# Navigation Risk Assessment

# Neart na Gaoithe

# Offshore Wind Farm

# Appendix 17.1

| | |
|---|---|
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# 1. INTRODUCTION

## *1.1 Background*

Anatec were commissioned by Mainstream Renewable Power to perform a shipping and navigation assessment of the Neart na Gaoithe (NnG) offshore wind farm, located in the outer Firth of Forth off the coastline of Fife.

The report presents information on the proposed development relative to the baseline navigational activity and features for the area. Following this, an assessment of the impact of the proposed development on navigation is presented.

## *1.2 Scope of the Assessment and Methodology*

The assessment methodology principally followed the Department of Energy and Climate Change (DECC) Risk Assessment Methodology (Ref. i) and the Maritime and Coastguard Agency's (MCA) Marine Guidance Notice 371 (MGN 371) (Ref. ii).

An overview of the general methodology applied in the assessment is presented in Figure 1.1. (More information on the regulations and guidance being addressed is presented in Section 2.)

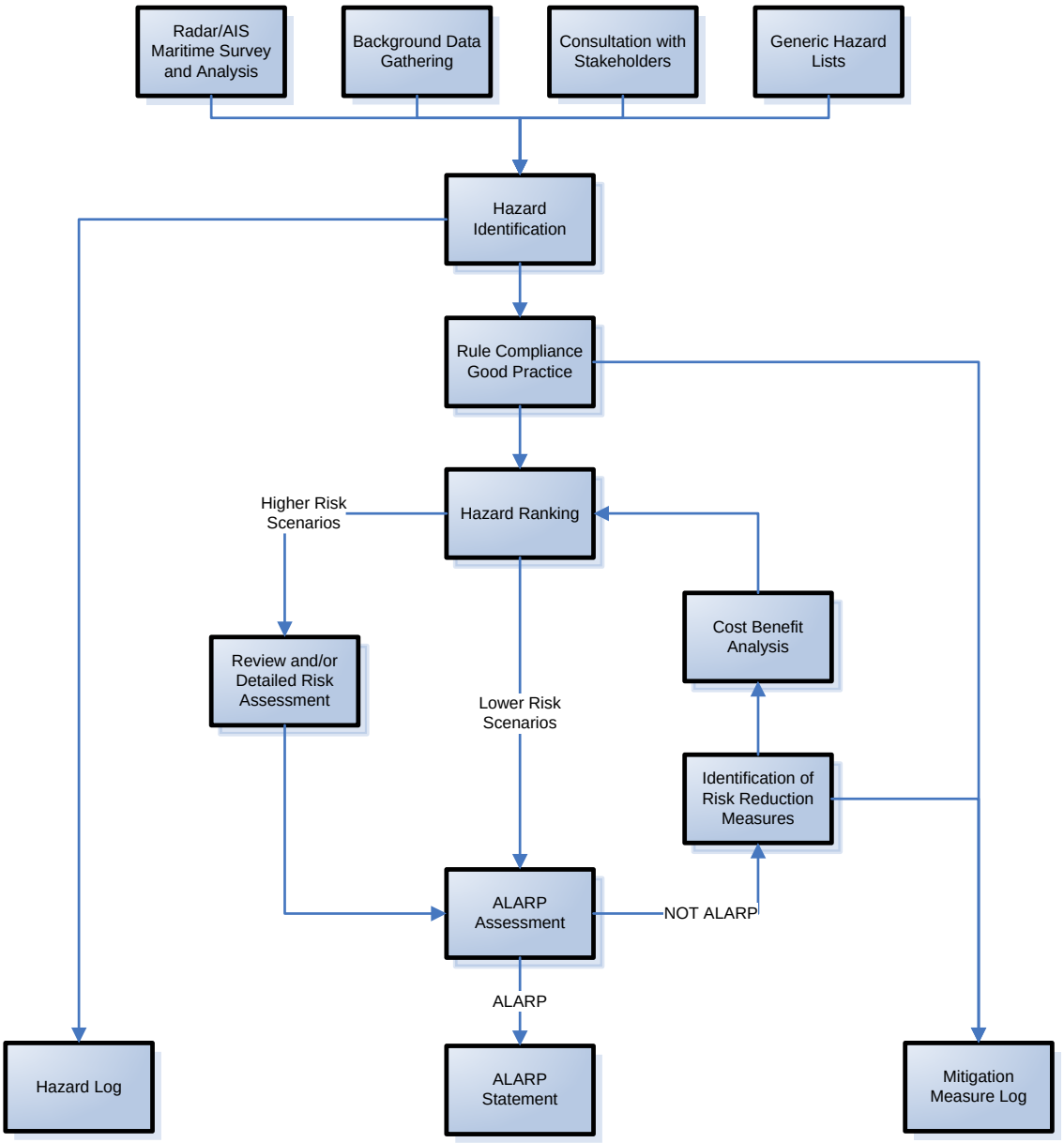


**Figure 1.1 Overview of Methodology for Navigation Assessment**

The main part of the assessment considers the impact of the surface structures associated with the operational phase of the wind farm on the following maritime activities:

- Commercial Shipping
- Fishing
- Recreational Sailing

In addition to these activities, consideration is given to the following:

- Impacts of Structures on Marine Radar

- Impact of Subsea cables
- Impacts associated with Construction / Decommissioning phases
- Cumulative Impacts with other nearby developments

## *1.3 Methodology for Assessing Cumulative Effects*

The assessment of cumulative effects includes considering the impacts arising from multiple offshore wind farm development activities within the UK North Sea and outer Firth of Forth region.

The following subsections review the methodology used for assessing the cumulative impact of the Neart na Gaoithe offshore wind farm.

### 1.3.1 Assessment of Individual Project Boundaries

The individual indicative project boundaries have been used for the cumulative and in-combination assessment. These boundaries are current as of January 2012 and include full site capacity for Neart na Gaoithe and Inchcape and a 3.5GW capacity layout for the Forth of Forth Zone 2.

It should be noted that the identification of these boundaries at this stage, and there use within the assessments, does not exclude the potential for any site modifications or future developments within the Forth of Forth Zone 2.

In addition, the assessment assumes industry standard mitigation measures as per MGN 371, International Association of Marine Aids to Navigation and Lighthouses (IALA) O-139, (Ref. vi) and any specific consent conditions that will be put in place at the developments.

### 1.3.2 Regional Approach

Cumulative issues are also being assessed as part of the FTOWDG remit. The Crown Estate formed FTOWDG to collaboratively identify potential cumulative effects of multi wind farm development.

The FTOWDG comprises of:

- Mainstream Renewable Power - Neart na Gaoithe offshore wind farm
- Seagreen - Firth of Forth Round 3 Zone 2 developments
- Repsol Nuevas Energías UK - Inch Cape offshore wind farm

The regional report was commissioned by FTOWDG (Ref. iii) to review the shipping and navigational aspects of the proposals on a regional level. This ensured that the individual developments are carried out in a coherent manner and cumulative issues relating to shipping and navigation are considered.

From the Regional Cumulative Shipping and Navigation review, the potential impacts on navigation from the regional developments (for both vessels transiting through the developments, and those vessels transiting in close proximity to sites) were assessed.

The FTOWDG report will be updated as consultations and assessments are undertaken on both project and cumulative levels throughout 2012. This will include the current indicative red line boundaries incorporating any changes in planned capacity and final site designs.

## *1.4 Abbreviations*

The following abbreviations are used in this report:

| | | |
|---|---|---|
| AIS | - | Automatic Identification System |
| ALARP | - | As Low as Reasonably Practicable |
| ALB | - | All-Weather Lifeboat |
| ARPA | - | Automatic Radar Plotting Aid |
| AtoN | - | Aid to Navigation |
| BERR | - | Department for Business Enterprise & Regulatory Reform |
| BWEA | - | British Wind Energy Association |
| CA | - | Cruising Association |
| CAA | - | Civil Aviation Authority |
| CAST | - | Coastguard Agreement on Salvage and Towage |
| COLREGS | - | International Regulations for Preventing Collisions at Sea |
| CoS | - | The Chamber of Shipping |
| CPA | - | Closest Point of Approach |
| DECC | - | Department of Energy and Climate Change |
| dB | - | Decibel |
| DfT | - | Department for Transport |
| DSC | - | Digital Selective Calling |
| DTI | - | Department of Trade and Industry |
| DWT | - | Dead Weight Tonnes |
| ECT | - | Evening Civil Twilight |
| EIA | - | Environmental Impact Assessment |
| ERCoP | - | Emergency Response Cooperation Plan |
| ES | - | Environmental Statement |
| ETV | - | Emergency Towing Vessel |
| FMA | - | Fishermen's Mutual Association |
| FTOWDG | - | Forth and Tay Offshore Wind Developers Group |
| FSA | - | Formal Safety Assessment |
| GPS | - | Global Positioning System |
| GRP | - | Glass Reinforced Plastic |
| GW | - | Giga Watt |
| HAT | - | Highest Astronomical Tide |
| HF | - | High Frequency |
| HSE | - | Health and Safety Executive |
| HW | - | High Water |
| IALA | - | International Association of Marine Aids to Navigation and Lighthouses |
| ILB | - | Inshore Lifeboat |
| ICES | - | International Council for the Exploration of the Seas |

| | | |
|---|---|---|
| IMO | - | International Maritime Organisation |
| IPS | - | Intermediate Peripheral Structure |
| ITOPF | - | International Tanker Owners Pollution Federation Limited |
| km | - | Kilometre |
| LORAN | - | Long Range Navigation |
| m | - | metre |
| MAIB | - | Marine Accident Investigation Branch |
| MBS | - | Maritime Buoyage System |
| MCA | - | Maritime and Coastguard Agency |
| MDA | - | Managed Danger Area |
| MEHRA | - | Marine Environmental High Risk Area |
| MGN | - | Marine Guidance Notice |
| MHWN | - | Mean High Water Neaps |
| MHWS | - | Mean High Water Springs |
| MLWN | - | Mean Low Water Neaps |
| MLWS | - | Mean Low Water Springs |
| MRCC | - | Maritime Rescue Co-ordination Centre |
| MRSC | - | Maritime Rescue Sub-Centre |
| MSL | - | Mean Sea Level |
| MW | - | Mega-Watt |
| NM | - | Nautical Miles |
| NLB | - | Northern Lighthouse Board |
| NnG | - | Neart na Gaoithe |
| NOREL | - | Nautical Offshore Renewable Energy Liaison |
| NUC | - | Not Under Command |
| NVG | - | Night Vision Goggles |
| OREI | - | Offshore Renewable Energy Installations |
| PLBs | - | Personal Locator Beacons |
| PLL | - | Potential Loss of Life |
| PPE | - | Personal Protective Equipment |
| RAF | - | Royal Air Force |
| REZ | - | Renewable Energy Zone |
| RNLI | - | Royal National Lifeboat Institution |
| Ro-Ro | - | Roll-on, Roll-off |
| RYA | - | Royal Yachting Association |
| SAR | - | Search and Rescue |
| SCA | - | Scottish Canoe Association |
| SFF | - | Scottish Fishermen’s Federation |
| SMS | - | Safety Management System |
| SPS | - | Significant Peripheral Structure |
| TSS | - | Traffic Separation Scheme |
| UHF | - | Ultra High Frequency |
| UKCS | - | United Kingdom Continental Shelf |
| UKHO | - | United Kingdom Hydrographic Office |
| VHF | - | Very High Frequency |

VMS - Vessel Monitoring Service
VTS - Vessel Traffic Services

# 2. REGULATIONS AND GUIDANCE

## *2.1 Introduction*

This section briefly summarises the key regulations and guidance relevant when considering the navigation safety issues associated with offshore wind farm developments in the UK.

## *2.2 MCA Marine Guidance Notice 371*

This guidance notice (Ref. ii) highlights issues that need to be taken into consideration when assessing the impact on navigational safety from offshore renewable energy developments, proposed for United Kingdom internal waters, territorial sea or Renewable Energy Zones.

There are five annexes containing recommendations (1-4) and regulatory extract (5) as follows:

- Annex 1: Considerations on site position, structures and safety zones.
- Annex 2: Navigation, collision avoidance and communications.
- Annex 3: MCA shipping template, assessing wind farm boundary distances from shipping routes.
- Annex 4: Safety and mitigation measures recommended for OREI during construction, operation and decommissioning.
- Annex 5: Standards and procedures for generator shutdown and other operational requirements in the event of a search and rescue, counter pollution or salvage incident in or around an OREI.

A checklist referencing the sections in this report which address MCA requirements is presented in Appendix C.

## *2.3 MCA Wind Farm: "Shipping Route" Template*

A trial performed by the Maritime & Coastguard Agency at the North Hoyle OWF (Ref. iv) indicated that turbines provide erroneous returns to radar transceivers. Multiple side echoes may be generated that have the potential to mask real targets. This has been validated by more recent trials carried out by the industry on the Kentish Flats Wind Farm in the Thames estuary (Ref. v). The onset range from the turbines of these returns is about 1.5 Nautical Miles (NM), with a progressive deterioration in the radar picture as the turbines are closed to about 500 metres (m). Adjustment of the radar controls can filter out some of these unwanted radar returns but comes at the cost of potentially losing small radar cross sectional targets such as buoys or small craft.

The MCA's Wind Farm Shipping Route Template (Annex 3 of Ref. ii), reproduced in Figure 2.1, indicates that turbines within 0.5NM of a route will be Very High Risk. Close scrutiny and potentially mitigation will be needed between 0.5NMm and 5NM to ensure risks are As Low as Reasonably Practicable (ALARP), particularly between 0.5NM and 2NM which is considered Medium to High Risk. Beyond 2NMm is Low Risk although an adjacent wind

farm or Traffic Separation Scheme (TSS) introduces cumulative effects which have to be scrutinised.

The template is not a prescriptive tool but needs intelligent application to explore where the distance should be measured from, e.g., route centre, 90% traffic level, nearest ship, etc. The potential boundaries are illustrated in Figure 2.2.

Marine traffic survey information collected for the Outer Firth of Forth area has been analysed in this study to inform such boundaries and investigate influencing factors such as route bias, vessel type, size, cargo, etc.

**WIND FARM: "SHIPPING ROUTE" Template**

| Distance in miles (nm) of Turbine Boundary from Shipping Route | Factors | Risk | Tolerability |
|---|---|---|---|
| < 0.25nm (500m) | 500m inter-turbine spacing = small craft only recommended | VERY HIGH | INTOLERABLE |
| 0.25nm (500m) | X band radar interference | VERY HIGH | |
| 0.45nm (800m) | Vessels may generate multiple echoes on shore based radars | VERY HIGH | |
| | | | TOLERABLE IF ALARP (As Low As Reasonably Practicable)*<br><br>* Descriptions of ALARP can be found in a) Great Britain Health and Safety Executive (2001) Reducing risks protecting people<br>b) IMO (2002) MSC Circ 1023 dated 5th April 2002 Formal Safety Assessment<br>c) IMO (2007) MSC 83-21-INF2 Consolidated guidelines for Formal Safety Assessment |
| 0.5nm (926m) | Mariners' high traffic density domain | HIGH | |
| 0.8nm (1481m) | Mariners' ship domain | HIGH | |
| 1 nm (1852m) | Minimum distance to parallel boundary of TSS | MEDIUM | |
| 1.5nm (2778m) | S band radar interference ARPA affected | MEDIUM | |
| 2 nm (3704m) | Compliance with COLREGS becomes less challenging | MEDIUM | |
| >2nm > (3704m) | But not near TSS | LOW | |
| 3.5nm (6482m) | Minimum separation distance between turbines opposite sides of a route | LOW | |
| | | | |
| 5nm (9260m) | Adjacent wind farm introduces cumulative effect Distance from TSS entry/exit | VERY LOW | BROADLY ACCEPTABLE |
| 10nm (18520m) | No other wind farms | VERY LOW | |

**Figure 2.1 Wind Farm "Shipping Route" Template (Ref. ii)**

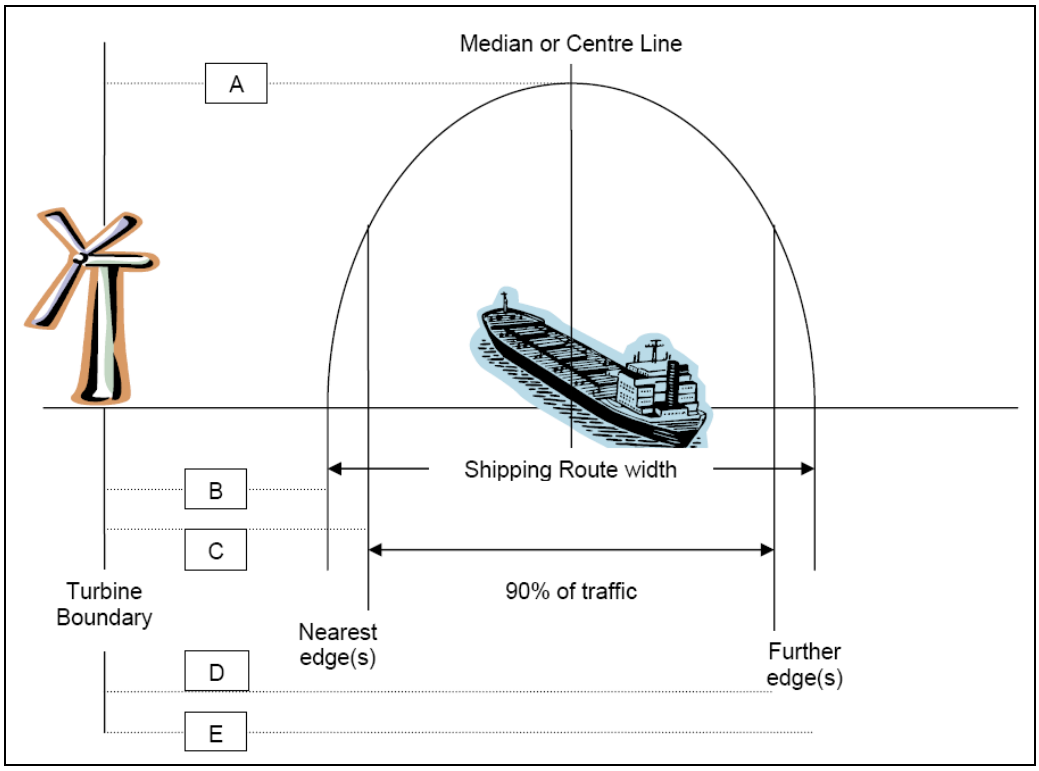


**Figure 2.2 Interactive Boundaries (require Interpretative Flexibility, where:**

A = Turbine boundary to the shipping route median or centre line
B = Turbine boundary to nearest shipping route edge
C = Turbine boundary to nearest shipping 90% traffic level*
D = Turbine boundary to further shipping 90% traffic level*
E = Turbine boundary to further shipping route edge
(* = or another % to be determined)

## *2.4 DECC Methodology*

DECC (formerly BERR) produced a Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms in association with the MCA and the DfT (Ref. i).

