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ENERGY ISLAND BORNHOLM
SCOPING REPORT – RADAR AND RADIO INTERFERENCE

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CONTENTS

1. SUMMARY

This scoping report defines the work to be carried out in relation to assessment of potential interference between offshore structures and radar and radio systems as input to the Strategic Environmental Assessment for Energy Island Bornholm. The report defines the area to be assessed, the data to be collected, as well as the overall methodology for performing the analysis of interference.

Furthermore, the scoping report includes a short description of aviation related issues and potential airspace conflicts between the windfarms and the air traffic to Bornholms Airport.

2. INTRODUCTION

The energy islands mark the beginning of a new era for the generation of energy from offshore wind, aimed at creating a green energy supply for Danish and foreign electricity grids. Operating as green power plants at sea, the islands are expected to play a major role in the phasing-out of fossil fuel energy sources in Denmark and Europe.

After political agreement on the energy islands have been reached, the Danish Energy Agency plays a key role in leading the project that will transform the two energy islands from a vision to reality. The islands are pioneer projects that will necessitate the deployment of existing knowledge into an entirely new context.

In the Baltic Sea, the electrotechnical equipment will be placed on the island of Bornholm, where electricity from offshore wind farms will be routed to electricity grids on Zealand and neighbouring countries. The offshore wind farms will be established approximately 15 km south-southwest of the coast and will be visible to the naked eye, but not dominate the horizon. The turbines off the coast of Bornholm will have an installed production capacity of up to 3,8 GW including overplanting.

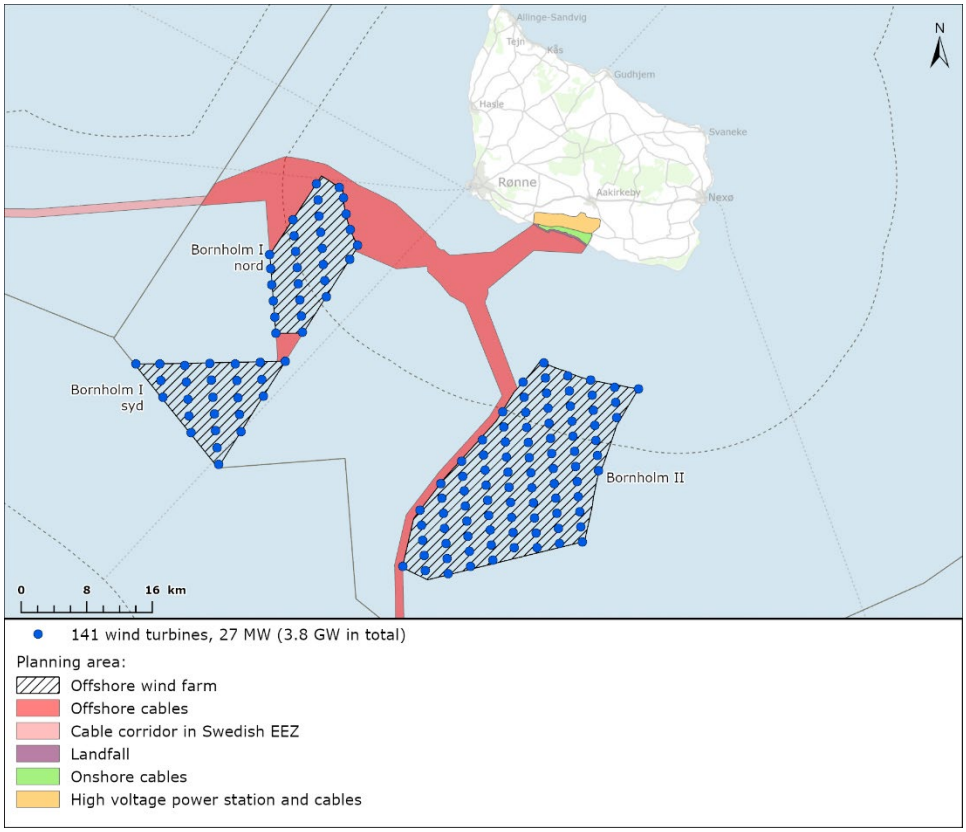

Figure 2-1 Planning area Energy Island Bornholm with tentative wind turbine layout.

The purpose of this report is to define the scope of work involved with the assessment of the interference between offshore structures of Energy Island Bornholm and external radar installations and radio chains.

