DOGGER BANK D WIND FARM

Preliminary Environmental Information Report

Volume 2
Appendix 16.2 Airspace Analysis and Radar Modelling

Document Reference No: 2.16.2
Date: June 2025
Revision: V1

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Document Title:	**Volume 2, Appendix 16.2 Airspace Analysis and Radar Modelling**
Document BIM No.	**PC6250-CRS-XX-OF-RP-EV-0070**
Prepared By:	**Cyrrus**
Prepared For:	**Dogger Bank D Offshore Wind Farm**

Revision No.	Date	Status / Reason for Issue	Author	Checked By	Approved By
V1	June 2025	Final	Cyrrus	PT	GA

Airspace Analysis and Radar Modelling

Dogger Bank D Offshore Wind Farm

18 October 2024

CL-5908-RPT-002 DA

www.cyrrus.co.uk

info@cyrrus.co.uk

Document Information	
Document title	Airspace Analysis and Radar Modelling
Author	Simon McPherson
Reviewed by	Peter Foulsham
Produced by	Cyrrus Limited Cyrrus House Concept Business Court Allendale Road Thirsk North Yorkshire YO7 3NY T: +44 (0) 1845 522 585 F: +44 (0) 8707 622 325 E: info@cyrrus.co.uk W: www.cyrrus.co.uk
Document reference and Version	CL-5908-RPT-002 DA
Date of release	18 October 2024

Change History Record

Issue	Change Reference	Date	Details
DA	Initial Draft	18 October 2024	Initial Issue
DA	Second Draft	29 November 2024	2nd Issue

Abbreviations

AARA	Air-to-Air Refuelling Area
AD	Air Defence
AIP	Aeronautical Information Publication
amsl	above mean sea level
ATC	Air Traffic Control
ATS	Air Traffic Services
BRA	Building Restricted Area
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CNS	Communication, Navigation and Surveillance
DA	Danger Area
DBD	Dogger Bank D
DME	Distance Measuring Equipment
DTM	Digital Terrain Model
ECC	Export Cable Corridor
FIR	Flight Information Region
FL	Flight Level
ft	feet
GIS	Geographic Information System
HMRI	Helicopter Main Routing Indicator
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
km	kilometres
LARS	Lower Airspace Radar Service
m	metres
MOD	Ministry of Defence
NERL	NATS (En-Route) plc
NSTA	North Sea Transition Authority
PEIR	Preliminary Environmental Information Report
PSR	Primary Surveillance Radar

RAF	Royal Air Force
RLoS	Radar Line of Sight
SAR	Search and Rescue
SRTM	Shuttle Radar Topography Mission
SSR	Secondary Surveillance Radar
SUA	Special Use Airspace
UAR	Upper Air Route
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VOR	VHF Omni Directional Range

References

[1] CAA (2024). UK Aeronautical Information Publication. Available at: https://nats-uk.ead-it.com/cms-nats/opencms/en/Publications/AIP/

[2] NSTA (2024). North Sea Transition Authority Open Data. Available at: https://opendata-nstauthority.hub.arcgis.com/search

[3] CAA (2016). CAP 764: Policy and Guidelines on Wind Turbines. Available at: https://www.caa.co.uk/our-work/publications/documents/content/cap-764/

[4] ICAO (2015). ICAO EUR DOC 015: European Guidance Material on Managing Building Restricted Areas. Available at: https://www.icao.int/EURNAT/EUR%20and%20NAT%20Documents/EUR%20Documents/EUR%20Documents/015%20-%20Building%20Restricted%20Areas/ICAO%20EUR%20Doc%20015%20Third%20Edition%20Nov2015.pdf

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1. Introduction

1.1. Overview

1.1.1. This document is an appendix to Chapter 16 Aviation, Radar and Military of the Dogger Bank D (DBD) Offshore Wind Farm (the Project) Preliminary Environmental Information Report (PEIR). It provides detailed airspace analysis and radar modelling, and outlines potential mitigation options where required.

1.1.2. Although the Planning Inspectorate has agreed that radar impacts across all phases of the development can be scoped out of further assessment, radar modelling is included in this document to provide the evidence that justifies this decision.

1.1.3. The DBD Array Area is approximately 262 square kilometres (km^2) within the North Sea off the north-east coast of England and lies approximately 210km from shore at its nearest point.

Impacts of Wind Turbines on Aviation

1.1.4. Wind turbines can be problematic for aviation Primary Surveillance Radars (PSRs) as the characteristics of a moving wind turbine blade are like an aircraft. The PSR is unable to differentiate between wanted aircraft targets and clutter targets introduced by the presence of wind turbines.

1.1.5. Secondary Surveillance Radars (SSRs) are less affected by wind turbines, but turbine towers can cause physical blanking and diffracting effects and reflections can result in the SSR outputting false targets.

1.1.6. The significance of any radar impacts depends on the airspace usage and the nature of the Air Traffic Service (ATS) provided in that airspace. The classification of the airspace in the vicinity of the Project and the uses of that airspace (civil and military) are set out in this document. Wind turbines can also have a direct impact on airspace due to their physical presence. The airspace analysis considers the impact wind turbines could have as obstacles for aviation activities such as military low flying, Search and Rescue (SAR) operations and offshore oil and gas helicopter operations.

1.1.7. Radar impacts may be mitigated by either operational or technical solutions, or a combination of both. In either case, the efficacy and acceptability of any operational and / or technical mitigation options available can only be determined through consultation with the radar operators and ATS providers.

1.2. Technical Data

1.2.1. Radar Data

1.2.1.1. All radar parameters used in the assessment have been taken from data held on file by Cyrrus.

1.2.2. Offshore PEIR Boundary

1.2.2.1. The offshore PEIR boundary was supplied as a geo-referenced Shapefile:

PC3991-RHD-OF-CR-M2-Z-0054_OffshorePEIRBoundary.shp.

1.2.2.2. The offshore PEIR boundary contains the DBD Array Area and offshore export cable corridor (ECC), as depicted in Figure 1. Note that surface piercing structures are not proposed to be installed within the offshore ECC.

