easily synchronized by a common Marine Area Spatial Planning. For a common MSP approach partly existing networks (VASAB 21, HELCOM) could be used.

As it takes several years to establish MSP in the different countries, in the meantime much can be achieved by undertaking SEA of particular sectors, such as those completed for offshore wind farms in Germany and Denmark which would facilitate the development of a spatial planning system like it does in Germany. The data

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<sup>13</sup> The view of many navigation practitioners is that the “Shipping Clearways” adopted for Offshore Oil development should be applied equally to offshore wind developments.

gained should be treated in a way that the use for MSP and transboundary MSP approaches are facilitated.

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## Annex

### Annex 1 List of contacted Persons

Name	Institution
Aldo Chircop Mail: aldo.chircop@dal.ca	LL.D. (Malta); LL.M.; J.S.D. (Dalhousie)
Mr. Peter HART Mail:GI5@bmu.bund.de	Head of Division, Federal Ministry of Environment, Nature Conservation and Nuclear Safety, GI5@bmu.bund.de
Achim Berge Managing Director Phone: +46850320-640 E-mail:a.berge@wpd.se	WPD Scandinavia AB
Raven Kurtz Wasser- und Schifffahrtsdirektion Nord, Phone.: (0431)3394-8120 Fax.:(0431) 3394-6399 Mail: rkurtz@wsd-nord.de	Wasser- und Schifffahrtsdirektion Nord, Dezernat Schifffahrt (Waterways and Shipping Directorate North, Shipping Division) Hindenburgufer 247 24106 Kiel
Dr. Nico Nolte D-20359 Hamburg Bernhard-Nocht-Str. 78 Phone: +49 (0) 40 3190-2190 Fax: +49 (0) 40 3190-5000 Mail: nico.nolte@bsh.de	Bundesamt für Seeschifffahrt und Hydrographie (BSH)
Susanne Endrulat D- 20359 Hamburg Phone: +49 (0) 40 3190-2151 Fax: +49 (0) 40 3190-5000 E-mail: susanne.endrulat@bsh.de	Bundesamt für Seeschifffahrt und Hydrographie (BSH)
Asa Marklund Andersson E-mail: asa.marklundandersson@sustainable.ministry.se	Division for Legal Services, Ministry of Sustainable Development
Jens Peter Hartmann (AIS) Head of inspectorate DK-Overgaden o. Vandet 62 B1415 København K Phone: (+45) 32 68 95 00 Fax (+45) 32 57 43 41 Mail: jph@fomfrv.dk	The Royal Danish Administration of Navigation and Hydrography
Klaus de Buhr DE 20539 Hamburg 3984 Billstraße 84 Phone: +49-40-428 453005 Fax: +49-40-428 45 mail: klaus.debuhr@bsu.hamburg.de	Hamburg Ministry for Urban Development and the Environment
Christian Schiødt Larsen DK 1023 Copenhagen K Overgaden o. Vandet 62B Phone: +45 32 68 95 97	Chief Officer / Nautical Case Officer ,Royal Danish Administration of Navigation and Hydrography

E-mail: csl@frv.dk	
<b>Seminar on offshore windfarm development on Kriegers Flak and the issue of maritime safety, Trelleborg, 12th December 2006</b>	
Mette Cramer Buch DK-1256 Copenhagen K Amaliegade 44 Phone: +45 3392 7572 E-mail: mcb@ens.dk	Danish Energy Authority, Ministry of Transport and Energy
Inger Alness SE 106 48 Stockholm Sverige/Sweden Tel: +46-08-698 13 58 Fax: +46-8-698 14 80 Inger.alness@naturvardsverket.se	Swedish Environmental Protection Agency
Anders Björk SE- 631 04 Eskilstuna, Kungsgatan 43, Phone: 016-544 20 00, Fax: 016-544 20 99, E-mail: registrator@energimyndigheten.se	Swedish Energy Agency, STEM
Jessica Johansson SE-400 22 GÖTEBORG T Phone: +46 31 772 9000 Fax: +46 31 772 9124 E-mail: Jessica.Johansson@sspa.se	SSPA Sweden AB
Göran Loman Stortorget 3 211 22 Malmö Phone: 040-664 46 15 Fax: 040-664 46 30 E-mail: kriegersflak@vattenfall.com	Projektleader, Vattenfall AB

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## Figures

## Glossary

AIS	Automatic Identification System
BSH	Federal Maritime and Hydrographic Agency
COLREG	Convention on the International Regulations for Preventing Collisions at Sea
EEG	The Renewable Energy Sources Act
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
Espoo Convention	Convention on Environmental Impact Assessment in a transboundary context
GL	Germanischer Lloyd
GPS	Global Positioning System
HELCOM	Helsinki-Kommission
IALA	International Association of Lighthouse Authorities
IMO	International Maritime Organisation
MSP	Marine Spatial Planning
SEA	Strategic Impact Assessment
SMHI	Swedish Meteorological and Hydrological Institute
SOLAS	Safety of Life at Sea Convention
SSPA	provides services in the areas ship design and maritime operations
TSS	Traffic Separation Schemes
UNCLOS	United Nations Conventions on the Law of the Sea
VASAB	Vision and Strategies around the Baltic Sea - Intergovernmental multilateral co-operation of 11 countries of the Baltic Sea Region in spatial planning and development.
VTs	Vessel Traffic Service



Please address any enquiries to:

Sybille Schnegelsberg

GAUSS mbH

Werderstrasse 43

28199 Bremen

Germany

Telephone:

Work: 0049 421 59054857

E-mail: [gauss@gauss.org](mailto:gauss@gauss.org)



  
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