Its purpose is to be used as a template by Developers in preparing their navigation risk assessments, and for Government Departments to help in the assessment of these.

The Methodology is centred around risk controls and the feedback from risk controls into risk assessment. It requires a submission that shows that sufficient risk controls are, or will be, in place for the assessed risk to be judged as broadly acceptable or tolerable with further controls or actions.

The key features of the Marine Safety Navigational Risk Assessment Methodology are risk assessment (supported by appropriate techniques and tools), creating a hazard log, defining the risk controls (in a Risk Control Log) required to achieve a level of risk that is broadly

acceptable (or tolerable with controls or actions), and preparing a submission that includes a Claim, based on a reasoned argument, for a positive consent decision.

**Table 2.1 Key Features of the DECC Methodology (Ref. i)**

| | |
|---|---|
| 1 | Define a scope and depth of the submission proportionate to the scale of the development and the magnitude of the risk |
| 2 | Estimate the "base case" level of risk |
| 3 | Estimate the "future case" level of risk |
| 4 | Create a hazard log |
| 5 | Define risk control and create a risk control log |
| 6 | Predict "base case with wind farm" level of risk |
| 7 | Predict "future case with wind farm" level of risk |
| 8 | Submission |

## *2.5 Aids to Navigation*

The wind farm will be marked according to IALA guidelines (Ref. vi). The Northern Lighthouse Board (NLB) is the statutory body advising on the marking of Renewable Energy Installations in Scottish waters.

The Aids to Navigation (AtoN) required for the site during the different phases of construction, operation and decommissioning will be agreed with the NLB upon deciding the final layouts.

Feedback on marking Neart na Gaoithe based on the two indicative layouts was received from NLB during the course of the project. Based on this information, the potential markings are presented in Section 4.4.

# 3. WIND FARM DETAILS

## *3.1 Introduction*

This section presents details on the proposed Neart na Gaoithe offshore wind farm which is located east of Fife Ness, and directly to the west of the Forth Round 3 Zone 2.

## *3.2 Wind Farm Boundary*

The licensed Neart na Gaoithe Offshore wind farm site is located 8.4NM to the east of Fife Ness, and directly to the west of the Forth Round 3 Zone 2. The total area of the wind farm is approximately 30.5NM$^2$ (105km$^2$).

The corner coordinates of the development area are presented in Table 3.1.

**Table 3.1 Co-ordinates of Neart na Gaoithe Boundary (WGS 84)**

| Corner | Latitude | Longitude |
|---|---|---|
| C1 (South East) | 56° 12' 43.11" | -002° 09' 15.25" |
| C2 (East) | 56° 15' 16.08" | -002° 09' 53.84" |
| C3 (North East) | 56° 20' 10.09" | -002° 14' 54.54" |
| C4 (South West) | 56° 20' 18.53" | -002° 16' 31.06" |
| C5 (North West) | 56° 19' 44.93" | -002° 17' 49.49" |
| C6 (West) | 56° 17' 25.66" | -002° 20' 13.90" |
| C7 (West) | 56° 15' 49.42" | -002° 20' 03.25" |
| C8 (South West) | 56° 12' 45.79" | -002° 16' 17.53" |

The proposed turbine layouts have yet to be confirmed, however it is likely that the final wind farm will have a perimeter (area formed by joining outer turbine locations) smaller than the application area.

An overview chart of the site boundary is presented in Figure 3.1. Water depths (at LAT) at the turbine locations range from approximately 41m to over 54m.

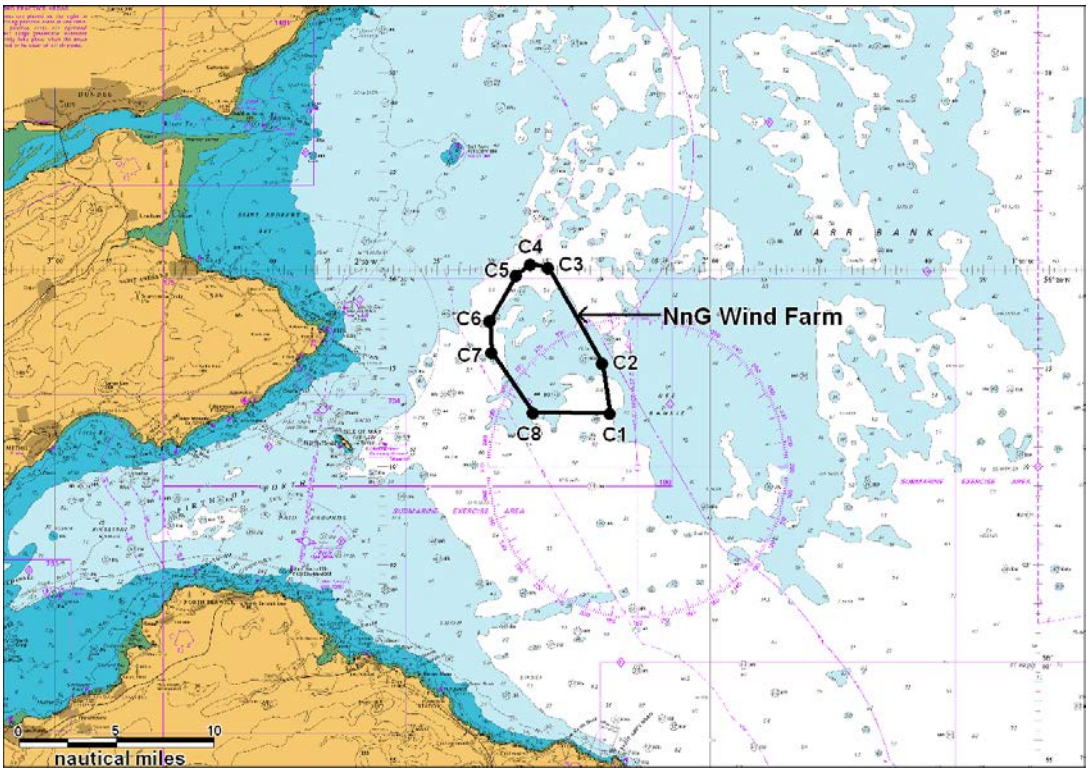


**Figure 3.1 Chart overview of Neart na Gaoithe**

### *3.3 Structure Details and Rochdale Envelope*

Several layout options have been considered for the Neart na Gaoithe offshore wind farm. The table below summarises the dimensions of the smallest (3.6MW turbines) and largest possible machines (7MW turbines).

**Table 3.2 Dimensions for minimum and maximum size machines**

| Wind Turbine Size | Max Hub Height above LAT (m) | Max Rotor Diameter (m) | Maximum Tip Height above LAT (m) |
|---|---|---|---|
| 3.6 MW | 115 | 120 | 175 |
| 7 MW | 115 | 164 | 197 |

For the collision risk assessment and Rochdale Envelope, the 3.6MW and 6MW indicative layouts have been used as Layout A has the maximum number of turbines and Layout B has the largest turbines assuming the worst case (largest top side) jacket foundation.

It is noted that there is a possibility of moving the turbines positions by up-to 500m from the indicative positions around the site perimeter. In addition, no more than two substations will be installed in the final layout.

Figure 3.2 and Figure 3.3 present the two proposed indicative layouts.

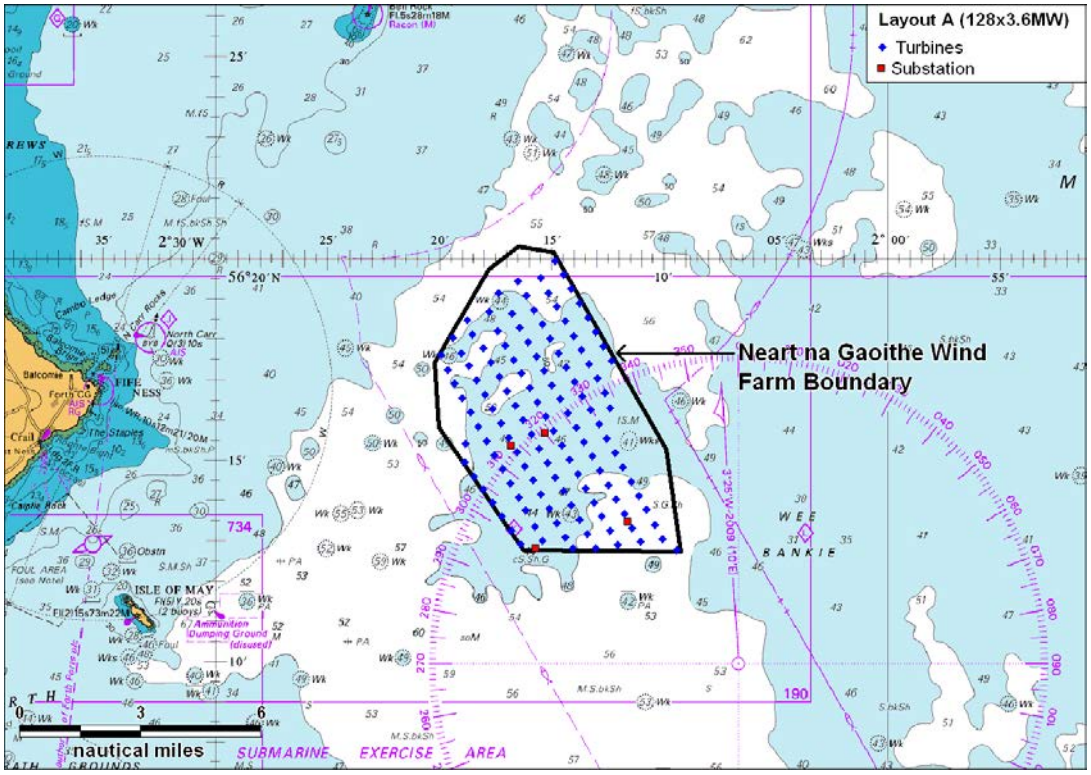


**Figure 3.2 Detailed chart of Neart na Gaoithe turbines (Layout A)**

Layout A shows 128 turbines and is to be used for both the 3.6 and 4 MW turbine options. In Layout A there are three additional 3.6MW turbines and an additional 19 for 4.135MW turbines.

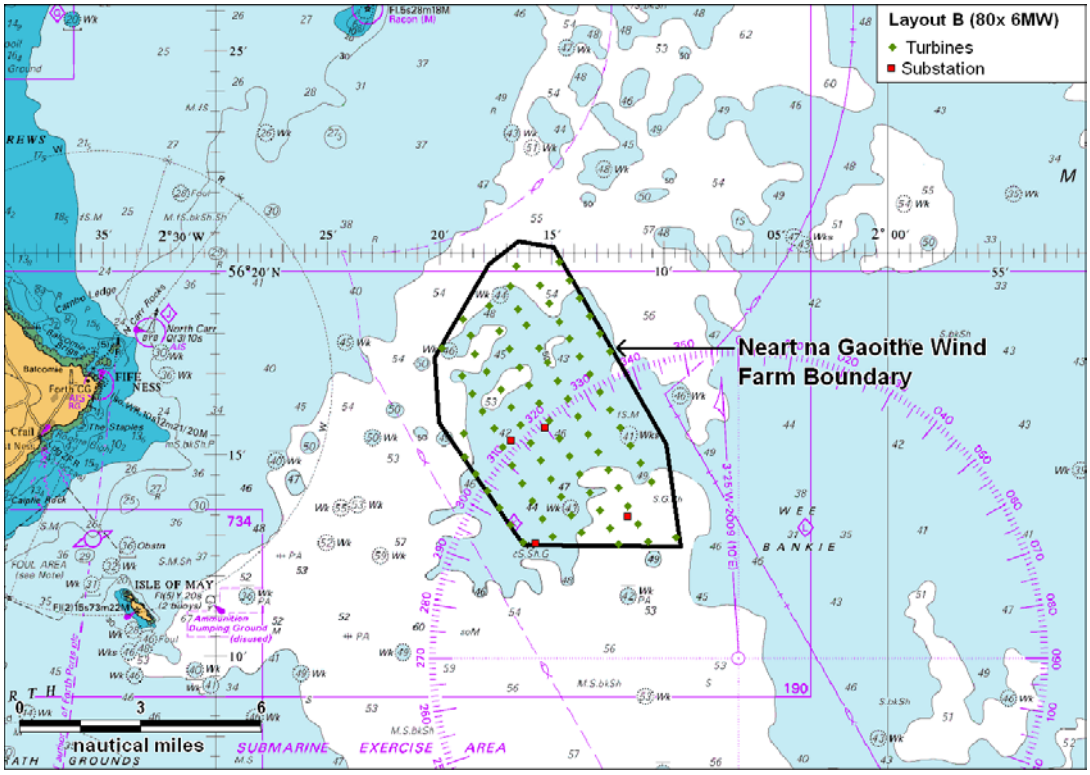


**Figure 3.3 Detailed chart overview of Neart na Gaoithe turbines (Layout B)**

Layout B shows 80 turbines and is to be used for both the 6 and 7MW turbines. Using 80 turbine positions means an additional five 6MW turbines and an additional 15 7MW turbines.

It is noted that the site is constrained to 450MW maximum output, therefore only the number of turbines up to the 450MW will be installed. It is considered that by using the maximum number of turbines in Layout A and B, the worst case assessment on the possible impact to shipping and navigation has been carried out.

A typical design of the wind turbine is represented in Figure 3.4. There will be a minimum 25.4m rotor blade tip clearance (air draught) over Lowest Astronomical Tide (LAT).

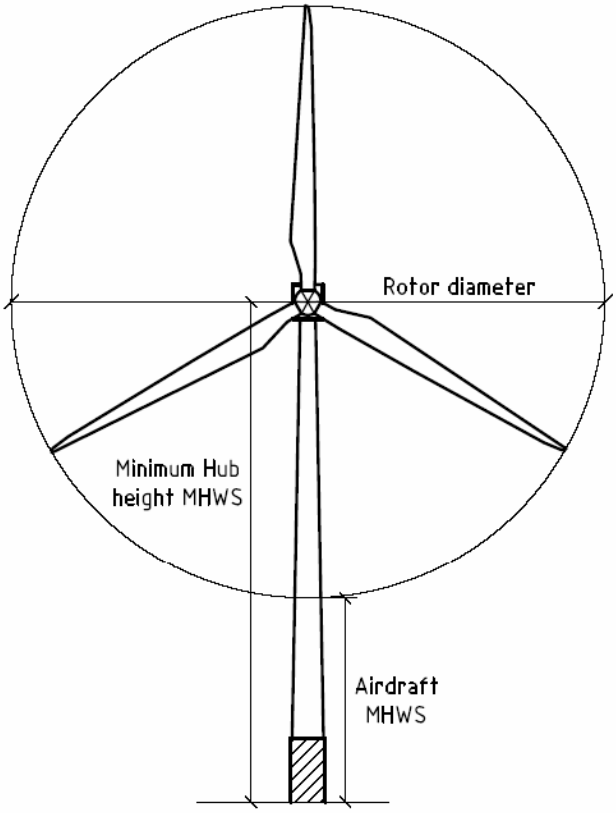


**Figure 3.4 Outline Turbine Structure**

## *3.4 Offshore Cable Route*

The proposed cable route corridor runs for approximately 17NM south by southwest from the south western boundary of the wind farm area. The landfall option is proposed at Thorntonloch approximately 1.1NM north west of Skateraw.

An overview of the proposed export cable route is presented in Figure 3.5.

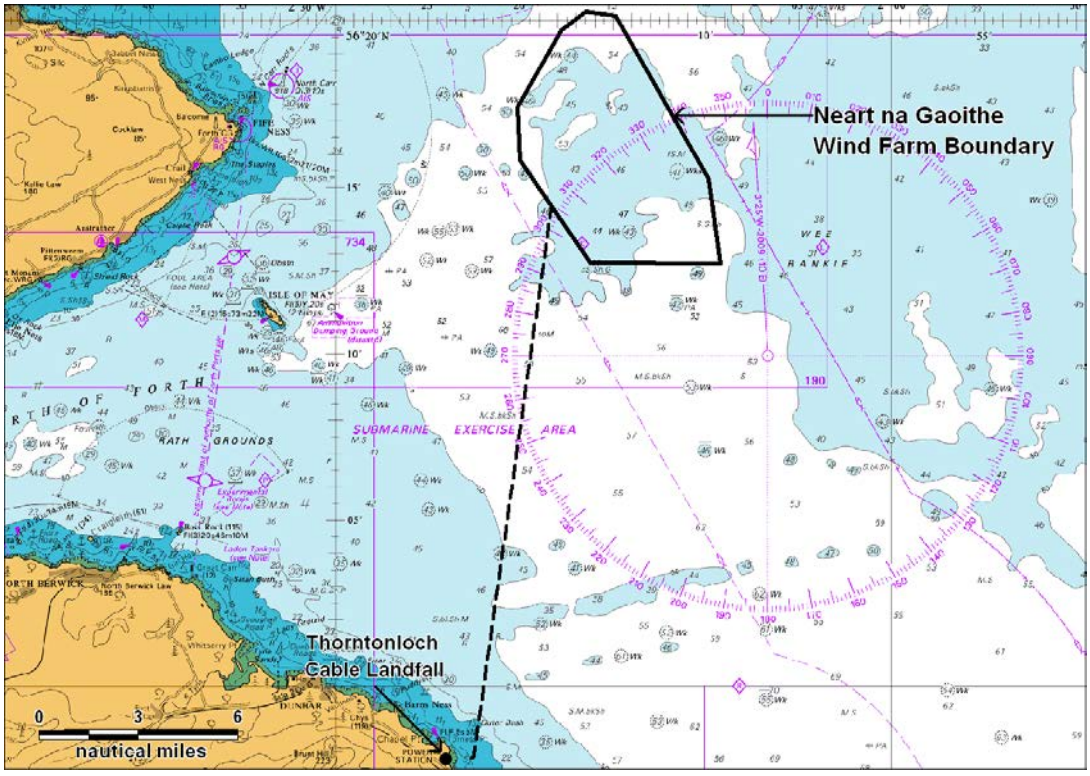


**Figure 3.5 Export cable route associated with Neart na Gaoithe**

Preliminary export cable route investigation works for the project note that the export and inter-array cables will be buried (where seabed conditions allow) to a minimum depth of 1m and to a maximum depth of 3m.