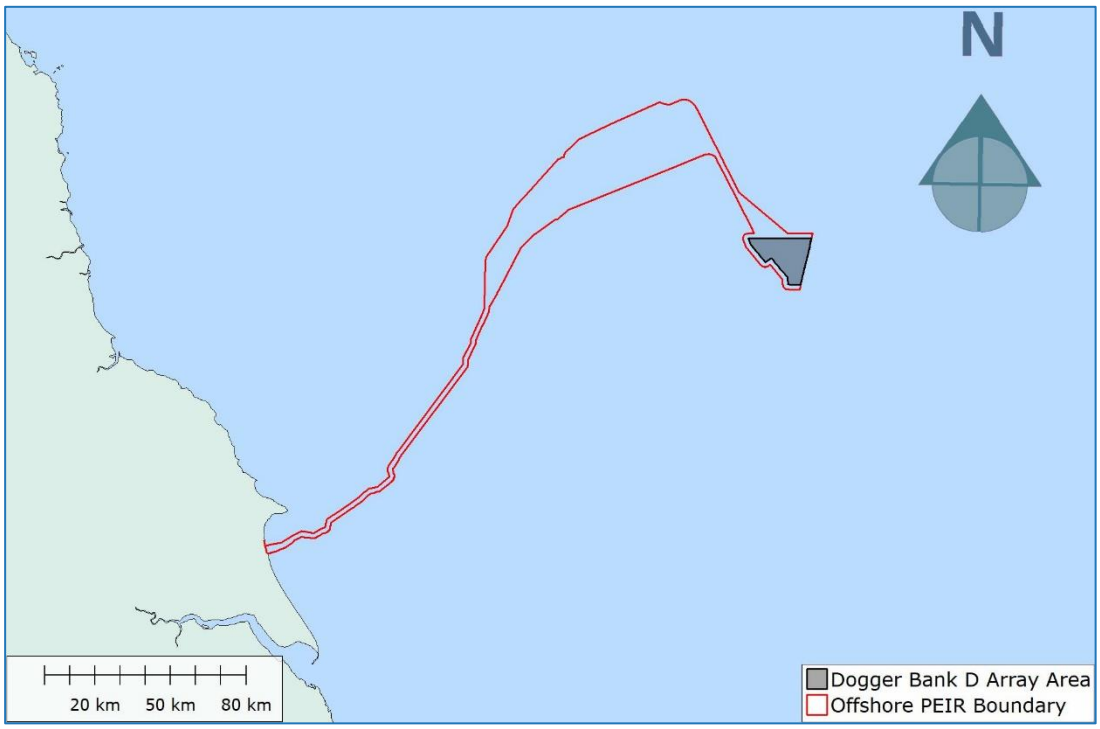

Figure 1: DBD Array Area

1.2.3. Onshore PEIR Boundary

1.2.3.1. The onshore PEIR boundary was supplied as a geo-referenced Shapefile:

PC3991-RHD-ON-CR-M2-Z-0059_OnshorePEIRBoundary.shp.

1.2.3.2. The onshore PEIR boundary is depicted in Figure 2.

Figure 2: Onshore PEIR boundary

1.2.4. Wind Turbines

1.2.4.1. The wind turbine design parameters are presented in Table 1.

Parameter	Smallest Wind Turbine	Largest Wind Turbine
Maximum blade tip height above mean sea level (amsl)	270 metres (m)	371m
Rotor diameter	236m	337m
Maximum number of wind turbines	113	59

Table 1: Wind turbine design parameters

1.2.5. Terrain Data

1.2.5.1. The following terrain data is used for the radar modelling:

Shuttle Radar Topography Mission (SRTM) V3 30m Digital Terrain Model (DTM).

1.2.6. Analysis Tool

1.2.6.1. The following software is used for the airspace analysis and radar modelling:

Blue Marble Global Mapper V25.1.2 Geographic Information System (GIS).

1.2.7. Mapping Datum

1.2.7.1. UTM Zone 31N (WGS84 datum) is used as a common working datum for all mapping and geodetic references.

1.2.7.2. Where necessary, mapping datum transformations are made using Global Mapper or Grid Inquest II Coordinate Transformation Program.

1.2.7.3. All heights stated in this document are amsl (Newlyn datum) unless otherwise stated.

2. Airspace Analysis

2.1. Introduction

2.1.1. This assessment is a review of potential impacts on aviation arising from the presence of wind turbines located in the DBD Array Area. Airspace altitudes are expressed in feet (ft), so for the purposes of this assessment a maximum blade tip height of 1,218 ft amsl for the wind turbines has been assumed, the equivalent of 371m rounded up to the nearest 1ft.

2.1.2. All airspace data has been referenced from the UK Aeronautical Information Publication (AIP) available online from source and is therefore the latest information available (Civil Aviation Authority (CAA), 2024)[1]. Additional information regarding offshore infrastructure has been sourced from the North Sea Transition Authority (NSTA) Open Data website (NSTA, 2024)[2].

2.1.3. The purpose of this assessment is to identify areas of potential impact, and does not draw any conclusions. Likely significant effects on airspace receptors are assessed in **Section 16.7** in **Chapter 16 Aviation, Radar and Military**.

2.2. Scope

2.2.1. The scope of the assessment includes the DBD Array Area and the surrounding airspace relating to aviation, its use and potential impact. The types of airspace and limitations on its use are identified.

2.3. Airspace Classification

2.3.1. In general, airspace can be characterised as either controlled or uncontrolled airspace. Aircraft in controlled airspace are being positively managed by Air Traffic Control (ATC) the entire time they are within that designated area (i.e. ATC are controlling the aircraft as opposed to providing advice and information on other traffic). This type of airspace is generally used by airlines and corporate aviation. Aircraft in uncontrolled airspace are operating within a framework of rules but are not being controlled by ATC, although many pilots flying in this environment may choose to report their position, altitude, and intentions to ATC to benefit from the enhanced situational awareness that brings. Users of this airspace tend to be small aircraft engaged in training or private (social) flying.

2.3.2. In addition, Special Use Airspace (SUA) is airspace designated for specific activities such that limitations on airspace access may be imposed on other non-participatory aircraft. An example of such airspace would be a Danger Area (DA) established for military flight training.

2.3.3. There are five classes of airspace in the UK, namely classes A, C, D, E and G. Classes A to E are types of controlled airspace, while class G is uncontrolled airspace. Class A is the most strictly regulated controlled airspace whereby aircraft are positively controlled by ATC, compliance with ATC clearance is mandatory, and aircraft are flown and navigated solely with reference to aircraft instruments. Certain onboard equipment is also a prerequisite.

Flight in class G airspace is generally visual, meaning pilots fly and navigate with reference to the natural horizon and terrain features they see outside. Pilots are required to maintain minimum distances from notified obstacles, including wind turbines, and may only fly within the minimum weather and visibility criteria.

Aircraft Vertical Reference

2.3.4. An aircraft's vertical reference above the ground or sea can either be an altitude amsl or, above a designated altitude, a Flight Level (FL). An aircraft's altitude, expressed in feet, is based on the last known verified local barometric pressure while a FL, expressed in 100ft increments, is based on a common international barometric pressure setting of 1013.2 hectopascals. With aircraft using a common vertical datum safe separation can be achieved by either ATC or between pilots of different aircraft.

2.3.5. The airspace where vertical reference changes from altitude to FL and vice versa is known as the Transition Layer and consists of a (lower) Transition Altitude and (higher) Transition Level. In UK airspace the Transition Altitude is set at 3,000ft amsl except in certain specified airspace where it is higher.

2.3.6. The vertical limits of airspace are defined in terms of either altitudes or FLs, with airspace commonly having a lower limit expressed as an altitude and an upper limit expressed as a FL.