This work package intends to map current civil and military radars and radio links, assess the consequences of the project on these and propose mitigation measures, as appropriate in close coordination with the Danish Ministry of Defence, Estate Agency (Forsvarets Ejendomsstyrelse). Also, civil radar and radio links must be included as well as weather radars, civil air traffic radars etc.

It is known from similar offshore wind farm (OWF) projects that radar operations may be disturbed by shadow effects and/or reflections of radar signals from the wind turbines. It is similarly known that wind turbines – if placed in the line of sight of a radio link system – may reduce/impair signals for telecommunication and data transmission.

The Client will initiate a process with the Danish Ministry of Defence, Estate Agency to secure assessments of worst-case conditions for impact on Danish Military radar, and radio link systems will be analysed according to EUROCONTROL guidelines.

3. AREA OF INVESTIGATION

The area of investigation comprises the three adjacent countries Denmark, Sweden and Germany in order to cover long range radio and radar systems such as weather radars or military surveillance systems.

4. METHODOLOGY

4.1 Methodology

The work to be executed for the intended assignment is divided into three major sections, which are data collection, assessment of interference, and proposal of mitigation measures.

4.2 Data collection

For the mapping of radar systems, data will be collected from relevant publicly available registers, authorities, private operators as well as through communication with relevant stakeholders.

Mapping of existing and planned radio links near the planning area will be carried out based on data collection from relevant public available registers (Frekvensregisteret) and authorities.

The following relevant entities have been identified:

Denmark

- DMI
- Søfartsstyrelsen
- Erhversstyrelsen
- Trafikstyrelsen
- Bornholms Lufthavn
- Danish telecommunication companies
- Marinestaben, Royal Danish Navy (contact by client)
- Flyverstaben, Royal Danish Air Force (contact by client)
- Forsvarets Ejendomstyrelse (contact by client)

Sweden

- Trafikverket
- Söfartsverket
- Post- och telestyrelsen
- Telekommunikationsföretag
- SMHI
- Försvaret

Germany

- GDWS, Generaldirektion Wasserstraßen und Schifffahrt
- DWD, Deutscher Wetterdienst
- Deutsche Flugsicherung
- Bundesnetzagentur
- Deutsche Telekommunikationsunternehmen
- Bundeswehr Marine
- Bundeswehr Luftwaffe

4.2.1 Required data on radar systems

To be able to assess interference between radar systems and offshore structures, the following information is relevant and will be collected where possible. General assumptions are done for the current impact assessment at plan level where detailed information is not available:

- Owner/operator, purpose of the system
- Radar location (this should include coordinates and associated spatial coordinate system). The precision should be to within single meters. For most existing systems, this should be publicly available information, but might not be the case for the defense systems. Also, an important distinction should be made that any analysis would only involve stationary systems (no mobile system installed on ships or aircrafts would be considered).
- Radar elevation (absolute elevation above mean sea level and associated vertical datum reference system). Precision should be to within 0.1 meters. This information may be specified for the base of the structure, but the goal is to estimate the center of the antenna, which may be calculated if the height of the structure (to the center of the waveguide feed) is also provided.
- Beam width: Operator should provide beam width [in degrees].
- Radar frequency [in (k/M/G) Hertz].
- Radar signal type: polarimetric, continuous, modulation, pulsed, doppler, etc. Are both reflectivity and phase shift used in product development? (Any specific radar characteristic that may be of interest should be included here).
- Range: The furthest range of any radar product (sometimes a given radar product may be developed for a given range). If multiple ranges are used, that info should be provided as well by specifying range and product, respectively.
- Range resolution: This is the size of the sampling volume in the direction of beam propagation. (Typically expressed in meters).
- Scanning pattern (this typically should involve the number of elevations with angle [in degrees] per each elevation. Also, specification should include information if those are full (360 deg) scans or sector scans.
- Typical target of interest: This will be different for different applications, but it is good to understand the typical characteristics of targets of interest.
- Known obstructions: (not critical), but if the radar is losing a portion of its power density, specifically in the direction of the proposed structures, it may be useful to understand that.
- Any existing clutter mitigation algorithms. Generally, each entity may have previously addressed similar issues, and this typically may be the path of least resistance, so worth knowing.