# 4. MARINE NAVIGATIONAL MARKINGS

## *4.1 Introduction*

Throughout the project marine navigational marking will be provided in accordance with the NLB requirements, which will comply with IALA Recommendation 0-139 on the Marking of Offshore Wind Farms and the additional requirements of MCA MGN 371(Ref. ii). It is also noted that there is a requirement to mark selected structures with lights for aviation as per Civil Aviation Authority (CAA) requirements.

NLB have advised that final marking and lighting recommendations will be made in a formal response through Section 36 of the Scottish Electricity Act 1989 (consents for renewable energy projects) and the Marine (Scotland) Act 2010. All navigational marking and lighting of the site or its associated marine infrastructure will require the Statutory Sanction of the NLB prior to deployment.

## *4.2 Construction/Decommissioning*

During the construction / decommissioning of an offshore wind farm, working areas will be established and marked in accordance with the IALA Maritime Buoyage System (MBS). In addition to this, where advised by NLB, additional temporary marking will be applied.

Notices to Mariners, Radio Navigational Warnings-NAVTEX and/or broadcast warnings as well as Notices to Airmen will be promulgated in advance of and during construction / decommissioning of any individual structure/farm.

## *4.3 Marking of Individual Structures*

The tower of every wind generator will be painted yellow all around from between 3.9m above the of LAT to 18.9m above LAT.

As per the MCA requirements, each of the structures will be marked with clearly visible unique identification characteristics at a location that is easily and readily serviceable. The identifications characteristics will each be illuminated by a low-intensity light, so that the sign is visible from a vessel thus enabling the structure to be detected at a suitable distance to avoid a collision with it. This will be such that under normal conditions of visibility and all known tidal conditions, they are clearly readable by an observer (with naked eye), stationed 3m above sea levels, and at a distance of at least 150m from the turbine. The light will be either hooded or baffled so as to avoid unnecessary light pollution or confusion with navigation marks.

## *4.4 Proposed Markings*

The final markings for the Neart na Gaoithe offshore wind farm will be agreed in consultation with NLB once the turbine layout has been selected. For the indicative Layout A the potential marking has been presented in Figure 4.1.

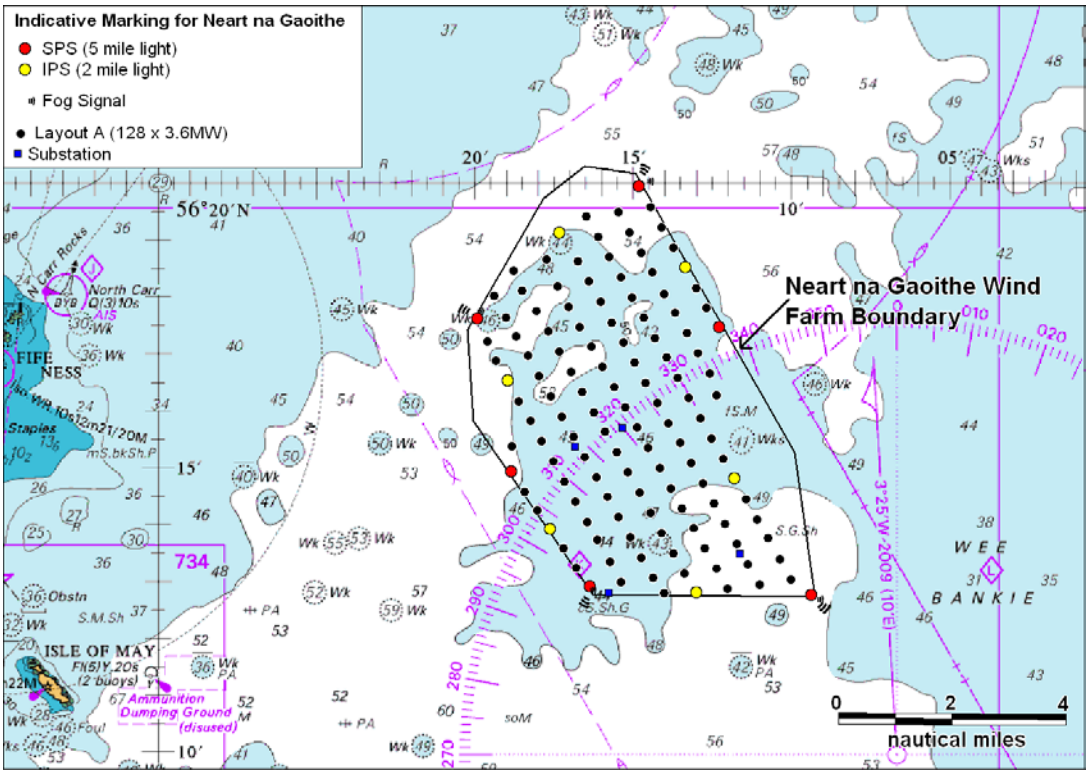


**Figure 4.1 Chart overview of Neart na Gaoithe indicative Layout A with NLB/IALA proposed marking**

As per IALA guidelines and NLB guidance, it is likely that:

- The six corner towers in the indicative Layouts (A/B) will be marked as Significant Peripheral Structures (SPSs).

- If the substation on the south west boundary of the wind farm was to be installed, then there is the possibility that the structure may obstruct the visible arc of the south western SPS light. Therefore, there may be a requirement to mark both the SPS and substation, with a 5NM lights.

- Six intermediate towers on each of the north, two on east/west edges (due to distance <2NM between the SPSs) and south facing boundaries will be marked as Intermediate Peripheral Structures (IPSs).

- In all the layouts, towers designated as SPSs are to exhibit Flashing Yellow 5 second (Fl Y 5s) lights of 5NM nominal range and omnidirectional fog signals with a character of 1 blast of 2 seconds duration every 30 seconds and an IALA usual range of 2NM. Towers designated as Intermediate Structures are to exhibit Fl Y 2.5s lights of 2NM nominal range.

- All the lights are to be visible to shipping through 360 degrees and if more than one lantern is required on a tower to meet the all-round visibility requirement, then all the lanterns on that tower should be synchronised.

- All the lights are to be exhibited at the same height at least 12m above Highest Astronomical Tide (HAT) and below the arc the turbine blades.

- All the lights are to be exhibited at least at night and when the visibility is reduced to 2NM or less. Fog signals are to be sounded at least when the visibility is 2NM or less.

- Based on the Indicative Layout A, there may also be a requirement to install additional Fog signals in the middle of the eastern and western boundaries of the wind farm, as the realistic range of sound system at sea is approximately 1NM.

- All the structures in the boundary of the turbine towers are to be coloured yellow from at least HAT to the height of the lights (the equivalent height on the unlighted structures).

- Any lighting required for aeronautical purposes is to be shielded / arranged such that it is not visible to shipping. If this cannot be achieved, then the requirement will be considered as having been met if the aviation light is reduced to 10% of its peak intensity when the visibility is more than 5km.

### *4.5 Superintendence and Management*

Mainstream Renewable Power will ensure that they have a reliable maintenance and casualty response regime in place such that the required availability targets are met.

# 5. CONSULTATION

## *5.1 Introduction*

Consultation and scoping responses on navigational issues has been carried out for stakeholders during the project. This section summarises the key consultation meetings and responses from scoping report (Ref. vii) which was reviewed to highlight the key issues relating to the proposed wind farm.

It is noted that as part of the Forth and Tay Offshore Wind Developers Group (FTOWDG) regional consultation was carried out using a number of methods.

## *5.2 Scoping Responses*

### 5.2.1 Marine Scotland

Developments should avoid shipping routes where possible through appropriate positioning within the option boundary. Where impacts cannot be avoided, these should be reduced through appropriate design.

Cumulative effects require further work within the plan review process and could be required at the project level. Appropriate navigation mitigation required, including taking account of individual and cumulative effects in collaboration with the shipping industry.

### 5.2.2 MCA

The Navigational Risk Assessment should be carried out according to MGN 371 (and MGN 372 – Guidance to Mariners Operating in the Vicinity of UK Offshore Renewable Energy Installations (OREIs)) and the DTI/DfT/MCA Methodology for Assessing wind farms. Navigation should be assessed according to cable routes/burial depth - subject to traffic volumes an anchor penetration study may be necessary.

Reference should be made to the Marine Environmental High Risk Areas (MEHRAs) established at Bass Rock, Dunbar and the Isle of May and adjacent coastlines. Assessment of impacts on ship's radar is required through discussion with radar sub group of Nautical Offshore Renewable Energy Liaison (NOREL).

### 5.2.3 MOD

The majority of the Neart na Gaoithe wind farm area is located within a submarine exercise area. There is also a firing practice area to the east of the site, but this is no longer in use. There are two Military Protected Places within the site: K4 and K17.

### 5.2.4 Fishing

From a fishing perspective the Neart na Gaoithe wind farm is not in a heavily fished area as identified in the scoping report. The 2010 shipping survey recorded trawling activity to the west of the wind farm with most fishing vessels passing through the site steaming as apposed to trawling.

Given wind farms can have a positive and negative impact on commercial fishing, the physical presence of the turbines and the behaviour and possible displacement of fish and shellfish over time will be assessed.

### 5.2.5 Chamber of Shipping

CoS state that navigation safety is of paramount importance when considering the development of a wind farm. All the guidance documents should be applied carefully whilst preparing the report and in consultation with CoS.

The report clearly addresses the key navigation issues and they are included here for ensuring that they are comprehensively addressed in the full assessment.

### 5.2.6 Recreation

Royal Yachting Association (RYA) states that the layout, spacing and direction of the set of turbines are crucial to avoid impeding navigation, particularly under sail. The relationship of the planned development to others in the area also needs to be considered as cumulative impacts of offshore developments can also affect the safety of navigation. RYA welcomes the creation of the FTOWDG in this respect but is concerned about the neighbouring Round 3 development Zone 2.

According to the RYA, any decommissioning plan should ensure that the structures are completely removed. Any parts of the structure remaining after the commercial operation of the installation may pose a hazard to navigation and should be avoided. However, RYA recognises that secondary uses may be identified for these structures once energy generation ceases. If structures are to remain in the water, navigational safety must be taken into account and structures should be appropriately marked and lit.

RYA state that any temporary exclusion zones during construction should conform to normal safety zone regulations and be lifted as soon as construction is completed.

The effect of the wind farm on the visibility of the lights from the Bell Rock and May lighthouses at night should be investigated, particularly as the helmsman on recreational vessels will be close to sea level. As the edge of the farm is porous, it may be difficult, particularly in fog or even at night, to identify which unit has been encountered, and consequently whether the vessel should turn port or starboard to clear the hazardous area. By no means all recreational vessels are equipped with chart plotters. The IALA regulations may not provide adequate guidance. There are mitigation actions that could be taken including the mounting of AIS units on some turbines along with large identification numbers and short range lights

### 5.2.7 Northern Lighthouse Board

Northern Lighthouse Board (NLB) assumes that any formal recommendations for lighting and marking will be given through the Coast Protection Act 1949 – Section 34 process.

Under the Merchant Shipping Act 1995 (sections 193 and 198), the Northern Lighthouse Board has the duty of superintendence over all Aids to Navigation (AtoN) within its area of jurisdiction. To this end the NLB work in partnership with all authorities to provide a seamless interface between their own statutory and third party maintained Aids to Navigation, for the safety of the mariner. NLB would therefore welcome any early opportunity to meet with the developers and the Harbour Authorities to discuss the navigational impact and any required marking.

As part of the formal application the NLB would require that a full Navigational Risk Assessment is undertaken, which should include procedures to be taken and navigational warnings to be broadcast during the data gathering, surveying, installation and cable laying/trenching operations etc. Any vessels engaged in these works shall exhibit signals in accordance with the International Regulations for Preventing Collisions at Sea 1972 (COLREGS).

The Statutory Sanction of the Commissioners of Northern Lighthouses must be sought to deploy, exhibit and subsequently remove any proposed navigational lighting or buoy stations required within any conditions of the consent to establish the offshore Wind farm or for any preparatory work.

### 5.2.8 Scottish Canoe Association

Scottish Canoe Association (SCA) noted that sea kayakers usually follow the coastline and coastal developments that introduce new artificial headlands create a danger to the passage of small craft. The SCA would therefore like to flag up their concern about the eventual landfall facilities where cables from offshore wind farms are brought ashore. If this is likely to be an issue the SCA would welcome the opportunity to take part in any consultation.

Groups of sea kayakers occasionally make the open crossing to the Bell Rock. The usual starting point for such a trip is Fife Ness, although it is possible to set off from other points such as Arbroath or Broughty Ferry. Any development in the sea area in the Outer Firth of Tay, especially during the construction phase could impact on groups of kayakers making this journey. The SCA would therefore welcome being kept updated on construction activity in that area.

## *5.3 Hazard Review Workshop*

A hazard review workshop held in Rosyth on the 4th November 2011. The purpose of the workshop was to identify and review the potential navigational hazards associated with the proposed offshore wind farm development with input from local navigational stakeholders.

Additional details on the workshop results are provided in Section 12 (a full methodology and results are provided in Appendix A), with a comprehensive log of the minutes recorded in in Appendix D.

The key information summarised from the navigation hazard review workshop is presented in the following subsections.

### 5.3.1 Search and Rescue/Emergency Response

- The closure of the Forth Coastguard Marine Rescue Coordination Centre (MRCC) was discussed along with the possible implication on SAR with future offshore developments proposed off the Firth of Forth and Tay area.
- MCA highlighted that Aberdeen would take responsibility for the area and that the Neart na Gaoithe wind farm would come under maritime SAR rescue rather than the coastal services.
- RNLI and Forth Ports Tugs noted that there are Tugs on 24 hour stand-by (5-10 minute call out time with a 120 tonne bollard pull) at the Hound Point and Braefoot Bay marine terminals.
- Tugs in the Firth of Forth can steam at approximately 13 knots with the possibility of responding to a drifting or ship collision incident at the proposed offshore wind farm within approximately two hours of mobilisation.
- It was emphasised that there is generally no option for smaller vessels to anchor in an emergency situation in the area of the proposed wind farm given that the water depth adjacent to the Neart na Gaoithe site is approximately 45m.
- RNLI noted that easterly or north easterly winds can result in a very large swell in this part of the North Sea and these sea conditions would make access to the wind farm difficult.
- In terms of a man overboard incident at the proposed wind farm, the use of Personal Locator Beacons (PLBs) could be investigated.

### 5.3.2 Offshore Safety Zones

- A question was raised regarding exclusion zones around wind turbines and what impact these zones would have for recreational and fishing vessels. No significant impact was predicted on sailing and fishing vessels (i.e. vessels could pass through the site), however it was not expected that merchant vessels would pass through the wind farm.
- Mainstream noted that they did not foresee the use of exclusion/safety zones during the normal operational phases of the wind farm, although there may be a requirement for substations to have a safety zone.
- RYA noted that it is highly unlikely that sailing vessels would approach within 50m of turbines installed in the Neart na Gaoithe site.
- Mainstream confirmed that mobile/phased 500m safety zones are likely to be used during the construction phase (for example around construction/installation vessels).
- RYA mentioned that recreational vessels are most likely to rely on electronic (plotter based) charts and these may not always be up-to-date (i.e. not showing the Neart na Gaoithe site when it is built) due to charts not been updated regularly.
- Furthermore, it was noted that pseudo charts can be used (for example by foreign recreational sailors) and the cost of updating charts could result in recreational craft not carrying the latest charts for the area.

### 5.3.3 Fishing Issues

- The fishing industry representatives (Fishermen's Mutual Association (FMA), Anglo-Scottish Fisherman's federations and Scottish Fisherman's federations (SFF)) highlighted potential issues with catching or snagging gear on subsea structures/cables. Information on cable routes that are generally distributed via Kingfisher and FishSafe. There is variation in the number of updates on the different FishSafe systems carried by fisherman, so they may not be carrying the most recent data. Currently no data is provided on offshore renewables infrastructure.
- Sea angling activity was discussed and Arbroath was identified as the main location for charter vessels, with no angling centres known to be located in the East Neuk ports/harbours.
- In terms of the expected export cable route FMA suggested that this could be at higher risk of fishing gear interaction.
- Mainstream noted that the export cable will be protected where possible based on the sea bed soil type. The inter-array cables within Neart na Gaoithe should also be buried based on seabed conditions. In addition, the J-tube could be protected by rock dumping or mattresses when protecting against scour.
- SFF stated the preference for rock dumping, as mattresses can be a hazard to gear, especially on smaller vessels with less power. In addition, a fishing vessel skipper will cut away snagged gear if they have no choice.
- FMA mentioned that in general fishing vessels in the area were of relatively low power/size and therefore could be significantly impacted in terms of fishing days lost due to repairing gear which was abandoned.
- FMA noted the potential implications of tugs pulling barges in the vicinity of Isle of May, as creels can be damaged and also that Notices to Mariners could be issued.
- SFF queried how often subsea cables would be surveyed. In response it was noted that initial surveys would be regular, but would become less frequent over time based on the findings of the initial surveys.
- SFF also stated that vessels may trawl through the wind farm site. In addition, seasonal squid fisheries are becoming more active in the North Sea due to squid not been a quota controlled species.

### 5.3.4 Recreational Vessels and Activities

- RYA noted that a portion of incidents in the area (for example, machinery failures and during adverse weather conditions) involved recreational craft from Scandinavian that had sailed off course when heading to Northern and Eastern Scotland.
- In addition, it was stated that the main risk is likely to be from foreign sailing vessels, which do not carry up-to-date charts, as local users are likely to become aware of the wind farm site.
- SCA commented on liaison with local harbour masters regarding the planned development.
- In terms of ship-to-ship collision risk, RYA noted concern for vessels been squeezed into narrower shipping routes, however most sailing routes are either north/south or east/west and hence it is less of an issue for recreational craft.