2.4. Current Airspace Baseline

2.4.1. The DBD Array Area lies within both the London and Scottish Flight Information Regions (FIRs) which together form the UK FIR, airspace regulated by the UK CAA. The northern three quarters of the DBD Array Area is within the Scottish FIR while the southern quarter is in the London FIR, as shown in Figure 3. The boundary of the Scottish FIR with the Copenhagen FIR (regulated by the Danish Civil Aviation and Railway Authority) lies 122km east of the DBD Array Area at its nearest point. The boundary of the London FIR with the Amsterdam FIR (regulated by the Netherlands Inspectie Leefomgeving en Transport) lies 109km to the south-east of the DBD Array Area at its nearest point.

2.4.2. NATS (En-Route) plc (NERL) provides en-route civil ATS within the London and Scottish FIRs, supported by a network of radar facilities which provide en-route information on airborne traffic for both civil and military ATC.

2.4.3. A portion of UK FIR airspace known as North Sea Area V is delegated to the Netherlands. The eastern boundary of the DBD Array Area lies along the maritime boundary (median line) between the UK and the Netherlands and this also defines the western boundary of North Sea Area V. Within this airspace the Netherlands provides an ATS to all aircraft between sea level and FL55, approximately 5,500ft amsl. Procedures and communications within this area are as if the airspace was an integral part of the Amsterdam FIR. North Sea Area V is depicted in Figure 3, together with the FIR boundaries.

2.4.4. Also shown in Figure 3 is the EGD323 Southern Complex Danger Area (DA). This is discussed further in Section 2.5.

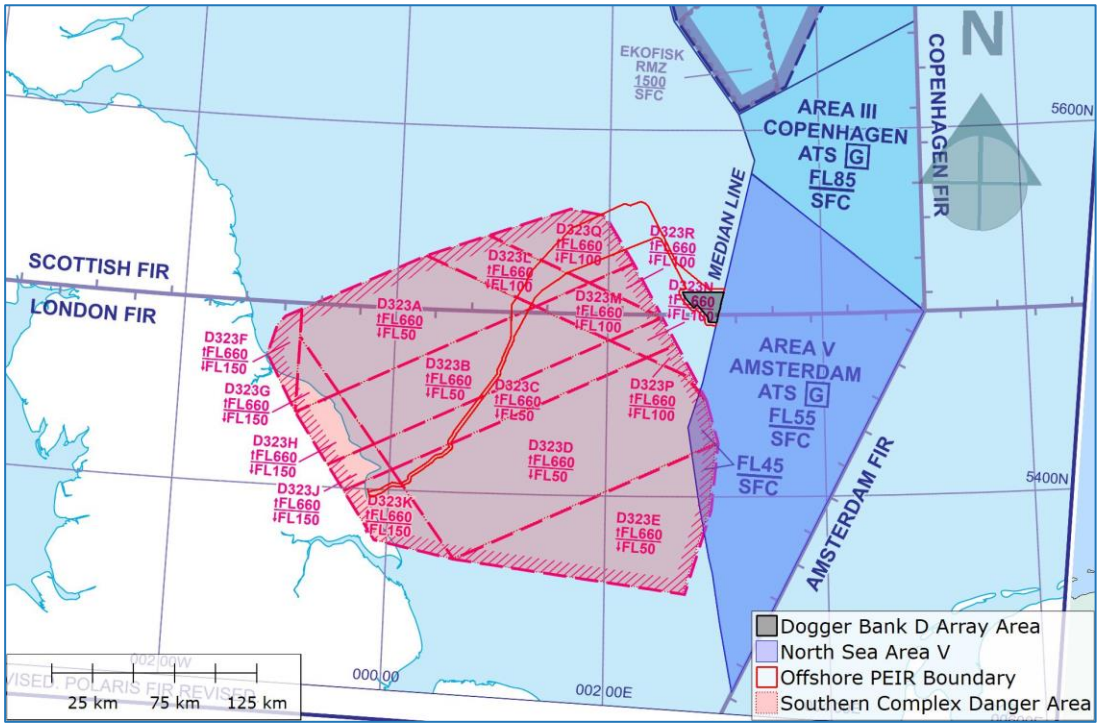

Figure 3: FIR boundaries and North Sea Area V

2.4.5. Immediately surrounding the DBD Array Area is uncontrolled class G airspace, extending from sea level to FL195, approximately 19,500ft amsl. This airspace is used by both civil and military aircraft, predominantly for low-level flight operations and generally by aircraft flying under Visual Flight Rules (VFR).

2.4.6. Aircraft operate under one of two flight rules: VFR or Instrument Flight Rules (IFR). VFR flight is permitted when the weather satisfies Visual Meteorological Conditions (VMC) and is conducted with visual reference to the natural horizon. VMC are weather conditions expressed in terms of visibility, distance from cloud, and ceiling equal to or better than specified minima. Under VFR flight the pilot is responsible for maintaining a safe distance from terrain, obstacles, and other aircraft.

2.4.7. Aircraft must be flown under IFR in class A controlled airspace and when weather restricts visibility, known as Instrument Meteorological Conditions (IMC). IMC exists when the weather conditions are less than the minima specified for VMC. IFR flight requires reference solely to aircraft instrumentation.

2.4.8. Above FL195 all airspace in the London and Scottish FIRs is notified as class C controlled airspace. The airspace between FL245, approximately 24,500ft amsl, and FL660, approximately 66,000ft amsl, is known as the Upper Airspace Control Area. This airspace includes Upper Air Routes (UARs), airways along which aircraft fly navigating via ground-based electronic aids or, increasingly, via Global Navigation Satellite System waypoints.

Airways are used where high levels of traffic move between areas. They may be standalone sections or embedded, either wholly or in part, within a segment of airspace.

2.4.9. UARs above the DBD Array Area are listed below together with their vertical limits:

L7 FL245 to FL460;
N44 FL245 to FL460; and
UP59 FL245 to FL460.