4.3 Required data on radio chains

To be able to assess interference between radio chains and offshore structures, the following information is relevant and will be collected where possible. General assumptions are done for the current impact assessment at plan level where detailed information is not available:

- Owner/operator
- Purpose of radio chain
- Location (coordinates of all elements of the radio chain: transmitter, transponder, receiver)
- Elevation (of all elements)
- Type of license (point to point, surface)
- Geographical area for surface license
- Frequency and modulation type (AM/FM radio, DAB, analog TV and digital TV, etc.).

4.4 Assessment

The assessment will be done individually for each radar location and radio chain location and envisages the following steps:

- Selection of affected systems: all radar systems and radio chains for which a spatial conflict cannot be ruled out from the outset are selected
- Spatial overlap of radar range and the Energy Island Bornholm project (EØB): this analysis contains a three-dimensional estimation of the volume of interference between the radar field of view and the proposed project. Since the design and configuration of the offshore structures (e.g., number, location and type of individual wind turbines) has not been finalized the estimation will be based on the scenarios provided by the client and, where necessary, on generalized assumptions of standard configurations and radar operating conditions.
- Spatial overlap between line-of-sight positions and radio target surfaces in relation to EØB Nature of interference, e.g., shadow, clutter, mirroring, blocking: this step contains a prediction and characterization of the expected impact on the radar and radio systems but does not quantify the effect.
  Significance of interference: the overall significance of a potential impact is assessed using the criteria defined in
- Table 41.
- Cumulative effects: the identified interferences will be assessed in relation to existing and planned offshore infrastructure projects. A selection of relevant project to be included in this assessment will be provided by the client.

Table 4-1 Criteria for overall significance of impacts.

Overall significance of interference	
Neutral/ no impact	No impact compared to status quo. Radar field of view/radio link does not include the proposed limits of the project.
Minor negative impact	Overlap exists and may lead to a marginal or minor but visible effect on the system. The system's ability to perform its functions is not affected.
Moderate negative impact	Overlap exists and may lead to potential deterioration of system's performance.
Significant negative impact	Significant overlap may lead to loss of radar system's ability to perform its function. Potential damage to the radar system should be considered. Evaluation of mitigation strategies will be required.
Positive impact	There are positive impacts on one or more of the above points.

The assessment will be based on the design and configuration scenarios for EØB provided by the client.

4.5 Mitigation

Mitigation measures will be discussed for each affected radar system or radio chain that have been identified as being moderately or significantly affected by the proposed project. A final selection of appropriate mitigation measures, however, cannot be determined at the stage of the SMV, since the design and configuration of turbines is not fixed yet. Selection of mitigation may require further detailed assessment of the system once the final configuration of the OWF is established.

5. DELIVERABLES

The deliverables under this work package (WP L) consist of:

- A scoping report describing on what data and with which methods the technical report will be based.
- A technical report on the project's impact on radars and radio link systems prepared in Danish and in English language.

6. MILESTONES

Table 6-1 Milestones and deadlines for work package L.

Work package	Milestone No.	Milestone	Deadline
WP L	M62	Scope report final	Dec. 2021
WP L	TBD	Technical report final (Danish)	TBD
WP L	M65	Technical report final (English)	TBD

7. AVIATION ISSUES

The location of the new windfarm is quite close to Bornholm and to Bornholm´s Airport at the South-Western corner of the island. Bornholm´s Airport is Denmark´s only state-owned airport administered by Trafikstyrelsen and operated by a local management team. The airport is as mentioned above located in the South Western corner of Bornholm with the coordinates 55°03'48"N 014°45'34"Ø close to Rønne town and to the sea in the western direction of the new windfarms.

The airport has a 2002 m long and 45 m wide runway and service all kinds of aviation comprising:

- Scheduled passenger traffic mainly to Copenhagen
- Charter traffic
- Cargo traffic
- General Aviation traffic (GA traffic)
- Search and Rescue traffic (SAR traffic)
- Military surveillance traffic

The airport is counted among the smaller airports in Denmark and had in 2021 180.000 arriving and departing passengers heavily influenced by the Corona pandemic.

The aim of this chapter and the technical report is to clarify if there will be any conflicts between the planned offshore windfarms on the one side and the operation of aircraft to and from Bornholm´s Airport on the other. In case any potential conflicts are identified we will carry out a risk analysis and present proposals of possible mitigating actions to reduce or eliminate the risks and conflicts.