### 5.3.5 Vessel Monitoring and Local Weather Conditions

- Forth Ports stated that they can recommend areas to shelter and anchor, e.g. Saint Andrews Bay.
- Mainstream noted that they may discuss with other developers and Forth Ports the possibility of a joint collaboration on vessel monitoring in the area.
- A general discussion between the attendees noted that during October to March there can be sustained easterly winds in the area.
- RNLI pointed out that sea haar and poor visibility can occur during an easterly sea breeze and this is most common during March to May.

### 5.3.6 Cumulative Issues

- A general discussion took place on the current Rochdale Envelope for the Forth Round 3 Phases and it was noted that there is a channel west of the potential wind farms (east of Inch Cape and Neart na Gaoithe); however there is limited routeing options for vessels headed east/west.
- In terms of the cumulative impacts, Forth Ports commented on smaller merchant vessels and coastal tankers re-routeing around the Round 3 Zone 2. They did not think these types of vessels would route east of the Round 3 Zone 2 given the marginal cost of operating smaller vessels and their need to take the shortest route.
- A general point was made that the Neart na Gaoithe wind farm site in isolation is not a problem in terms of ship-to-ship collision risk due to the available sea room (east and west of the site). However, with the construction of the Round 3 Zone 2 to the east of Neart na Gaoithe and Inch Cape to the north there could be an increased cumulative impact.

## *5.4 Forth and Tay Offshore Wind Developers Group Consultation*

Consultation on navigational issues was carried out during the FTOWDG regional work to gather input from the marine community (Fig. iii). It was carried out using three different methods as follows:

1. Meetings

Meetings were held with the following:

- The Chamber of Shipping (CoS)
- Forth Ports
- Northern Lighthouse Board
- Department for Transport
- Maritime and Coastguard Agency

2. Remote Consultation

The most regular vessels using the area were identified and provided with an information pack detailing the proposals. The pack requested feedback on the proposals and also invited further consultation should the stakeholder consider this necessary.

3. Presentations

Presentations were given to the following:

- RYA

Summary details of the main feedback relevant to the Neart na Gaoithe project are provided in the following sub-sections.

### 5.4.1 The Chamber of Shipping

A meeting was held at The Chamber of Shipping offices in London on 11th January 2011. The objective of the meeting was for FTOWDG to present an overview of the regional shipping and navigation study approach, to seek a preliminary response from CoS on the study methodology and proposed strategy to communicate the findings to key shipping and navigation stakeholders. A summary of the main points is provided below:

- CoS stated that FTOWDG need to consider ship-to-ship transfers (which were proposed near the entry of the Firth of Forth in 2008). These ships have deeper draughts (up to 23m) and need to be considered in the assessment. (It is noted that at the time of writing in June 2011, regulations were to be implemented by the UK Government which would ban ship-to-ship transfers in open water apart from off the Suffolk coast. Therefore rules would prevent oil transfers occurring outside port/harbour authority limits, (i.e. in the outer Firth of Forth off Bass Rock and Isle of May)).

- CoS also commented on a number of the shipping routes identified to pass through the region. Their main comments on the route relevant to Neart na Gaoithe was as follows:

    - Coastal shipping passing west of Inch Cape and Neart na Gaoithe from northern Scottish ports to the Forth (east/west of Bell Rock) – Use of shipping routes north of Isle of May – CoS stated that this route was used due to the high volume of traffic entering the Firth of Forth south of Isle of May. Safety concerns were raised by CoS over the proposed alternative rotueing (vessels will pass west of developments/inshore) due to increasing the volume of vessel traffic along an existing route. Need to assess ‘safe passage’ and probability of collision risk resulting. Dialogue with vessel operators could provide some information about current strategies in use when navigating east and west of Bell Rock.

- In general discussion CoS stated that even one vessel per day on any given route could be strategically important and must therefore be given due consideration in the regional shipping and navigation study.

### 5.4.2 Forth Ports

A meeting was held with the Forth Ports in January 2011. The objective of the meeting was for FTOWDG to consult with the main ports in the area which are operated by Forth Ports PLC. A summary of this meeting is provided below.

Vessel Activity in the Region:

- Forth ports have 20-22 movements a day (in 24hr period). They stated that this is not that busy in terms of the number of movements, but is significant in terms of tonnage.

- Oil and gas accounts for 80-90% of Forth Ports business and around 60 cruise liners visit in the summer.

- Regarding coastal tankers routeing to/from Grangemouth, BP lost the contract in 2011, hence the *Border* vessels now mainly work out of Immingham, and these vessels now pass further east of the coast when supplying fuel to ports around Scotland.

- It was noted that no ship-to-ship transfers take place in the Forth area as government regulations only permit ship-to-ship transfers inside their port limits. In addition, it was stated that anchorages are generally further inshore as depicted on admiralty charts.

- No major tidal variation. The vessels will sit at anchor as opposed to slowing down in the North Sea.

- It was thought that it is probably personal preference as to why vessels go East/West of Bell Rock. It could be that smaller vessels go closer to the coast for shelter.

Issues Discussed:

- General concerns were expressed regarding smaller vessels being pushed further offshore and the impact on them being further east and hence out in heavier weather.

- Forth ports felt the impact could be reduced by having a route through the middle between Neart na Gaoithe and Inch Cape for the deviated route from both Forth and Dundee.

Future Developments:

- Future developments in the Forth include the potential for 3 to 4 biomass plants, which if constructed could bring in an increased number of large bulk carriers.

### 5.4.3 Marine Coastguard Agency and Department for Trade

A meeting was held with MCA and Department for Trade (DfT) and in January 2011. The objective of the meeting was for FTOWDG to consult and discuss the collaborative works and outline each of the projects and the subsequent development programmes. A summary of this meeting is provided below.

Background and Data Collection:

- MCA discussed the datasets used in the analysis and asked that AIS, Vessel Monitoring Service (VMS), Catch Data and radar data are included in the final regional assessment. It was noted that the current data set was only for 28 days AIS and the intention is to expand the study covering the longer term data collection across the region. (AIS shipping data provided in the report covers the combined survey period from August 2009 to July 2011).

- It was highlighted that the AIS data tracks showed poor coverage in the south of the Firth of Forth Round 3 Zone 2 and it was informed that the data used was from last year's collection (2010). In response to this it was noted the recording station in the south of the region had since been re-located to provide greater coverage in this area.

General Points:

- Overall the MCA were supportive of the approach taken in the regional assessment, however they are of the opinion that the majority of stakeholders are likely to be uncomfortable with many of the route change proposals, especially those around Bell Rock. Without stakeholder support the MCA would be unable to support the route changes.

- MCA requested further analysis to understand the percentage of traffic in the area that comprises regular running vessels as this would help to identify the appropriate stakeholders to meet/consult.

- It was emphasized that the assessment must consider what hazards are created by the suggested route changes and that reference to potential impacts of turbines on radar and how this is impacted on the route changes.

- The MCA suggested that when looking at all the routes in and around Bell Rock, an assessment needs to be made on the increase in shipping densities and encounters.

- DfT asked that offshore accommodation, maintenance, Search and Rescue (SAR) were considered by the developers later in the individual projects.

### 5.4.4 Marine Stakeholder Consultation

Shipping operators were identified and contacted for feedback on the potential impact of the proposals on the navigation from regional development of the area. A summary of the main feedback received relevant to Neart na Gaoithe is presented below.

Solstad (offshore vessels):

- The regional developments will not affect their operations. In general port callings are to Aberdeen or Peterhead. If vessels pass through the region following construction of wind farms, Solstad indicated that they would not have any problems navigating through the wind farms.

Marine Scotland - Compliance (views from different fisheries law enforcement vessels):

- Inch Cape and the Neart na Gaoithe proposals will cause vessels to route in shallower water and close proximity to Bell Rock and the coastline. Whilst being in close proximity to Bell Rock is not usually a problem for the masters of fisheries vessels - they would not feel comfortable in this area in an Easterly or South Easterly Gale.

Transmarine Management ApS (tankers bound for Dundee):

- Initial findings are that when Transmarine Management ApS ships are bound to Dundee (in-ward) the developments are not a problem, but when leaving Dundee for direction Skaw (Skagen), Denmark they will require re-routeing.

SAGA Cruises (cruise vessels)

- In general the proposals do not pose a safety risk to SAGA Cruise vessels.

Fred Olsen Cruises (cruise vessels):

- Fred Olsen Cruises transit the area, especially during the summer months, however they have no concerns regarding the impact on operations.

James Fisher Everard (coastal tankers bound for Forth, Tay and Northern Ports):

- No comments were supplied during the Regional work.

Armac Marine Management Ltd (cargo vessels bound for Montrose):

- Some routes will be affected but provided that the constructions are adequately marked and correctly charted Armac Marine Management Ltd does not have any concerns regarding safe navigation, (the opinion of several Masters in the company).

# 6. EXISTING ENVIRONMENT

## *6.1 Introduction*

This section presents the following baseline information relating to navigation in the outer Firth of Forth:

- Ports
- Navigational Aids
- Sailing Directions
- Wrecks
- Oil & Gas Infrastructure
- Exercise Areas
- Metocean data

## *6.2 Outer Firth of Forth*

Firth of Forth comprises of the land locked estuary stretching from around the Isle of May to Alloa. The outer Firth also encompasses a number of coastal harbours and two important water ways, the River Tay and River Forth.

A chart overview of the region relative to the main ports and harbours is presented in Figure 6.1.

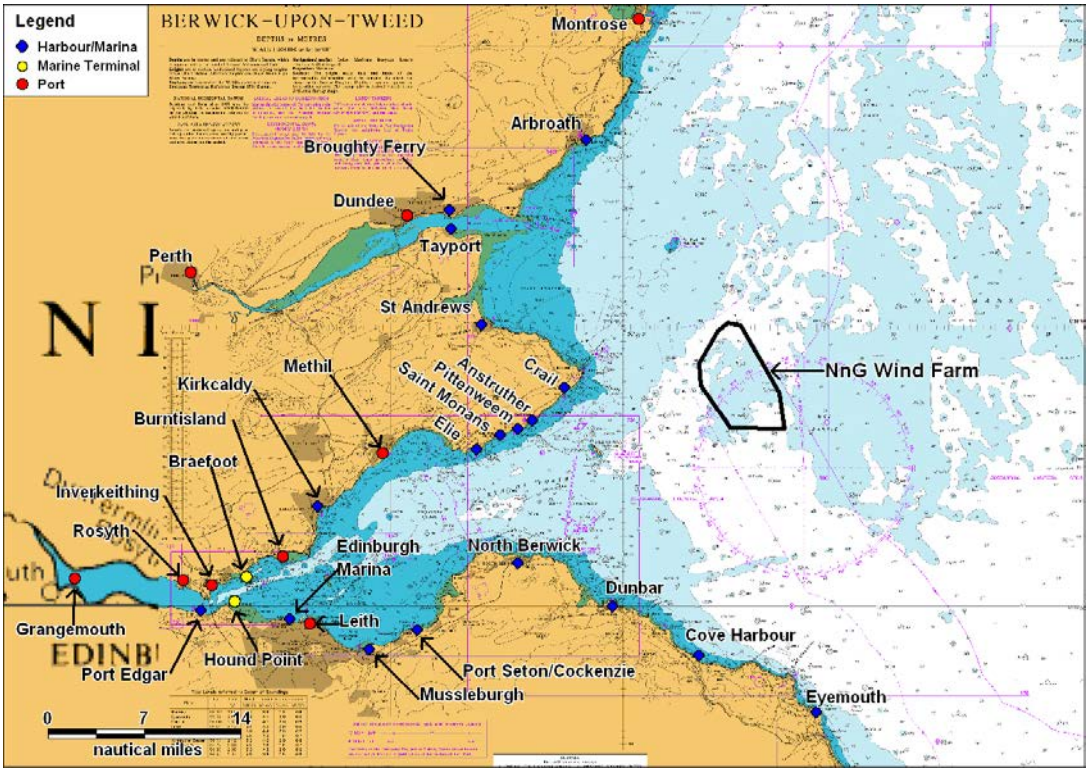


**Figure 6.1 Overview of ports and harbours in the area**

## *6.3 Port/Harbour Facilities*

A number of ports and harbour facilities are located within the Firth of Forth and Tay, with smaller harbours (mainly fishing and recreational) located along the Fife and East Lothian coastlines.

A summary of the facilities at the main ports, harbours and marinas is provided in the following sub-sections.

### 6.3.1 Maximum Limiting Conditions

The port of Grangemouth operated by Forth Ports Ltd. can handle the largest vessels in the area, with draughts up to 11.7m, and Leith is also able to accommodate vessels up to 210m and draught 9.1m, (however larger vessels can be berthed dependant on tidal conditions).

It is noted that larger vessels also enter the Firth of Forth bound for the Hound Point and Braefoot Oil and Gas terminals. The Hound Point Oil Terminal can accommodate tankers of draught 21.64m (springs) and 20.71m (neaps) tides.

### 6.3.2 Forth & Tay Navigation Service / Pilotage

Forth and Tay Navigation Service is manned 24 hours a day (all year) by personnel who are supported by Vessel Traffic Service (VTS) Operators. The service they provide includes radar surveillance of the Forth Estuary from the Eastern Port Limit (Tantallon Castle on the south shore to Fife Ness on the north shore) and of the Tay Estuary from the Abertay Outer Buoy to a position just west of the Tay Rail Bridge.

The Forth and Tay Navigation Service duties also include enforcement of the Forth Byelaws and general directions for Navigation and the Byelaws for the Port of Dundee. This ensures safety and efficient passage of all shipping passing through the Forth Ports and Harbour limits. Forth Ports has five radars covering the Forth Estuary; at Gullane, Leith, Burntisland, Port Edgar and Grangemouth and one radar at Buddon Ness on the Tay.

Forth Ports Ltd. exercises compulsory pilotage for passenger-carrying vessels and for other vessels in Forth Deep Water Channel and its immediate vicinity and in the firth/river as a whole (west of 3°, 15.4 minutes W). Pilotage is also compulsory for vessels over 8,000 Dead Weight Tonnage (DWT) bound for Leith and vessels using the Eastern Channel lying within Grangemouth Docks. However vessels bound for a closed dock, lock or other closed limits, are generally excluded from compulsory pilotage.

Pilotage is compulsory in the Dundee Pilotage District, which extends to the port limits south by south west of the Fairway Light-buoy. In terms of pilotage in the inner River Tay, this is not compulsory however masters are strongly advised to make use of the services of a local pilot which will be arranged by the Perth Harbour Master.

### 6.3.3 North East Ports/Harbours

Montrose is formally a small commercial and fishing port but has seen an increase in its commercial activity over recent years, mainly as a result of the offshore industries. Vessels up to 165m in length and 7m in draught can be accommodated.

Arbroath is mainly a fishing port used by medium and small fishing vessels. Arbroath also has a small marina for sailing vessels.

### 6.3.4 Tay Ports

Broughty Ferry harbours a lifeboat station, with one All-weather Life Boat (ALB) and one Inshore Life Boat (ILB), Tayport Harbour has a small tidal harbour and marina which dries on low tide and nearby Dundee is the main port handling general cargo and imports of crude oil. The repair and servicing of offshore gas and oil installations is also undertaken at Dundee. Vessels with a maximum length of 250m, beam 50m and draught up to 9m can normally be accommodated.

Perth handles about 100,000 tonnes of cargo a year, mainly agricultural products, sand, chemicals and forest products. The largest vessel received at the port was 94.7m in length in 2009.

### 6.3.5 Fife Harbours (East Neuk and St Andrews)

St Andrews is minor harbour used by small fishing vessels (i.e. potters) and recreational craft.

The East Neuk harbours (including Crail, Anstruther, Pittenweem, Saint Monans and Elie) are mostly used by small to medium sized fishing vessels and recreational craft.

### 6.3.6 Forth Ports:

A number of ports and harbour facilities are located within the Firth of Forth, the main ports, harbours, marine terminals and marinas are summarised below:

- Methil – a commercial port handling wood pulp and timber, fertiliser, stone and general cargoes. The maximum size of vessel handled is up to 102m in length, 14.6m beam and 5.5.m draught.
- Kirkcaldy – little or no commercial traffic and is mainly used by local fishing vessels.
- Burntisland – small commercial port handling general cargo. The maximum size of vessel handled is 122m in length, beam 16.8m and draught 6.7m.
- Breafoot Gas Terminal – is situated on the north west side of Mortimer's Deep on the north bank of the Firth of Forth. It is a gas tanker terminal serving the Mossmorran petro-chemical complex. The maximum size of vessel handled is draught of 10.8m.
- Inverkeithing – vessels up to 90m in length (approx.) load scrap at the Deep Water Berth and No 1 Berth. Smaller vessels up to 70m load stone at the quarry berth.
- Rosyth –is a commercial port handling general cargo and cruise liners. Additionally there is a Ro-Ro passenger and freight service to Zeebrugge. There is no restriction on length and beam for vessels using the tidal harbour but the maximum permitted

draught is 7.8 m. It is noted that de-commissioned nuclear submarines are also located in the Royal Dockyard.

- Grangemouth – handles all types of vessels including container vessels, tankers and LPG carriers, with a maximum draught to of 11.7m at the entrance lock at high water.
- Port Edgar – accommodates a yacht marina, with vessels up to 18m in length using the harbour at all states of the tide.
- Hound Point Oil Terminal – is on the western extremity of the Forth Deep Water Channel. The terminal can accommodate tankers of draught 21.64m (springs) and 20.71m (neaps) tides.
- Edinburgh Marina (Granton Harbour) – formerly a small commercial port, now used by leisure craft.
- Leith – the port for Edinburgh and handles cruise liners, general cargoes and dry and liquid cargoes in bulk. It is also a support base for the North Sea offshore industry. The port can accommodate vessels up to 210m in length, beam 30m draught 9.1m, however larger vessels can be accommodated dependant on the high tide.
- Musselburgh – mainly used by recreational vessels up to 18m in length and 2m in draught.
- Port Seton/Cockenzie – used by small to medium sized fishing vessels and a number of recreational craft.

### 6.3.7 Harbours South of Neart na Gaoithe

A number of small fishing harbours are located along the coastline of East Lothian/Scottish Boarders including, North Berwick (mainly used by recreational vessels and a small number of fishing boats), Dunbar (used for landing fish and recreational vessels), Cove Harbour (a small fishing harbour) and Eyemouth (a busy fishing harbour, with marina facilities.)