2.4.10. The UAR route structure in the vicinity of the DBD Array Area is shown in Figure 4.

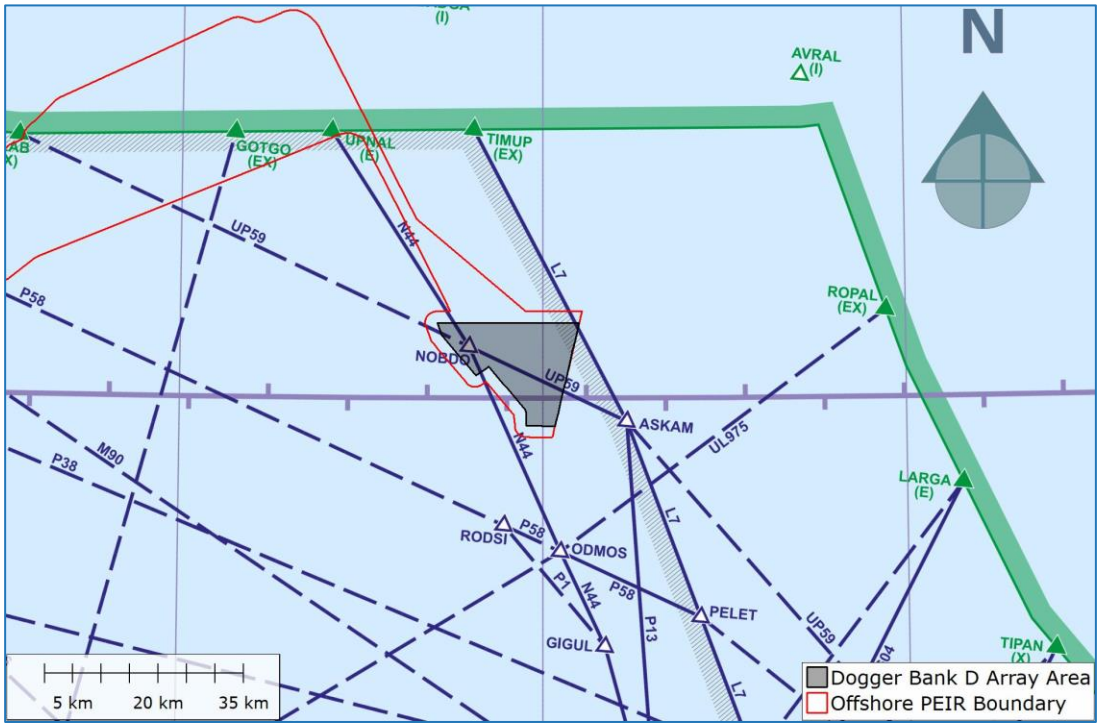

Figure 4: UARs in the vicinity of the DBD Array Area

2.4.11. Given the maximum blade tip height of 1,218ft amsl and the base of controlled airspace above, wind turbine structures would have no impact on aircraft operations within controlled airspace.

2.5. Special Use Airspace

2.5.1. The EGD412 Staxton DA lies more than 86km west of the DBD Array Area but is infringed by some of the offshore ECC, as shown in Figure 5. This airspace extends from the surface to 10,000ft amsl. Activities within Staxton DA include ordnance, munitions and explosives.

2.5.2. Most of the offshore ECC lies beneath the EGD323 Southern Complex DA, one of four DA complexes in UK airspace that provide segregated airspace for military flying training. Specifically, Figure 5 shows that the offshore ECC lies beneath DAs EGD323A, B, C, D, K, L and Q which, when activated, have vertical limits of no less than FL50, approximately 5,000ft

amsl, up to FL660, approximately 66,000ft amsl. Activities within the Southern Complex include high energy manoeuvres, ordnance, munitions and explosives, electrical / optical hazards and unmanned aircraft systems operating beyond visual line of sight.

2.5.3. The offshore ECC also lies partially beneath the EGD514 Combat Airspace DA, newly established airspace to support large-scale military training exercises predominantly over the North Sea. EGD514's vertical limits extend from FL85 (approximately 8,500ft amsl) to FL660 and activities within the airspace include high energy manoeuvres, ordnance, munitions and explosives and electrical / optical hazards.

2.5.4. DA airspace is not permanently active, but rather is activated on request and notified by appropriate agencies such as the Ministry of Defence (MOD) or CAA through the issue of a NOTAM (Notice to Aviation).

2.5.5. Figure 5 also shows that the DBD Array Area and offshore ECC partially lie beneath airspace designated as Area 07, an Air-to-Air Refuelling Area (AARA) with vertical limits of FL100 (approximately 10,000ft amsl) to FL290 (approximately 29,000ft amsl). Within AARA airspace, fuel is transferred from tanker aircraft to receiver aircraft under a Radar Control Service provided by military controllers based at Swanwick.

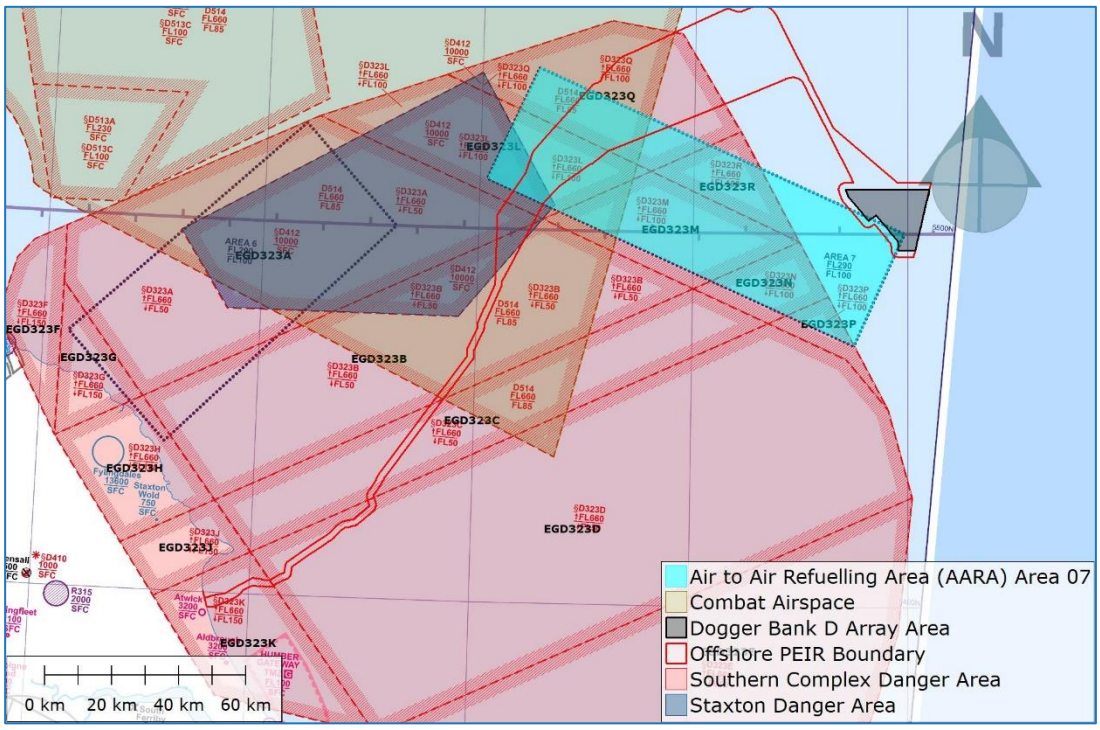

Figure 5: Special Use Airspace

2.6. Southern North Sea Offshore Operations

2.6.1. To enhance flight safety and expedite SAR operations over the Southern North Sea, various Flight Information Services are provided by NATS Anglia Radar based at Aberdeen Airport. These services are available to helicopters operating in support of the offshore oil and gas

and renewables industries and other civil and military aircraft transiting the airspace. The Anglia Radar Area of Responsibility, in which these services are available, extends from sea level to FL65 (approximately 6,500ft amsl) and is shown in Figure 6. The southern quarter of the DBD Array Area is within the Anglia Radar Area of Responsibility.