The airport is a so-called precision approach CAT 1, 4C airport meaning that it is equipped with instrumental landing systems for safe landings under poor weather conditions.

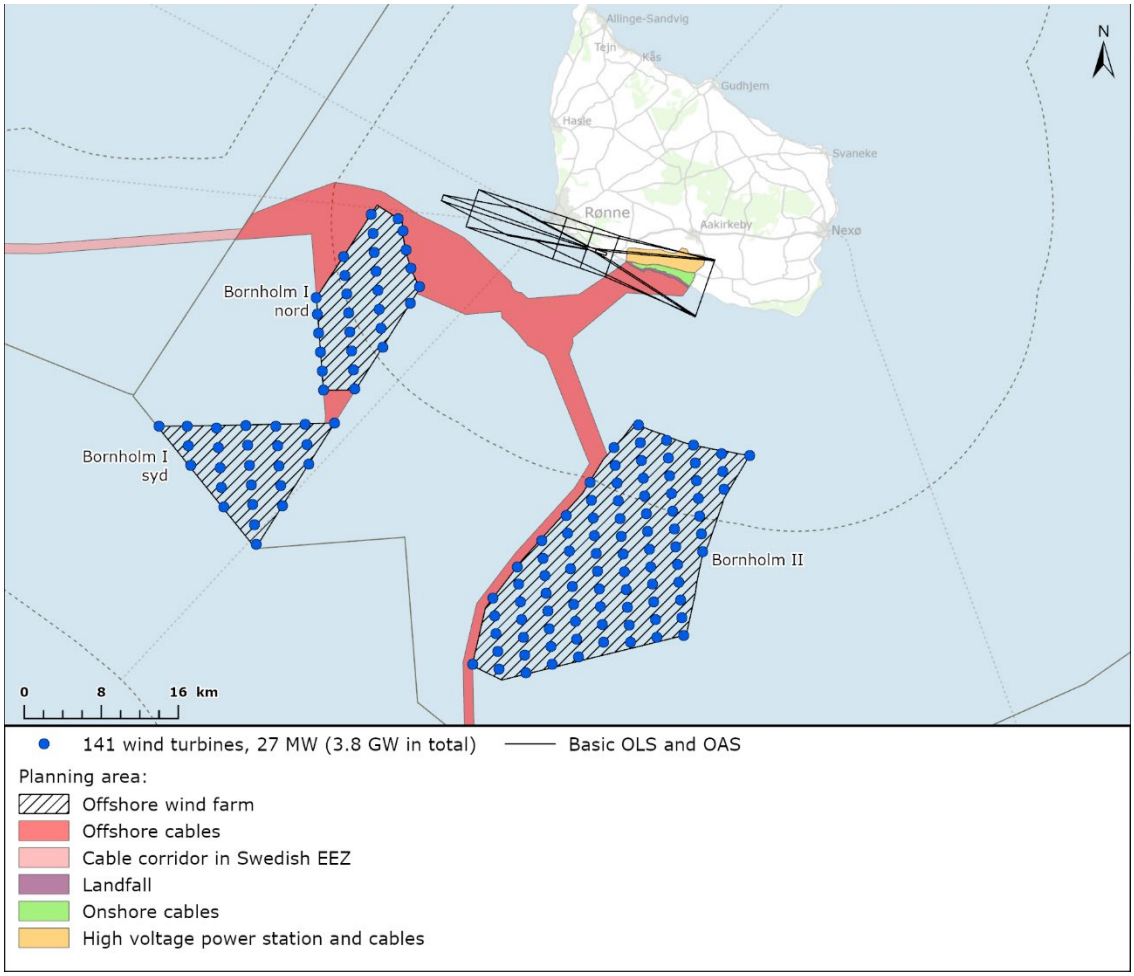

Figure 7-1: Obstacle limitation surfaces related to the windfarms

As shown in the above figure the location of Bornholm 1 and 2 will not interfere with the outer horizon for the instrument approach and landings with a 15 km distance between the windfarm and the airport. However, if the northern tip of the windfarm is moved closer to the airport to allow for more wind from the sea it may be necessary to move the upper rows of windmills to another location in the windfarm areas to avoid a conflict with the 15 km outer surface.

The above-mentioned analysis of aviation related issues and scope of work will comprise civil traffic, military traffic, helicopter traffic and drone traffic.