### 6.3.8 Anchorages in the Area

A number of coastal anchorages are presented in Figure 6.2.

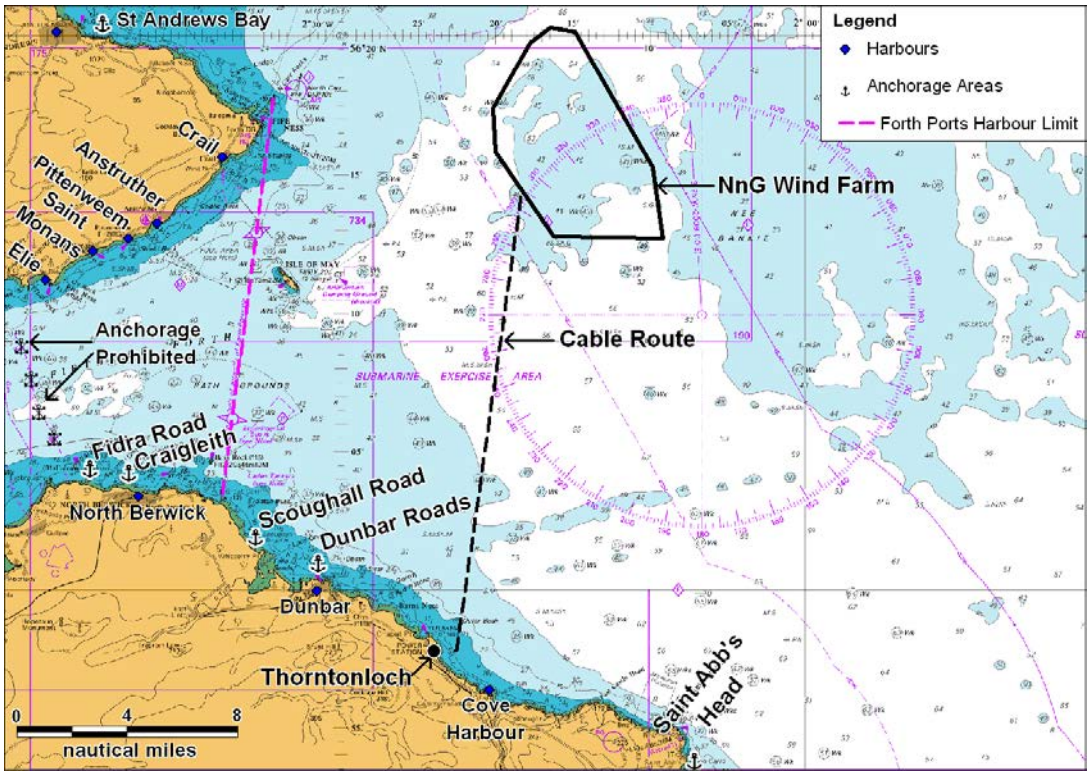


**Figure 6.2 Anchorage areas, ports and harbours relative to Neart na Gaoithe**

The closest anchorage to Neart na Gaoithe is located 14.4NM west by north west in Saint Andrews Bay. Dunbar Roads is the nearest charted anchorage area relative to the proposed export cable, approximately 5.5NM west of the corridor. It is noted that anchorage is prohibited in the vicinity of a submarine oil and gas pipelines from Fife to East Lothian.

From north to south the following anchorage areas have been identified:

- Fidra Road – anchorage can be found 0.6NM east by north east of Fidra Light in westerly winds;
- Craigleith – anchorage is available off the west end of Craigleith, sand and clay. East of the anchorage the seabed is foul and uneven;
- Scoughall Road anchorage – 0.8NM north by north west of Whitberry Point, in depths of 9 to 11m, clay, advised during offshore winds;
- Dunbar Roads – anchorage in depths of 13m, 876m north west of the harbour entrance; and
- Saint Abb's – anchorage in depths of 5m in the bay.

An analysis of anchoring within the 10NM of Neart na Gaoithe is presented in Section 8.5.

## *6.4 Navigational Aids*

A plot of the principal navigational aids within the region is presented in Figure 6.3.

The principal lights and buoys are those listed in Admiralty Sailing Directions for the area (Ref. viii). The buoy and light positions are taken from Admiralty Charts of the area.

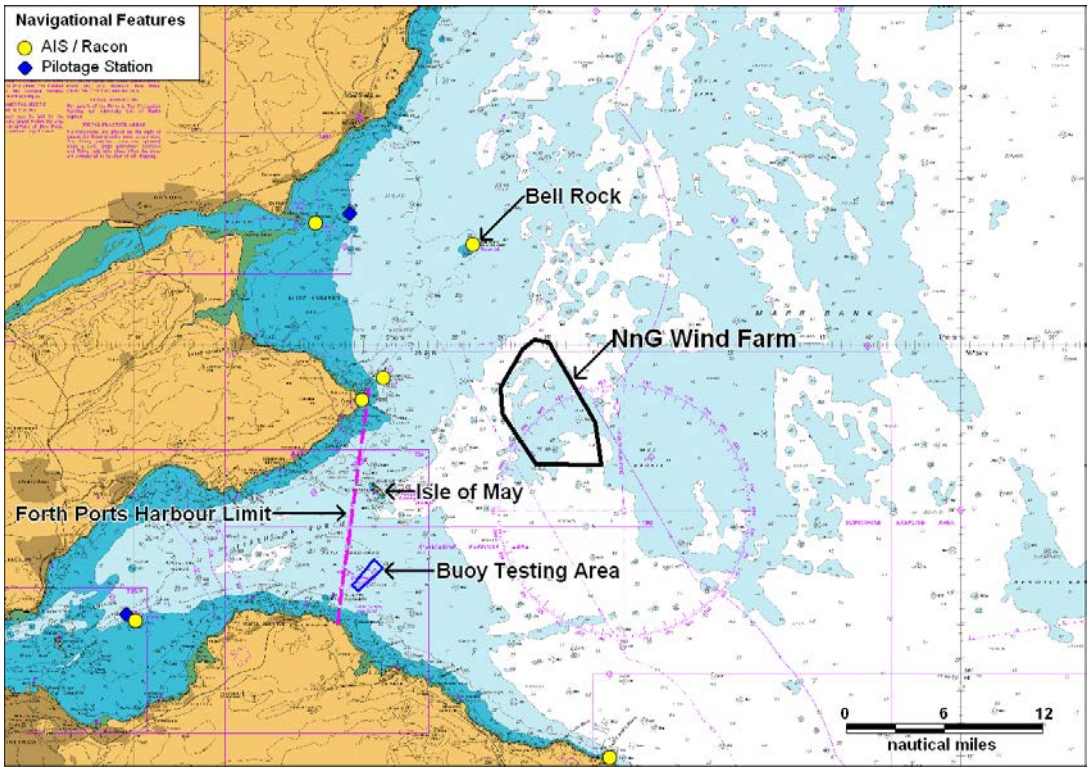


**Figure 6.3 Overview of navigational aids relative to Neart na Gaoithe**

The main navigational aid /feature in the area is the Racon located on Bell Rock 6.9NM north by north west of Neart na Gaoithe. In addition, North Carr and Fife Ness AIS transmitters are located approximately 7-8nm west of the proposed wind farm.

It is noted that a buoy testing area is located 11NM south west of Neart na Gaoithe.

## *6.5 Sailing Directions*

Sailing directions for the area are presented in the North Sea (West) Pilot (Ref. viii). A plot of the routes for vessels bound from Rattray Head and Isle of May is presented in Figure 6.4.

The arrows are not accurate if superimposed on a chart but they illustrate the general passages used by ships. A description of the route passing from the entrance of the River Tay to Fife Ness (passing the wind farm area) is given below.

- (3.219) From the vicinity of the Fairway Light-Buoy (56° 29’ 2N, 2° 28’ 2W) off the entrance to the River Tay the coastal route is South-southeast to Fife Ness, passing (with positions from Fife Ness): east by north east of Saint Andrew Bay (7NM west by north west), with the town of Saint Andrews at its head. The west coast of the bay is fronted by shoal water with depths of less than 5m. Targets and target buoys may be moored off Tentsmuir Sands and there are range beacons ashore.
- Thence: east by north east of North Carr Rock (1NM north by north east), which dries. The rock has a prominent beacon (red column on a stone base, globe top-mark, all supported by six metal stays) and lies at the northeast extremity of foul ground extending 1NM north east of Fife Ness. North Carr Light-Buoy (East cardinal) is moored 1NM northeast of North Carr Rock, which is also covered by the red sector (197 degrees – 217 degrees) of Fife Ness light.
- Thence: east by north east of Fife Ness, a dark cliff, 10m high, above a rocky foreshore.

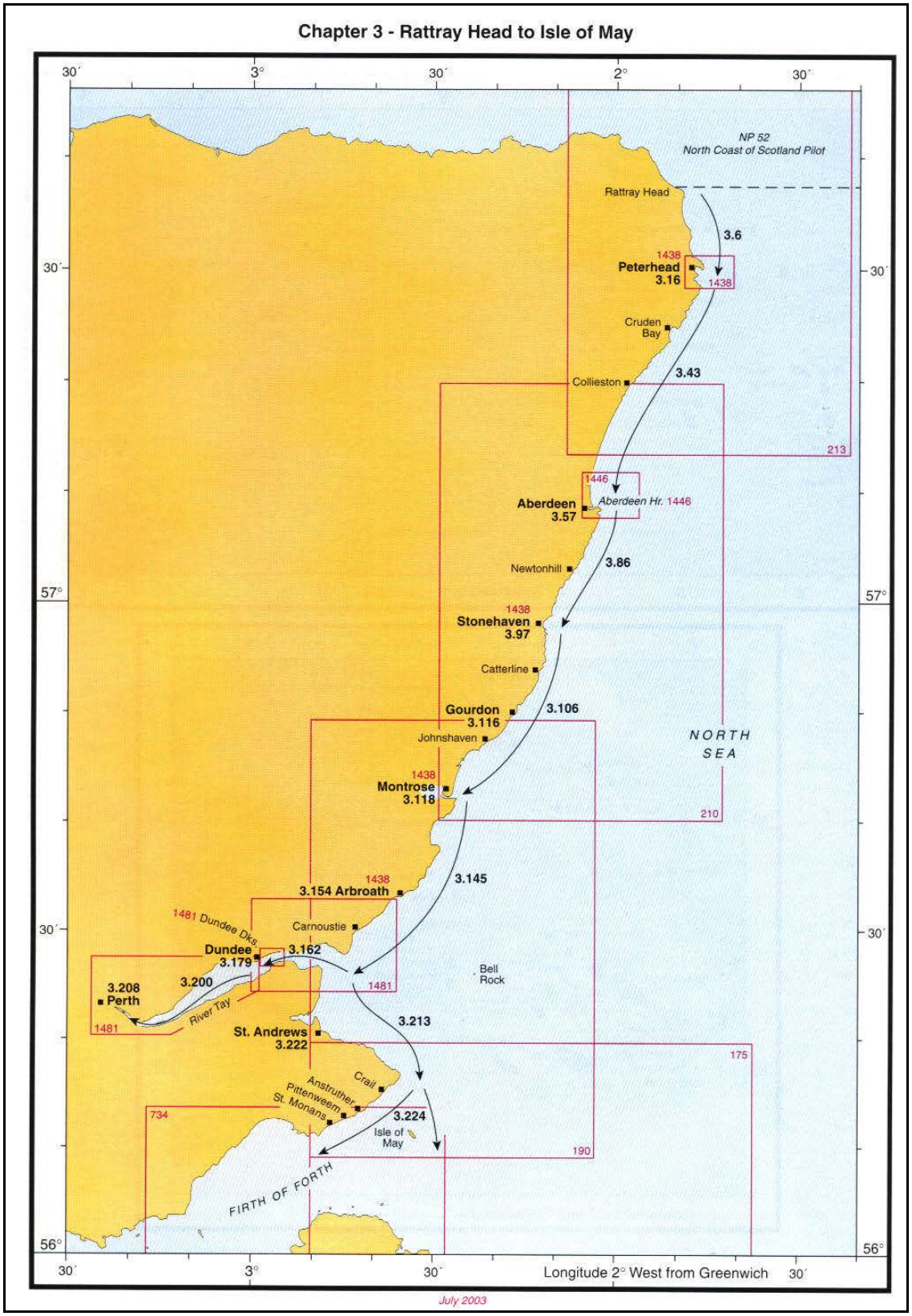


**Figure 6.4 Routes from Rattray Head to Isle of May (Ref. viii)**

## 6.6 Wrecks

A figure presented charted wrecks is presented in Figure 6.5.

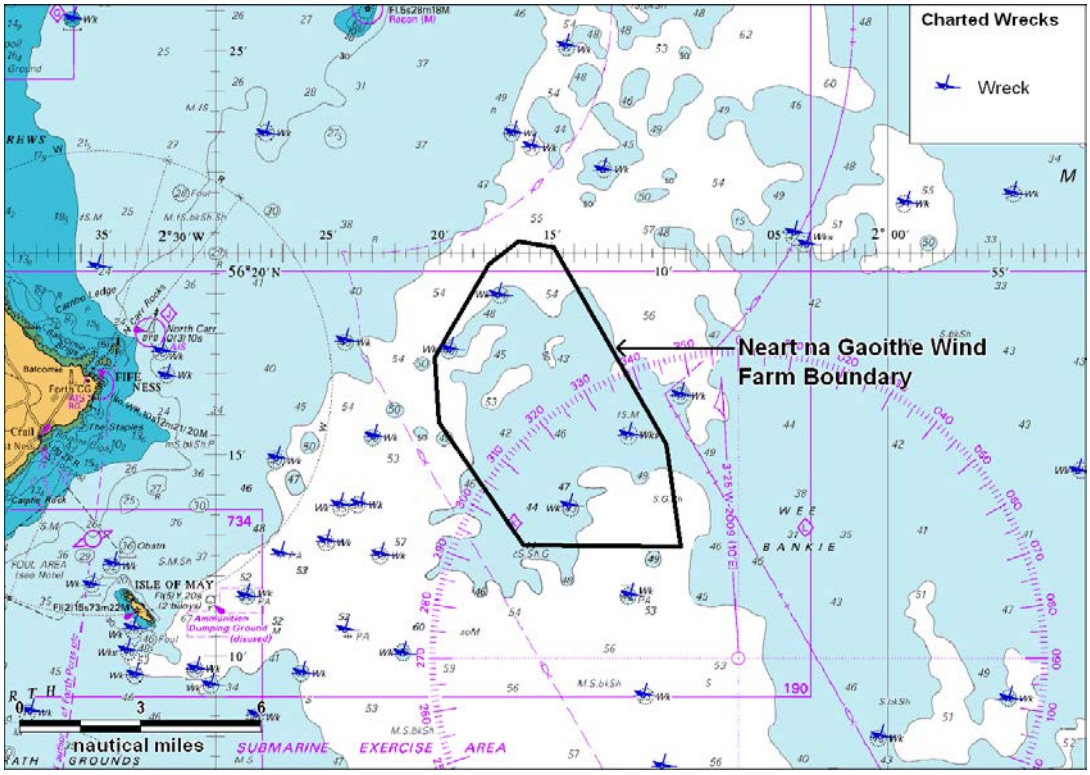


**Figure 6.5 Charted wrecks relative to Neart na Gaoithe**

Based on admiralty charts, there are approximately five wrecks marked within the Neart na Gaoithe and two are Military Protected Places (K4 and K17) located approximately 0.7NM west of the eastern boundary of the wind farm. Outside the wind farm boundary the nearest wreck is located approximately 0.9NM east.

## *6.7 Oil & Gas Infrastructure*

The licence blocks in the area of the proposed wind farm are presented in Figure 6.6.

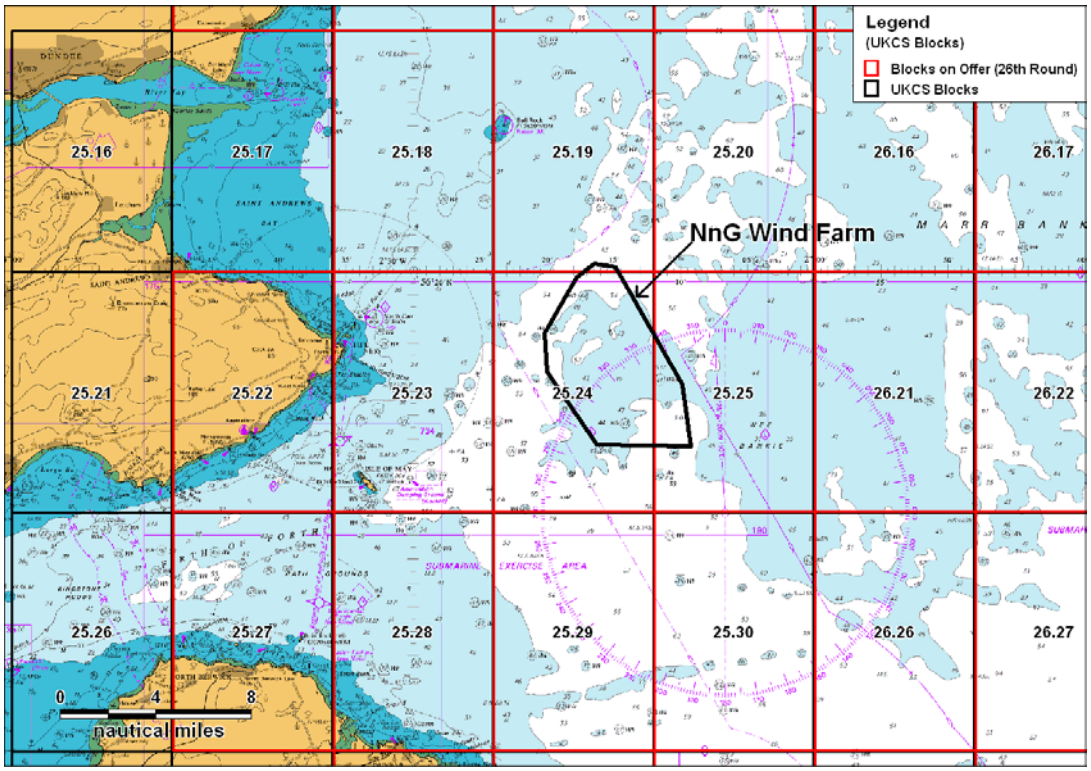


**Figure 6.6 Oil & Gas United Kingdom Continental Shelf (UKCS) Blocks, installations and licence areas**

The proposed site is largely within UKCS Block 25/24 which was on offer as part of the 26th round of UKCS licensing. This block has never been previously licensed and, no offer was received during the latest UKCS round of licensing.