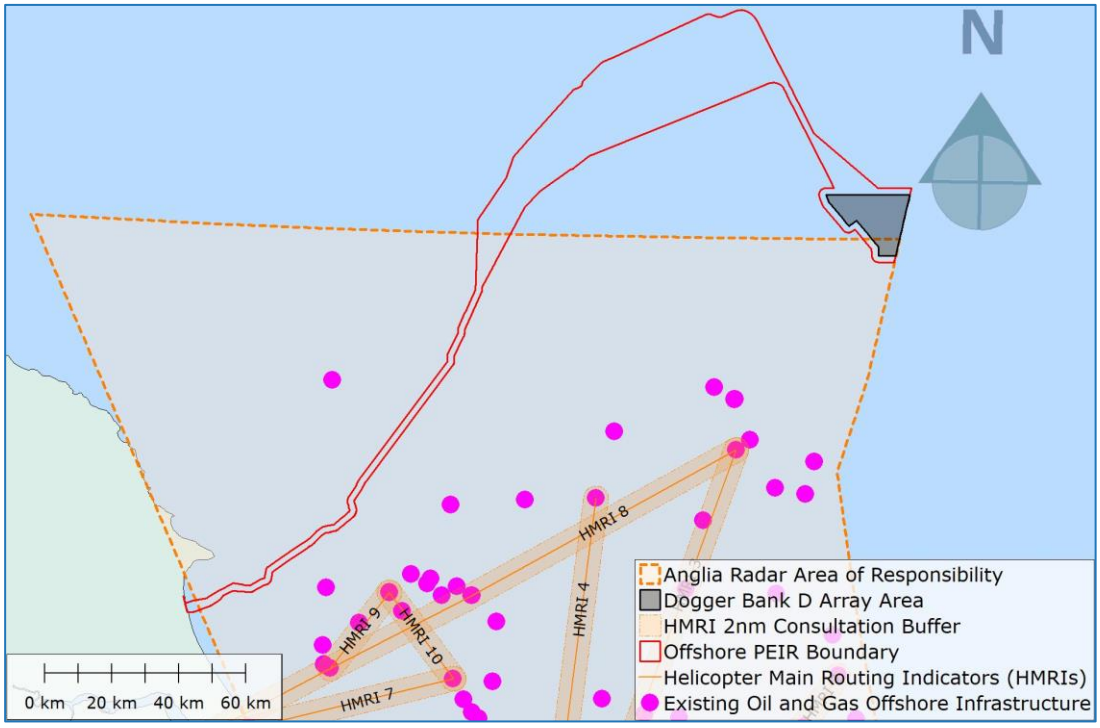

Figure 6: Anglia Radar Area of Responsibility

2.7. Helicopter Main Routing Indicators

2.7.1. A network of offshore routes over the Southern North Sea are flown by civilian helicopters in support of offshore oil and gas installations. The routes typically and routinely flown are published on charts as Helicopter Main Routing Indicators (HMRIs) to alert other airspace users of the potential for frequent low-level helicopter traffic.

2.7.2. These routes have no lateral dimensions and assume the background airspace classification within which they lie. HMRIs over the Southern North Sea generally extend vertically from 1,500ft amsl to FL60 (approximately 6,000ft amsl), although icing conditions or other flight safety considerations may require helicopters to operate below 1,500ft amsl.

2.7.3. Civil Aviation Publication (CAP) 764 Policy and Guidelines on Wind Turbines (CAA, 2016)[3] advises that planned obstacles within 2 nautical miles (nm) of an HMRI route centreline should be consulted upon with helicopter operators and the Air Navigation Service Provider (Anglia Radar). The 2nm distance is based upon operational experience, the accuracy of navigation systems, and practicality. Such a distance provides time and space for helicopter pilots to descend safely to an operating altitude below the icing level. 2nm buffers around the closest HMRIs to the DBD Array Area and offshore ECC are depicted in Figure 6. The

closest HMRI to the Project is HMRI 9, which is more than 24km (13nm) south-east of the offshore ECC at its nearest point.

2.8. Offshore Helidecks

2.8.1. To help achieve a safe operating environment, a 9nm consultation zone for planned obstacles exists around offshore helicopter destinations. Within 9nm, obstacles such as wind turbines can potentially impact upon the feasibility of helicopters to safely fly low visibility or missed approach procedures at the associated helideck site. There are no offshore oil and gas helidecks within 9nm of the DBD Array Area, but the Tolmount helideck is within 9nm of the offshore ECC, as shown in Figure 7.

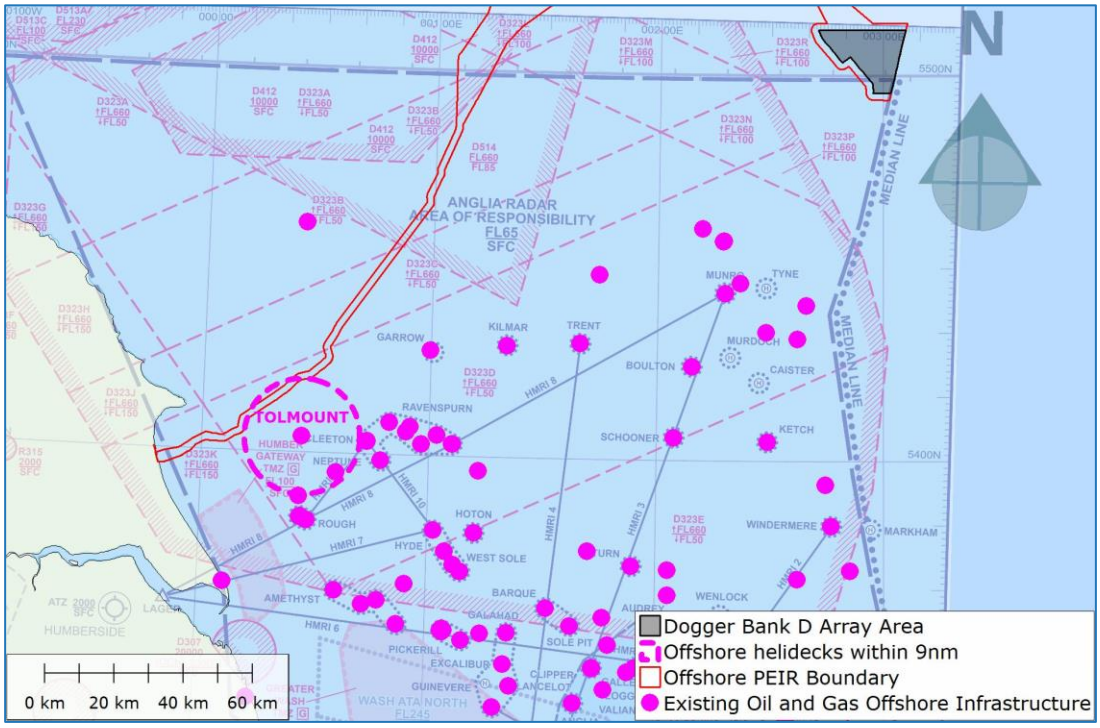

Figure 7: Offshore helidecks

2.8.2. As stated in CAP 764, the 9nm zone does not prohibit development, but is a trigger for consultation with offshore helicopter operators, the operators of existing installations and exploration and development locations to determine a solution that maintains safe offshore helicopter operations alongside proposed developments. Surface piercing structures are not proposed to be installed within the offshore ECC.

2.9. Search and Rescue

2.9.1. SAR operations are a highly specialised undertaking involving not only aviation assets, but also small boats, ships, and shore-based personnel. SAR operations are generally carried out in extremely challenging conditions and at all times of the day and night. There are ten helicopter SAR bases, incorporating 22 aircraft, around the UK with Bristow Helicopters

currently providing helicopters and aircrew on behalf of the Maritime and Coastguard Agency.

2.9.2. The nearest SAR base is at Humberside Airport, 261km south-west of the DBD Array Area. Its helicopters provide rescue services for both offshore and onshore incidents up to approximately 460km from their base.

2.9.3. The random nature of people, watercraft or aircraft in distress makes it very difficult to determine the routes taken by SAR aircraft. Fixed wing SAR aircraft would tend to stay at higher altitudes in a command-and-control role during major incidents, whilst helicopters would be used in a low-level role, sometimes in support of small rescue boats.

3. Radar Line of Sight Assessment

3.1. Methodology

3.1.1. Radar Line of Sight (RLoS) is determined by use of a radar propagation model (Global Mapper) using 3D DTM data (SRTM) with 30m horizontal resolution. Radar data is entered into the model and RLoS to the wind turbines from each radar is calculated.

3.1.2. Note that by using a DTM no account is taken of possible further shielding of the wind turbines due to the presence of structures or vegetation that may lie between the radar and the wind turbines. Thus, the RLoS assessment is a worst-case result.

3.1.3. For PSR the principal source of adverse wind farm effects are the wind turbine blades, so RLoS is calculated for the maximum blade tip height of the wind turbines which for the Project is 371m (1,218ft) amsl.

Figure 8: 30m resolution DTM used for RLoS modelling

3.2. Civil and Military Airfields with Surveillance Radar

3.2.1. In general, PSRs installed on civil and military airfields have an operational range of between 40nm and 60nm (between approximately 74km and 111km). There are no radar-equipped airfields within 60nm or 111km of the DBD Array Area.

3.2.2. The closest radar-equipped civil airfield to the DBD Array Area is Humberside Airport, 261km to the south-west. CAP 764 recommends consultation with any aerodromes with a

surveillance radar facility that are within 30km of wind turbines, however this distance can be greater depending on the type and coverage of the radar and the particular operations at the aerodrome. Controllers at Humberside may provide a Lower Airspace Radar Service (LARS) to aircraft operating outside controlled airspace at a maximum range of 30nm (56km) from the Humberside facility.

3.2.3. The closest radar-equipped military airfield to the array area is Royal Air Force (RAF) Leeming, 289km to the west of the DBD Array Area. Controllers at this station offer a LARS to a range of 30nm (56km).

3.2.4. Wind turbines within the DBD Array Area would be beyond the maximum operational ranges of any civil or military airfield PSRs and would have no impact on their performance.

3.3. NERL Radars

3.3.1. En-route radars operated by NERL are required to provide coverage at ranges in excess of 60nm (111km). Such radars with potential RLoS of wind turbines within the DBD Array Area include the NERL facilities at Claxby, Cromer and Great Dun Fell.

3.3.2. Claxby is located 269km south-west of the DBD Array Area, Cromer is 251km south south-west and Great Dun Fell is 334km west. RLoS coverage for these radars at the maximum blade tip height of 371m amsl is shown in Figure 9.

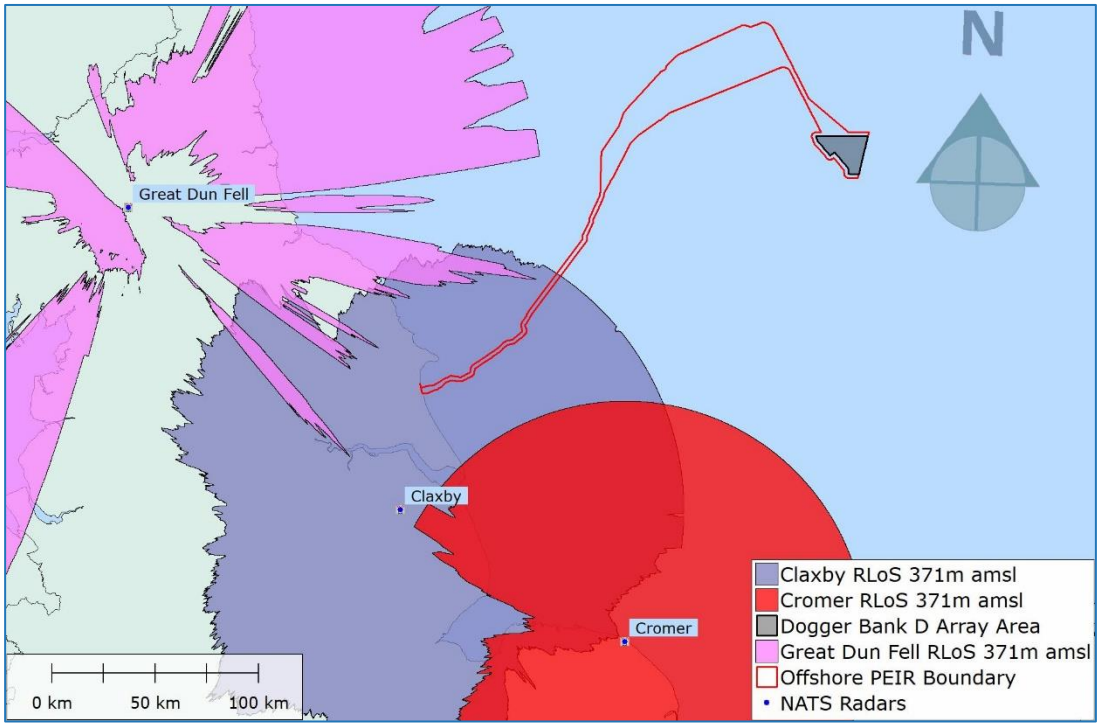

Figure 9: NERL radars RLoS 371m amsl

3.3.3. Wind turbines within the DBD Array Area would not be in RLoS of any NERL radars and would have no impact on their performance.

3.4. MOD Air Defence Radars

3.4.1. MOD Air Defence (AD) radars are required to provide coverage at ranges in excess of 60nm (111km). Such radars with potential RLoS of wind turbines within the DBD Array Area include the MOD AD facilities at Brizlee Wood, Neatishead and Staxton Wold.

3.4.2. Brizlee Wood is located 286km west north-west of the DBD Array Area, Neatishead is 268km south south-west and Staxton Wold is 227km west south-west. RLoS coverage for these radars at the maximum blade tip height of 371m amsl is shown in Figure 10.