The nearest existing offshore surface installation is the Booster 36/22a Norpipe platform 97NM southeast.

The nearest exploration well is located 22.7NM northeast of the Neart na Gaoithe wind farm boundary originally drilled by Cluff Oil Plc. in October 1985.

## *6.8 Other Navigational Features*

The other main navigational features in the area are related to the military Practice and Exercise Areas (PEXA's) within the outer Firth of Forth as shown in Figure 6.7.

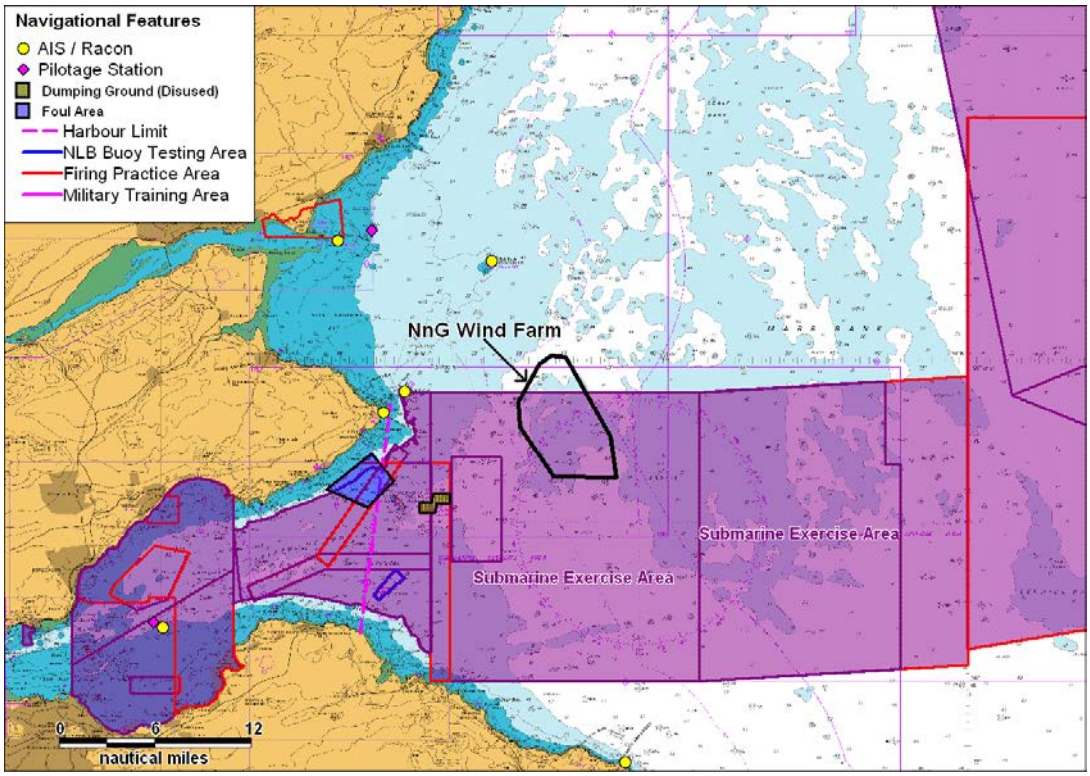


**Figure 6.7 Military practice areas and other navigation features in the area**

A general practice and submarine exercise area overlies approximately 25NM$^2$ (82%) of the proposed wind farm (total area 30.5NM$^2$). In addition, a large part of the Firth of Forth contains military Practice and Exercise Areas (PEXA's) including general practice and firing, submarine and exercise areas. No restrictions are placed on the right to transit firing practice areas at any time. Exercises and firing only take place when the areas are considered to be clear of all shipping.

The proposed wind farm is located approximately 8.4NM east of the eastern limit of authority of Forth Ports Ltd. There is a foul area and an ammunition dumping ground (disused) at distances of 8.5NM and 6.5NM, respectively. It is noted that a number of de-commissioned nuclear submarines are moored at Rosyth Dockyard.

The only aggregate dredging license in Scotland (leased to Westminster Gravels Ltd) was located within the inner Firth of Forth, approximately 30NM southeast of the Neart na Gaoithe wind farm. It is noted that the 10 year lease between Westminster Gravels Ltd and The Crown Estate ended in January 2011. Therefore the impact of Neart na Gaoithe on dredging activities was screened out of the NRA.

### 6.8.1 Marine Environmental High Risk Areas

Marine Environmental High Risk Areas (MEHRAs) are areas that have been identified by the UK Government, as an area of environmental sensitivity and at high risk of pollution from ships. The Government expects mariners to take note of MEHRAs and either keep well clear or, where this is not practicable, exercise an even higher degree of care than usual when passing nearby.

MEHRA are located within 10NM of Neart na Gaoithe along the cliffs of Isle of May, as presented in Figure 6.8.

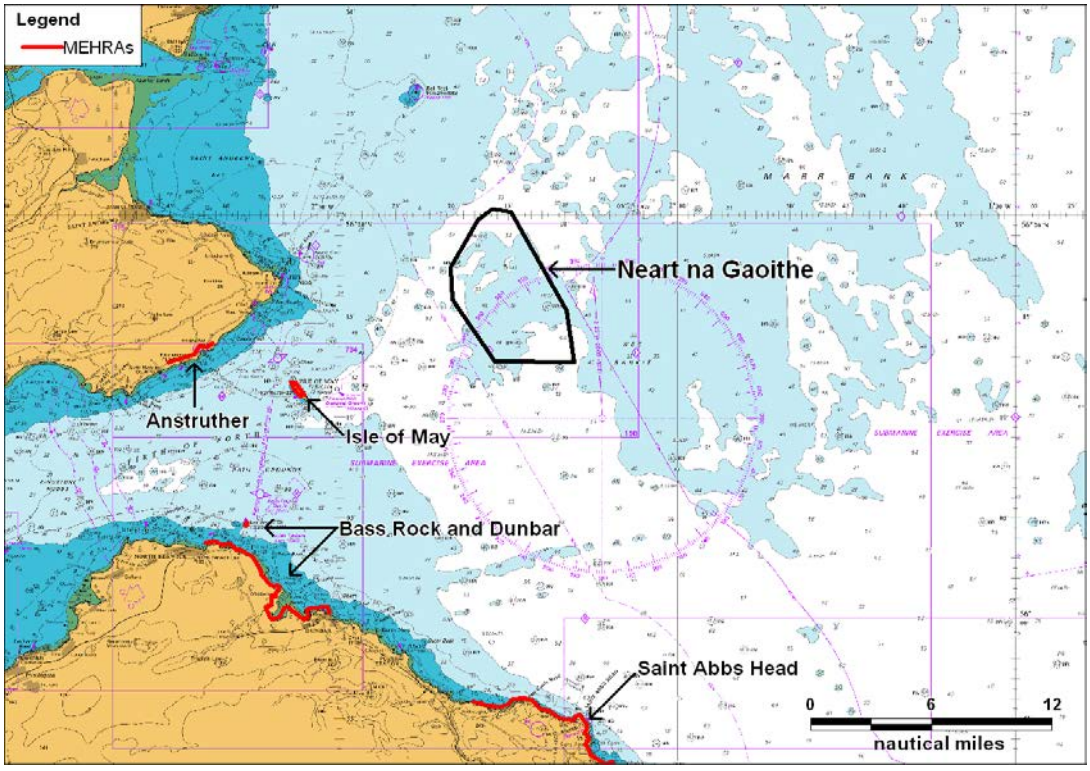


**Figure 6.8 MEHRAs relative to Neart na Gaoithe**

Within 20NM of the wind farm development there are also MEHRAs located on the Fife coastline at Anstruther, around Bass Rock / between North Berwick and Dunbar and at Saint Abbs Head.

## *6.9 Metocean Data*

### 6.9.1 Introduction

This section presents Metocean data for the area of the Neart na Gaoithe which have been used as input to the risk assessment.

According to the Admiralty Sailing Directions (Ref. viii), the west North Sea region enjoys a generally mild climate. Winds blow from between the south and northwest most usually, and are often fresh or strong. Gales are more common in the winter months, although they still may occur during the summer.

Rainfall is not considerable, and there is little variation throughout the year. It is frequently cloudy throughout the year; however, the winter months are more susceptible to overcast skies. Fog (or haar) occasionally affects the east cost of the UK, particularly in the north.

Metocean data recorded at Neart na Gaoithe and the surrounding area is also presented based on the following sources:

- Site specific wind and weather data collection (Ref. ix) and (Ref. x);
- Regional weather monitoring for FTOWDG (Ref. xi); and
- Local information recorded during the Hazard Log workshop.

### 6.9.2 Wind

The wind data for the site has been taken from recordings made at Neart na Gaoithe met buoy. The wind direction distribution is presented in Figure 6.9. It can be seen that the wind direction is mostly variable; however the predominant wind direction is westerly.

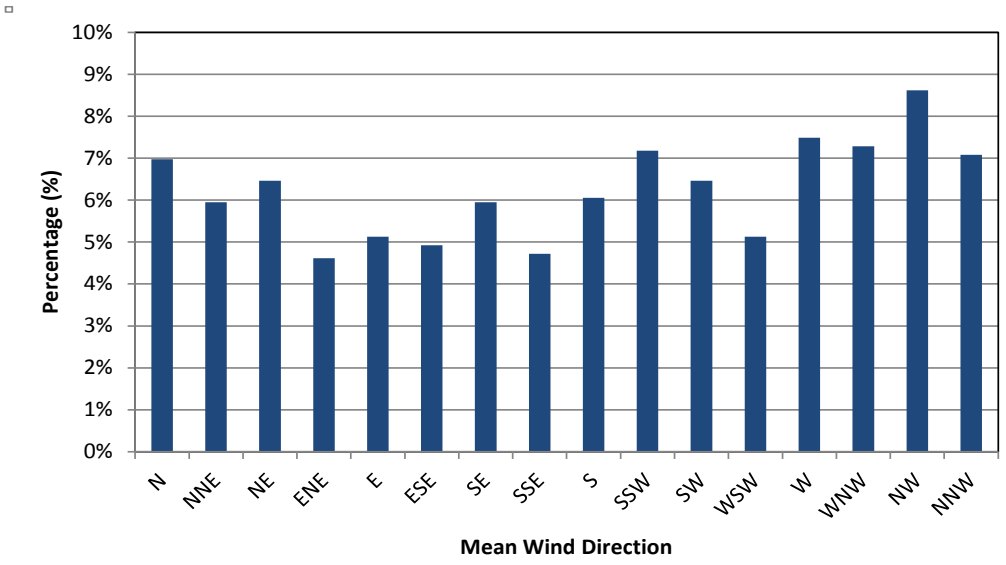


**Figure 6.9 Average annual wind direction distribution**

It was also noted at the shipping and navigation Hazard Review workshop that easterly or north easterly winds can result in a very large swell near to the Neart na Gaoithe site. This may result in poor sea conditions in the proposed wind farm area, for example when accessing the wind farm for operations/maintenance and search and rescue.

### 6.9.3 Visibility

Historically, visibility has been shown to have a major influence on the risk of ship collision. The annual probability of visibility less than 1km for the UK North Sea is approximately 0.03, i.e., approximately 3% of the year.

During the shipping and navigation Hazard Review workshop attendees noted that sea haar and poor visibility can occur in the area of Neart na Gaoithe during an easterly sea breeze and this is most common during March to May.

### 6.9.4 Wave Height

The wave height data taken from recordings made at Neart na Gaoithe met buoy is presented below.

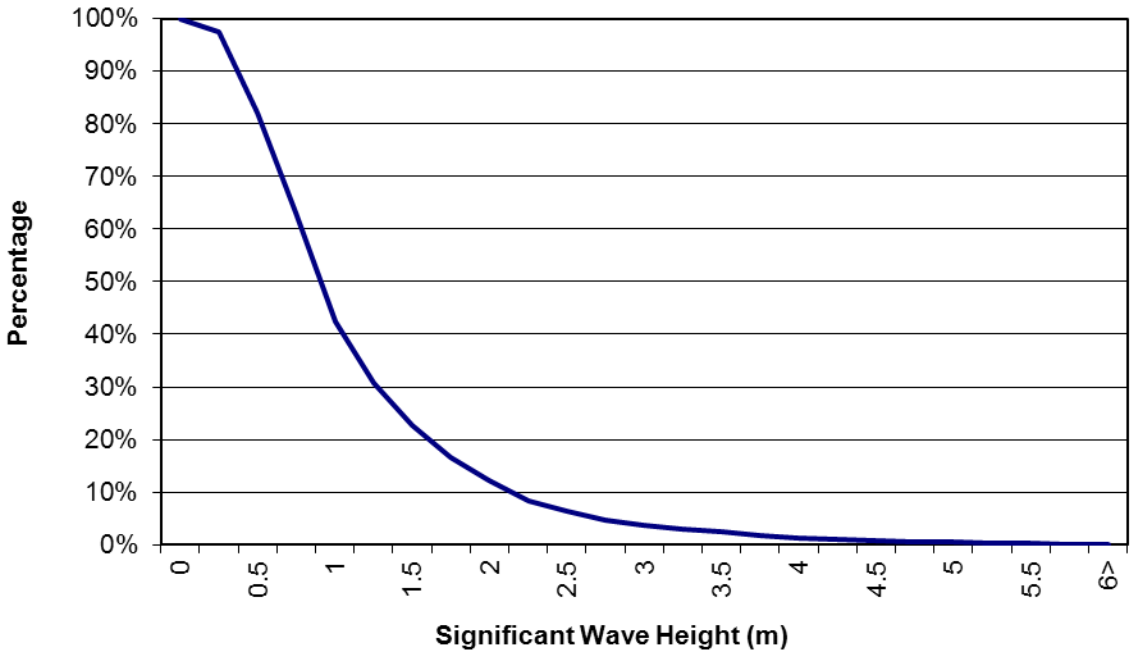


**Figure 6.10 Average wave height December 2009 to September 2010**

The large majority of the wave heights recorded at the site were under 5m, with approximately 0.4% of the year recording a significant wave height over 5m.

### 6.9.5 Tide

A description of the tidal streams in the general area is provided below (Ref. viii):

> *The offshore stream runs generally north and south from Rattray Head to Bell Rock.*
>
> *South of Bell Rock, clear of the land and in the outer part of Firth of Forth the tidal streams are weak, spring rate at 1 knot, but run in various directions throughout the tidal cycles.*

Chart Datum and Ordnance Datum for the Neart na Gaoithe wind farm based on values recorded at Anstruther are presented below.

**Table 6.1 Chart datum and ordnance datum figures for Neart na Gaoithe (Ref. xii)**

| Tidal Level | Height above Chart Datum |
|---|---|
| Highest Astronomical Tide (HAT) | 5.4m |
| Mean High Water Neaps (MHWN) | 3.8m |
| Mean High Water Springs (MHWS) | 4.9m |
| Mean Sea Level | 2.9m |
| Mean Low Water Springs (MLWS) | 0.8m |
| Mean Low Water Neaps (MHWN) | 1.8m |
| Lowest Astronomical Tide (LAT) | 0.0m |

Figure 6.11 presents the locations of charted tidal diamonds relative to Neart na Gaoithe.

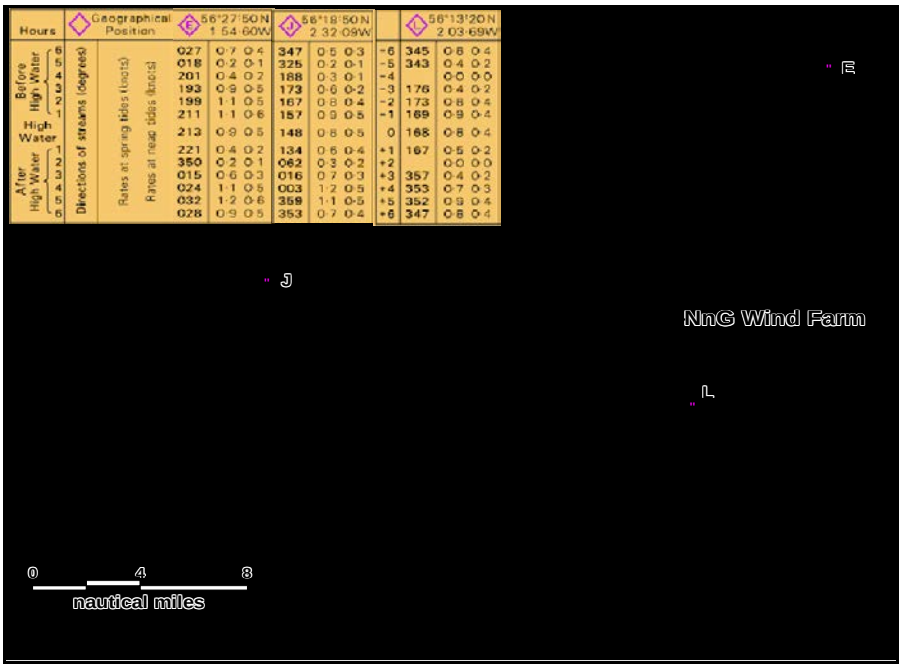


**Figure 6.11 Tidal stream data for Neart na Gaoithe (Tide Point "E, J and L")**

Admiralty Chart 115 (Tidal Diamond "F" approximately 3.4NM south west of the Neart na Gaoithe) indicates that currents in the area set in a generally west by south west direction on the flood and east by north east direction on the ebb, with a peak spring tidal rate of 0.5 knots and peak neap rate of 0.3 knots.

# 7. MARITIME INCIDENTS

## *7.1 Introduction*

This section reviews maritime incidents that have occurred in the vicinity of the proposed Neart na Gaoithe offshore wind farm in the last ten years.

The analysis is intended to provide a general indication as to whether the area of the proposed development is currently low or high risk in terms of maritime incidents. If it was found to be a particular high risk area for incidents, this may indicate that the development could exacerbate the existing maritime safety risks in the area.

Data from the following sources has been analysed:

- Marine Accident Investigation Branch (MAIB)
- Royal National Lifeboat Institution (RNLI)

(It is noted that the same incident may be recorded by both sources.)