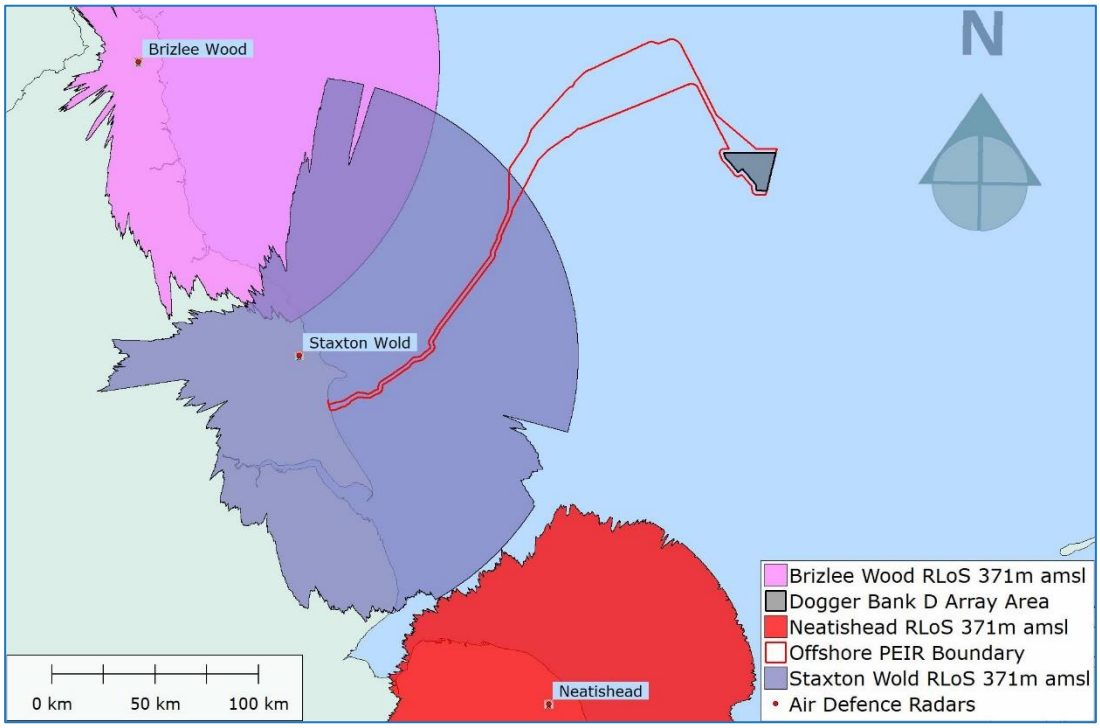

Figure 10: MOD AD radars RLoS 371m amsl

3.4.3. Wind turbines within the DBD Array Area would not be in RLoS of any MOD AD radars and would have no impact on their performance.

4. Onshore Assessment

4.1. Onshore Infrastructure

4.1.1. Onshore infrastructure associated with the Project would have the potential to impact the performance of nearby radars and aviation radio navigation aids. For example, large buildings could block radio navigation aid signals from being received by aircraft, or they could reflect signals and cause multipath interference.

4.2. Safeguarded Zones

4.2.1. In order to protect navigation aid signals, safeguarded zones are established around the facility sites. The purpose of the safeguarded area is to identify obstacles with the potential for causing unacceptable interference to the signals. Structures that infringe the safeguarded area must undergo technical assessments to determine the degree of potential interference, if any, and whether the interference would be acceptable to the Air Navigation Service Provider.

4.2.2. The International Civil Aviation Organisation (ICAO) document EUR Doc 015 European Guidance Material on Managing Building Restricted Areas (ICAO, 2015)[4] details safeguarding criteria to protect the radio signals of Communication, Navigation and Surveillance (CNS) facilities from interference caused by buildings or other large objects. The document defines Building Restricted Area (BRA) shapes for both directional and omni-directional navigation aid facilities.

4.3. Assessment

4.3.1. The closest surveillance facilities to the onshore PEIR boundary are the MOD Staxton Wold AD radar to the north and the Humberside Airport and NERL Claxby radars to the south. The closest radio navigation aid is the NERL en-route facility known as Ottringham VOR / DME (VHF Omni Directional Range / Distance Measuring Equipment) to the south-east of the onshore PEIR boundary.

4.3.2. Radars and VOR / DMEs are omni-directional facilities. The omni-directional BRA shape as depicted in EUR DOC 015 Figures 2.1 and 2.2 is reproduced in Figure 11.

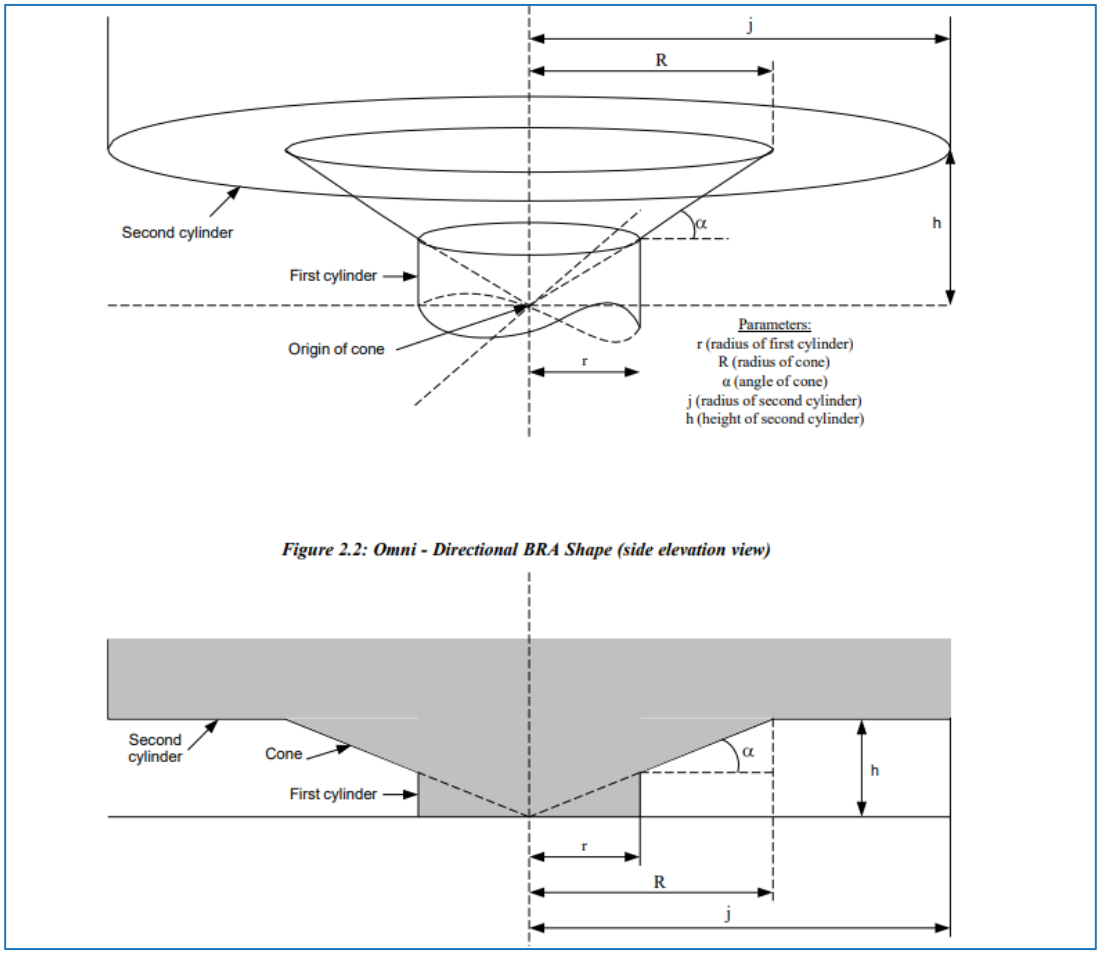

Figure 2.2: Omni - Directional BRA Shape (side elevation view)