## *7.2 MAIB*

All UK-flagged commercial vessels are required to report accidents to MAIB. Non-UK flagged vessels do not have to report unless they are within a UK port/harbour or within UK 12 mile territorial waters and carrying passengers to or from a UK port (including those in inland waterways). However, the MAIB will record details of significant accidents of which they are notified by bodies such as the Coastguard, or by monitoring news and other information sources for relevant accidents. The Maritime and Coastguard Agency, harbour authorities and inland waterway authorities also have a duty to report accidents to MAIB.

The locations[1] of accidents, injuries and hazardous incidents reported to MAIB within 10NM of Neart na Gaoithe between January 2001 and December 2010 are presented in Figure 7.1, colour-coded by type.

[1] MAIB aim for 97% accuracy in reporting the locations of incidents.

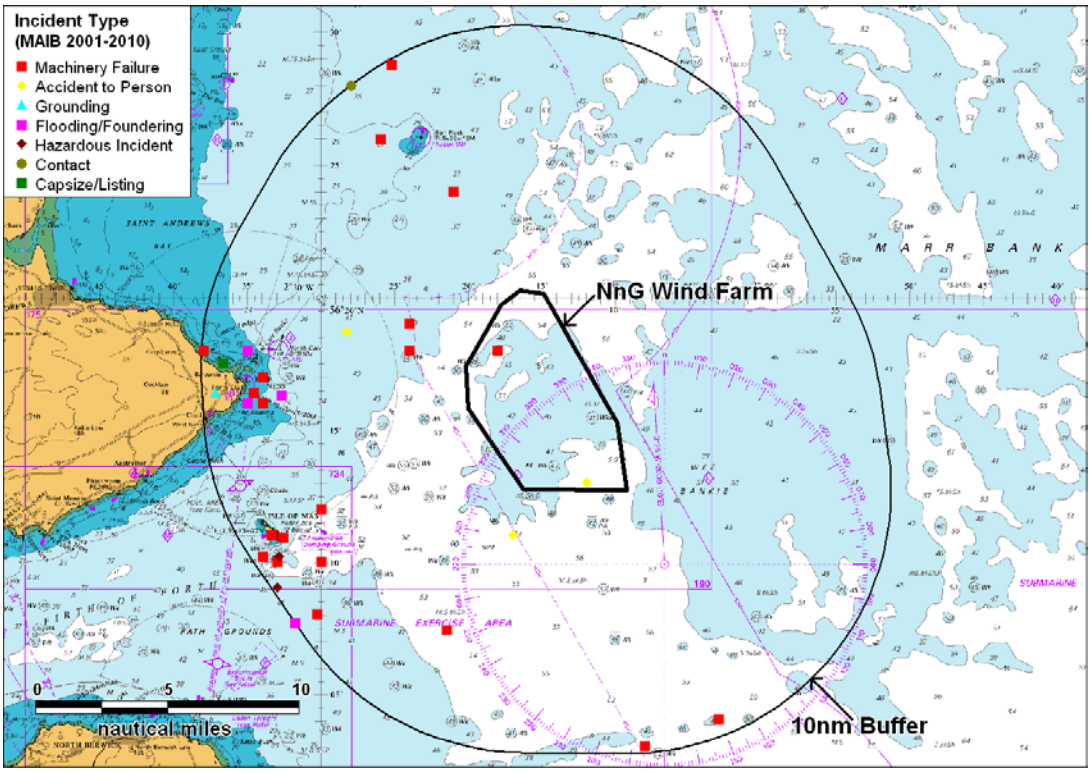


**Figure 7.1 MAIB incident by type within 10NM of Neart na Gaoithe**

A total of 33 unique incidents were reported in the area, corresponding to an average of 3 per year. The majority of the incidents occurred in and around Fife Ness and Isle of May.

The distribution by incident type is presented in Figure 7.2.

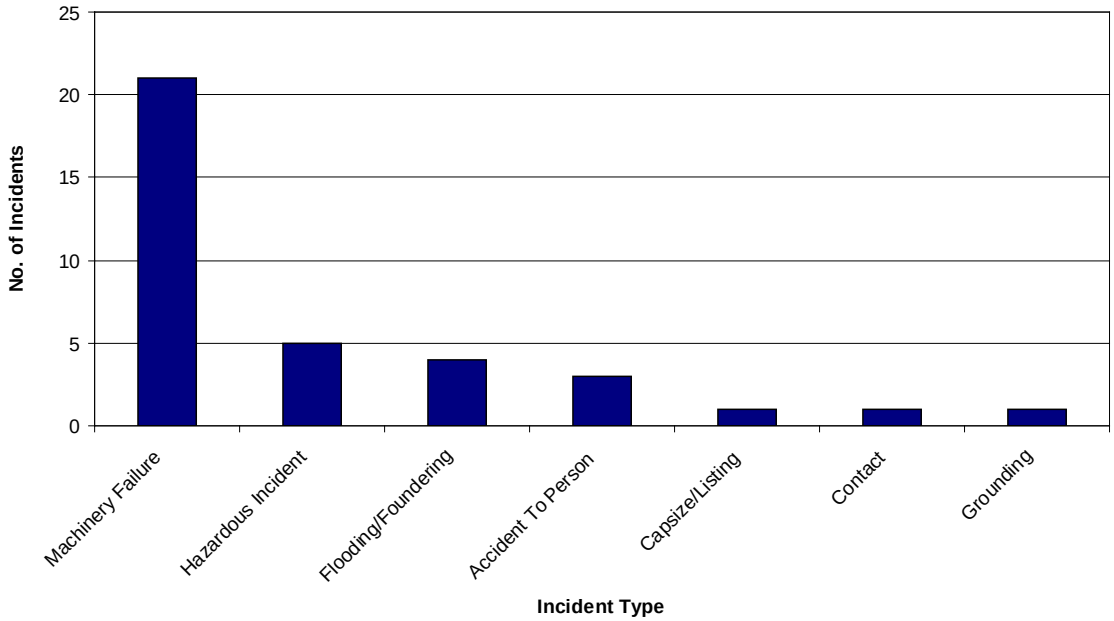


**Figure 7.2 MAIB incidents by type within 10NM of Site (2001-2010)**

The most common incident type recorded within 10NM of the site boundary was accident to person, representing 57% of all incidents over the ten year period.

The number of incidents recorded per year within 10NM of Neart na Gaoithe is presented in Figure 7.3

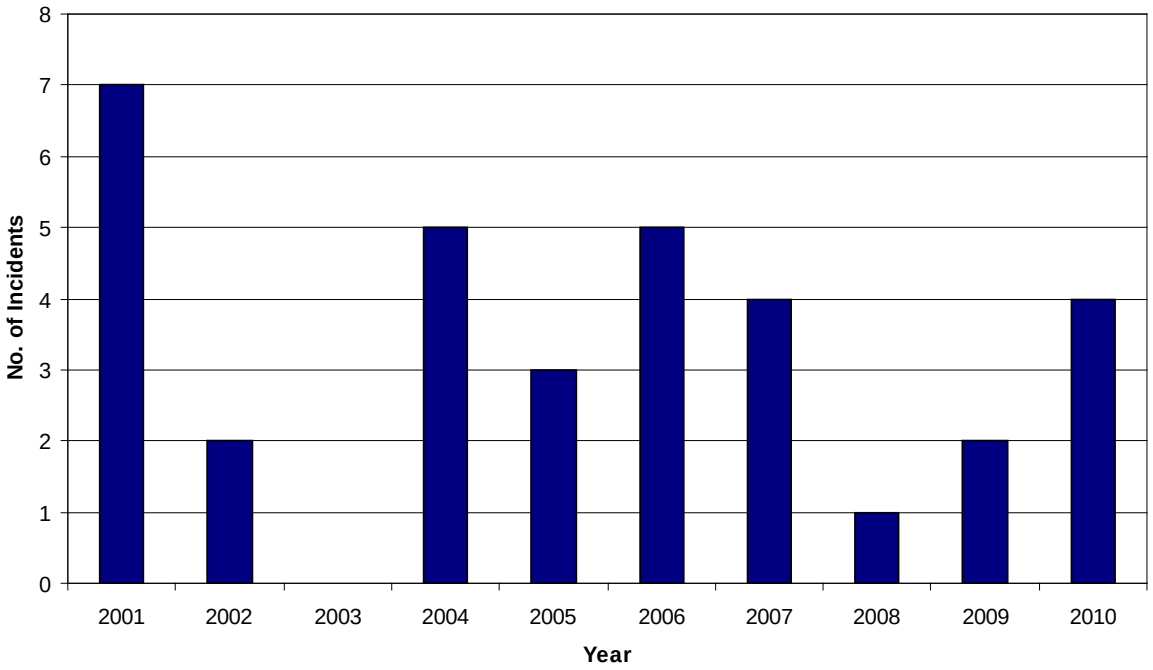


**Figure 7.3 MAIB incidents by year within 10NM of Site (2001 - 2010)**

The highest number of incidents within 10NM of Neart na Gaoithe was recorded in 2001 with 7 incidents reported. It is noted that no incidents were recorded during 2003.

Two incidents were reported within the proposed Neart na Gaoithe wind farm area. An accident to person occurred to the south of the proposed wind farm area on-board a research/survey vessel in moderate sea conditions during September 2010.

The second incident inside the wind farm boundary involved a UK-registered fishing vessel of 6.6m length which had a machinery failure in September 2001, no other details were supplied and the vessel was undamaged.

It is noted that no collisions were recorded within 10NM of the site boundary.

## *7.3 RNLI*

Data on RNLI lifeboat responses within 10NM of the Neart na Gaoithe site in the ten-year period between 2000 and 2010 have been analysed. A total of 107 launches to 80 unique incidents were recorded by the RNLI (excluding hoaxes and false alarms).

Figure 7.4 presents the geographical location of incidents colour-coded by casualty type. It can be seen that the vast majority occurred near the coast off Fife Ness and around the Isle of May, with relatively few further out to sea.

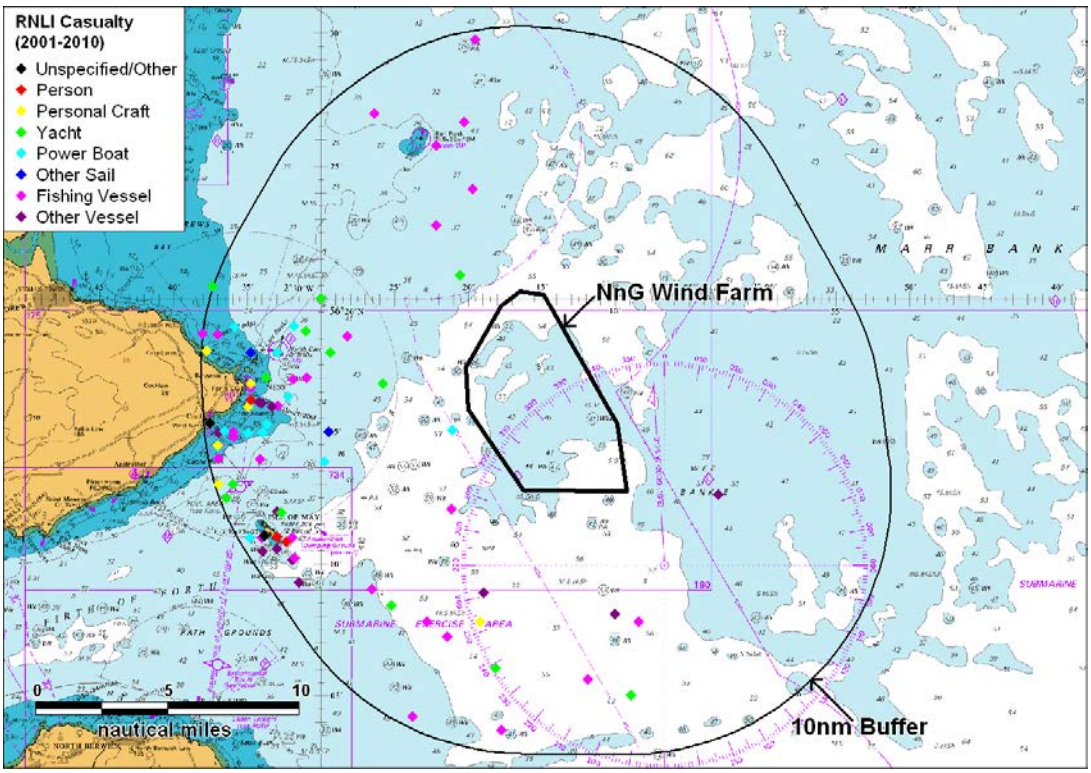


**Figure 7.4 RNLI incidents by casualty within 10NM of Neart na Gaoithe**

There were no incidents recorded within the proposed wind farm area over the 10 years analysed. The closest incident was recorded approximately 1NM west of the wind farm area and involved a large power boat in April 2004 in wind force 5. A leak/swamping occurred on the power boat and Dunbar all-weather lifeboat (ALB) assisted the vessel.

The overall distribution by casualty type is summarised in Figure 7.5.

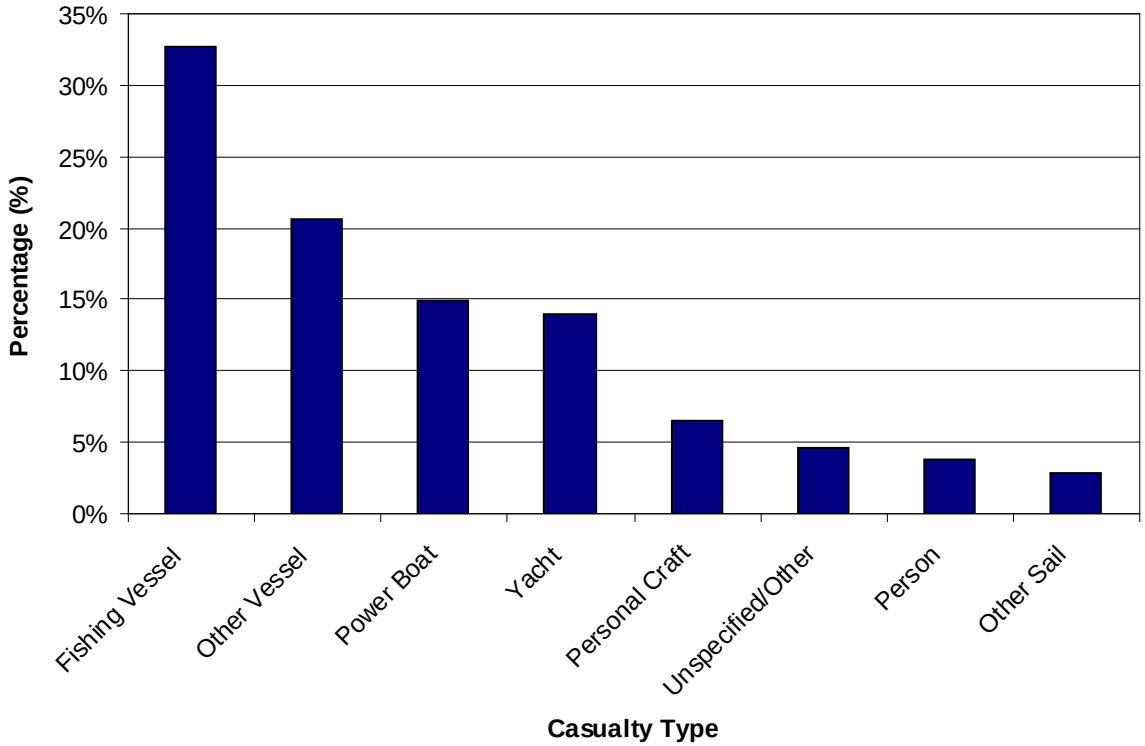


**Figure 7.5 RNLI incidents by casualty within 10NM of site (2001-2010)**

The most common vessel types involved were fishing vessels (33%), other vessels (mostly diving vessels) (21%) and power boats accounting for 15% of all incidents. Yachts represented 14% with the remaining incidents (17%) made up of other casualties including personal craft, unspecified/other, person and other sail made.

A chart of the incidents by cause is presented in Figure 7.6.

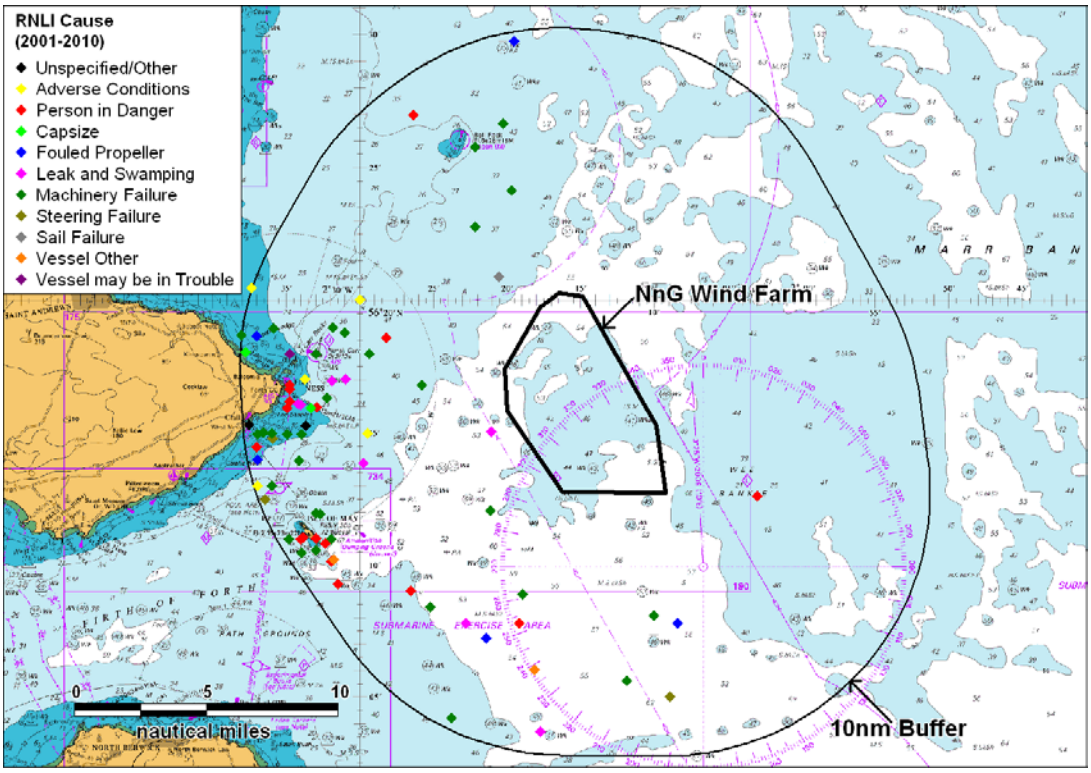


**Figure 7.6 RNLI incidents by cause within 10NM of Neart na Gaoithe**

The reported causes are summarised in Figure 7.7.