Figure 11: EUR DOC 015 Figures 2.1 and 2.2 – Omni-directional BRA shape

4.3.3. Applicable dimensions to be applied for radars, VORs and DMEs are reproduced in Figure 12 and Figure 13.

*Type of **surveillance** facilities*	*Alpha (a – cone) ( )*	*Radius (R- cone) (m)*	*Radius (r – cylinder) (m)*	*Origin of cone*
PSR	0.25	15000	500	Base of antenna at ground level
SSR	0.25	15000	500	Base of antenna at ground level

Figure 12: EUR DOC 015 Table 4 (extract) – Harmonised guidance figures for omni-directional surveillance facilities

Type of ***navigation*** *facilities*	*Radius (r – Cylinder) (m)*	*Alpha (a – cone) (°)*	*Radius (R- Cone) (m)*	*Radius (j – Cylinder) (m) Wind turbine(s) only*	*Height of cylinder j (h -height) (m) Wind turbine(s) only*	*Origin of cone and axis of cylinders*
DME N	300	1.0	3000	N/A	N/A	Base of antenna at ground level
CVOR	600	1.0	3000	15000	52	Centre of antenna system at ground level
DVOR	600	1.0	3000	10000	52	Centre of antenna system at ground level

Figure 13: EUR DOC 015 Table 1 (extract) – Harmonised guidance figures for omni-directional navigational facilities

4.3.4. For radars (surveillance facilities) the safeguarded zone extends from the facility to a radius of 15km.

4.3.5. NERL apply a 10km safeguarded zone around its VOR / DME facilities, which is in line with the recommendation in EUR Doc 015 for protection from wind turbine interference. However, the safeguarded zone is reduced to 3km for other obstacles, which is more appropriate for any infrastructure within the onshore PEIR boundary for an offshore wind farm such as DBD.

4.3.6. The applicable safeguarded zones in the vicinity of the onshore PEIR boundary are shown in Figure 14.

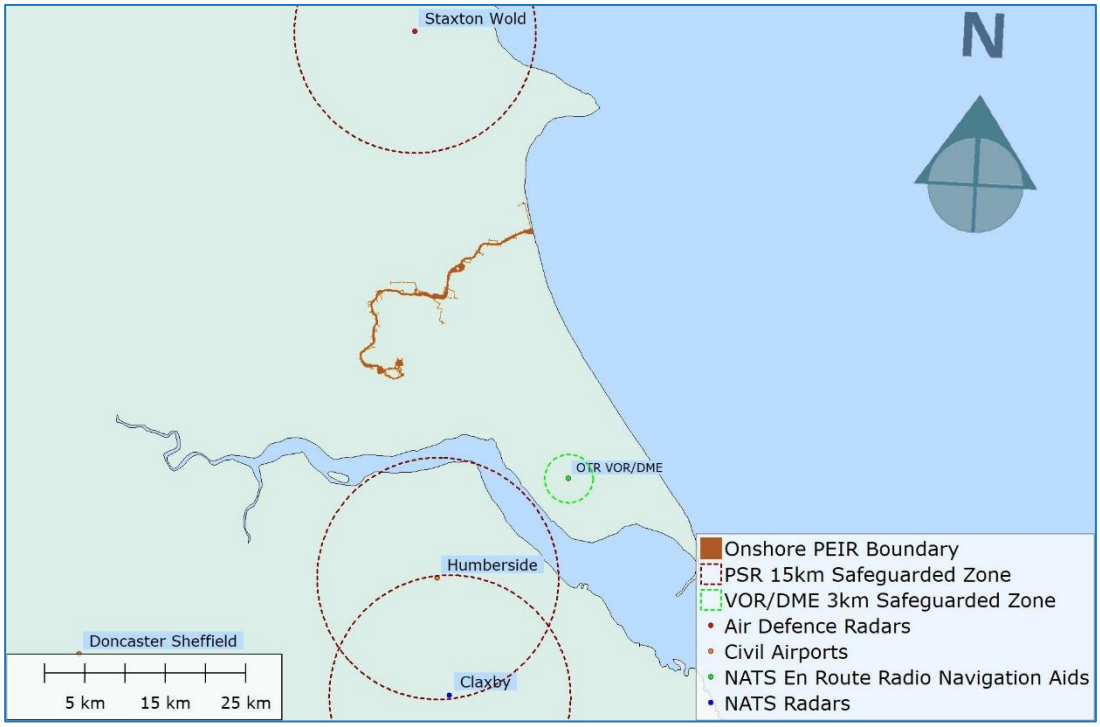

Figure 14: Safeguarded zones

4.3.7. The onshore PEIR boundary would not infringe the safeguarded zones of the closest radars or radio navigation aids. Onshore infrastructure associated with the Project would have no impact on the performance of these facilities.

5. Summary

5.1. Airspace

5.1.1. The DBD Array Area and Offshore ECC lie entirely within UK airspace; however, the eastern boundary of the DBD Array Area is next to a portion of airspace known as North Sea Area V which is delegated to the Netherlands.

5.1.2. The EGD412 Staxton DA airspace extends from the surface to 10,000ft amsl and is infringed by some of the offshore ECC. Ordnance, munitions and explosives activities take place within Staxton DA.

5.1.3. The DBD Array Area and offshore ECC do not infringe the 2nm buffers of any HMRIs and the DBD Array Area is beyond the 9nm consultation zones of any known offshore oil and gas helidecks. Tolmount helideck is within 9nm of the offshore ECC, but surface piercing structures are not proposed to be installed within the offshore ECC.

5.1.4. No other areas of potential airspace impact have been identified.

5.2. Radar and Aviation Radio Navigation Aids

5.2.1. Radar modelling confirms that wind turbines within the DBD Array Area would be beyond the maximum operational ranges of any civil and military airfield PSRs, and would not be in RLoS of any NERL or MOD AD radars.

5.2.2. Onshore infrastructure associated with the Project would be outside the safeguarded zones of the closest radars and aviation radio navigation aids and would have no impact on the performance of these facilities.

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