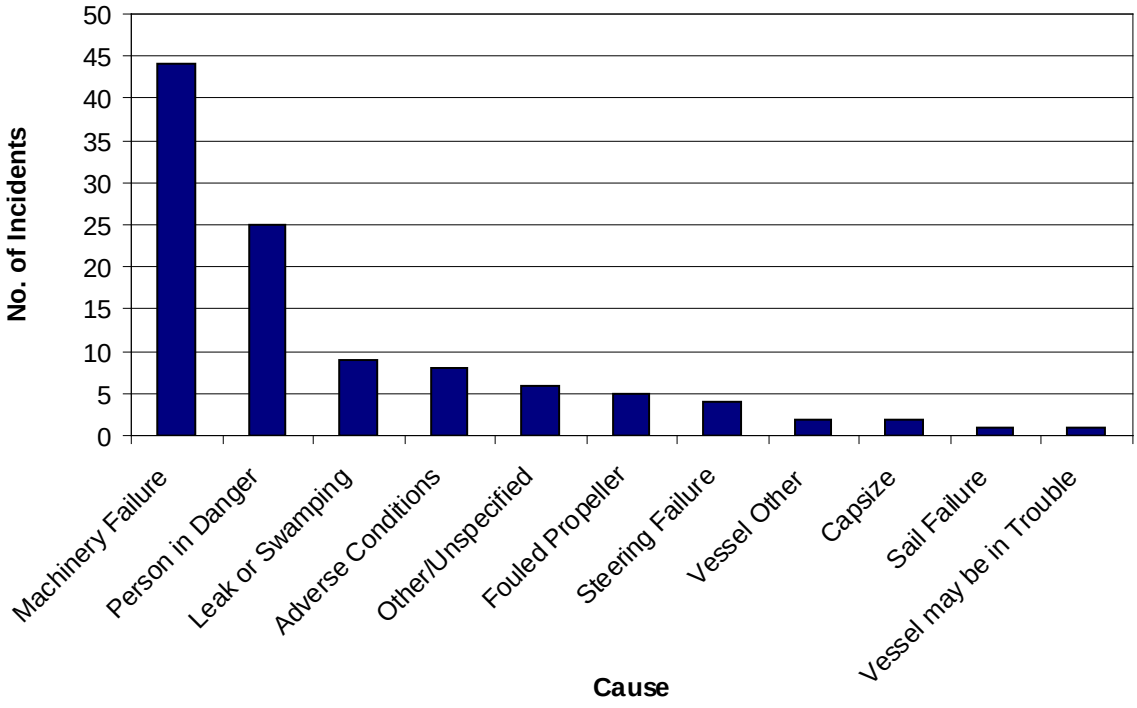


**Figure 7.7 RNLI incidents by cause within 10NM of site (2001-2010)**

The two main causes were machinery failure (41%) and person in danger (23%).

The annual rate of incidents in the past ten years is summarised in Figure 7.8.

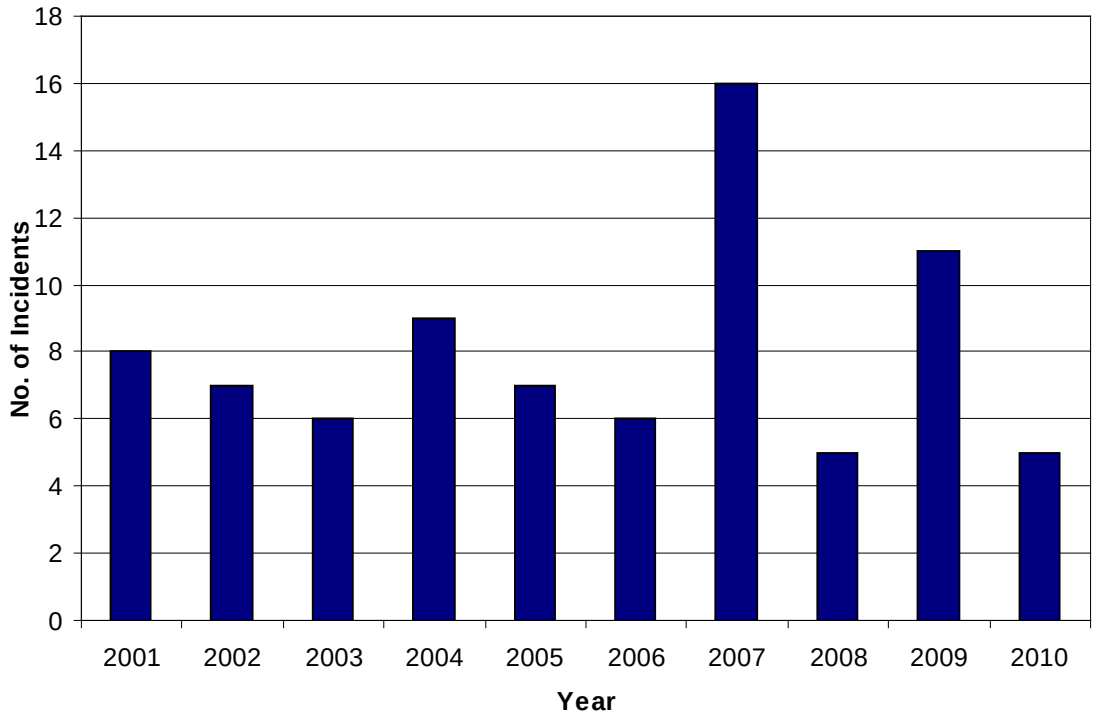


**Figure 7.8 RNLI incidents by year within 10NM of site (2001-2010)**

There was an average of 8 RNLI incidents recorded within 10NM of the wind farm area from 2001-2010, with the most incidents recorded in 2007 (16).

The stations and types of lifeboat responding to incidents (ALB) and ILB (inshore lifeboat) are illustrated in Figure 7.9.

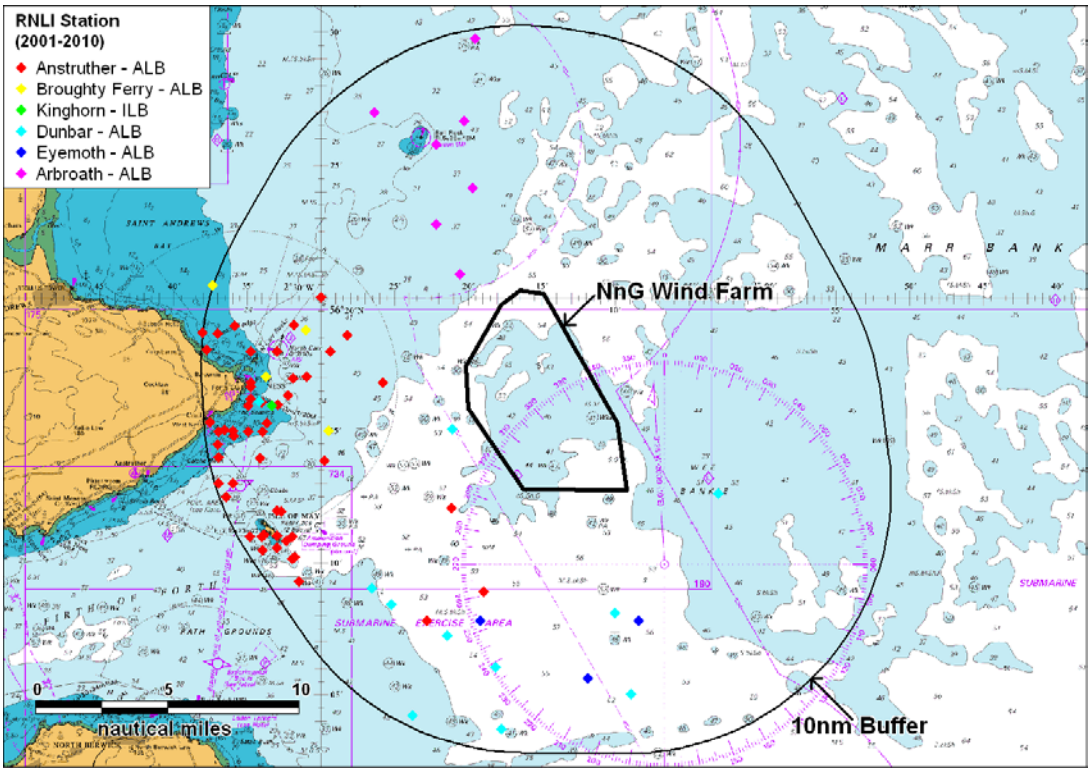


**Figure 7.9 RNLI incidents by station within 10NM of the wind farm**

Figure 7.10 presents a percentage break-down of stations responding to incidents within 10NM of Neart na Gaoithe from 2001 to 2010.

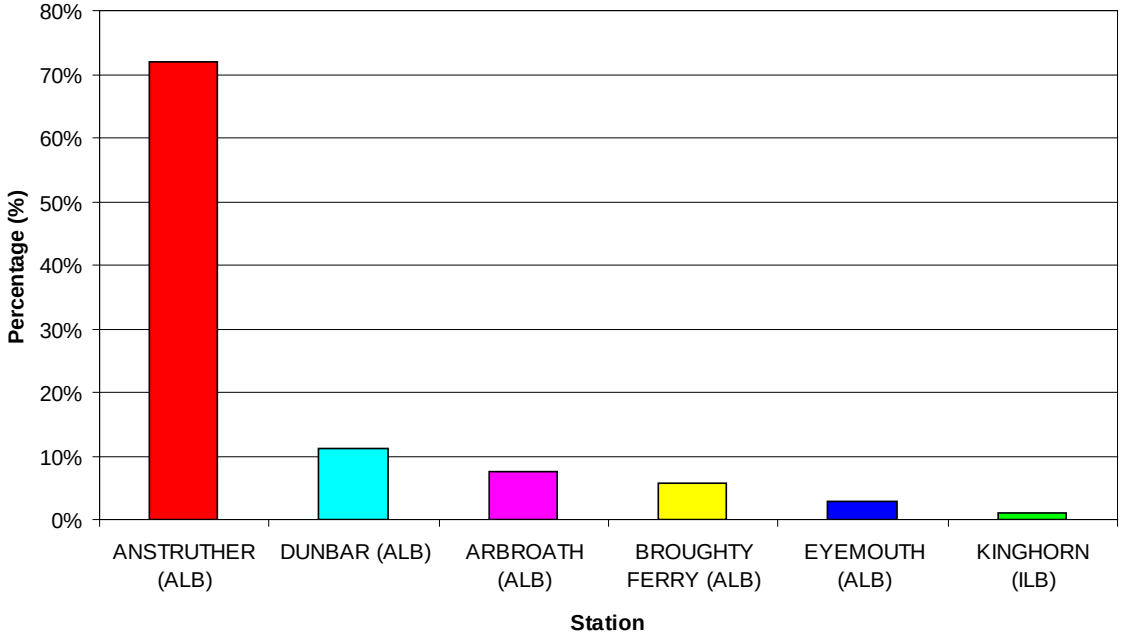


**Figure 7.10 RNLI incidents by station (percentage)**

The large majority of incidents within 10NM of Neart na Gaoithe were responded to by Anstruther ALB (72%). The other main RNLI stations which responded to incidents within the area were Dunbar ALB (11%) and Arbroath ALB (7%).

## *7.4 Conclusions*

Based on the review of incidents, it can be seen that the proposed Neart na Gaoithe offshore wind farm and its immediate vicinity has experienced a relatively low rate of accidents in recent years. Most incidents in the area have occurred on the coastline off Fife Ness and Isle of May.

# 8. MARITIME TRAFFIC SURVEYS

## *8.1 Introduction*

This section summarises the results of the maritime traffic surveys carried out in the Outer Firth of Forth for the Neart na Gaoithe offshore wind farm, using a combination of shore-based AIS, AIS/radar ship data and visual observations.

## *8.2 Survey Details*

Two surveys recorded shipping data at the Neart na Gaoithe wind farm in the Outer Firth of Forth. AIS shipping data were collected from coastal AIS surveying by FTOWDG, from November 2009 to July 2011. This report presents the most recent month collected in July 2011.

A geo-technical survey vessel was also on site for 29 days recording AIS and radar tracks during August to October 2010. The details of each survey are provided in the following sub-sections.

### 8.2.1 Ocean Discovery Survey

The main shipping AIS and radar survey was conducted from the survey vessel *Ocean Discovery*. Figure 8.1 presents a library image of the vessel.

**Figure 8.1 Picture of the survey vessel *Ocean Discovery***

AIS and radar data were recorded by *Ocean Discovery* during geo-technical operations within the Neart na Gaoithe wind farm during August to October 2010.

The area of operation of the survey vessel during the shipping traffic survey within a 10NM range is presented in Figure 8.2. The 10NM provides an indication of meaningful data coverage relative to the proposed wind farm area.

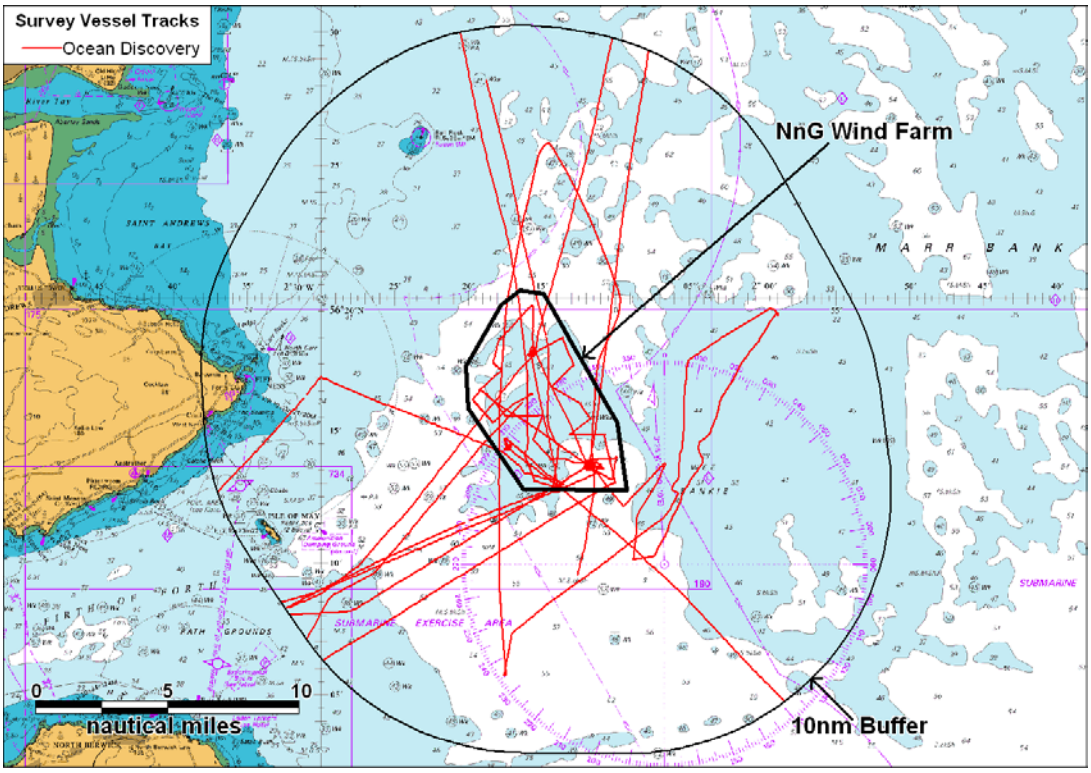


**Figure 8.2 Tracks of survey vessel relative to Neart na Gaoithe**

As the survey vessel *Ocean Discovery* returned to port in Leith, Montrose and Aberdeen on a number of occasions, AIS coverage dropped-off at the eastern boundaries of 10NM buffer when heading to or departing the site.

Therefore Anatec supplemented the *Ocean Discovery* survey data during days that were partially recorded with coastal based AIS survey trials to improve and provide comprehensive AIS coverage for the proposed wind farm and the outer Firth of Forth.

The non-AIS radar data was recorded from the ARPA systems onboard the survey vessels, with radar data logging equipment set-up to record each target acquired on radar. The target positional data was recorded from a feed from the radar to the serial port of the survey laptops.

The radar surveys were conducted 24 hours per day during periods when the bridge was manned. The radar range varied based on weather and sea conditions, however visual target details were logged in survey log forms and vessels were generally tracked over 6NM from the survey vessels and some targets beyond 15NM.

### 8.2.2 Coastal Based Survey Data

Longer-term AIS shipping data was collected by FTOWDG from coastal AIS surveying locations at Stonehaven, Dundee, Inner Forth and Dunbar during November 2009 to July 2011.

The coastal survey data covered seasonal fluctuations in shipping activity and validated the *Ocean Discovery* survey data. Details of the baseline data and *Ocean Discovery* survey is presented in the separate report prepared by Anatec (Ref. xiii).

Data was analysed in the Baseline Assessment before and after the *Ocean Discovery* survey, encompassing two periods:

- November 2009 to May 2010
- November 2010 to July 2011

The tracks of *Ocean Discovery* are excluded from the shipping analysis (Section 8.3) to improve the understanding of passing and other types of shipping in and around the Neart na Gaoithe wind farm.

## *8.3 Survey Analysis*

The *Ocean Discovery* AIS and radar survey data from 2010 (29 days) is presented along with the most recent month of coastal AIS data collected from July 2011 (31 days). Both datasets are analysed in terms of:

- Ship Type plots within 10NM
- Type Distribution
- Ship Size (Length and Draught)

It is noted that tracks of *Ocean Discovery* and the survey vessel *Ixplorer* (recorded within the southern part of Inch Cape wind farm on ten days of the survey) have been excluded from the following analysis.

Plots of the vessels recorded on AIS and radar colour-coded by ship type are presented in Figure 8.3 and Figure 8.4.

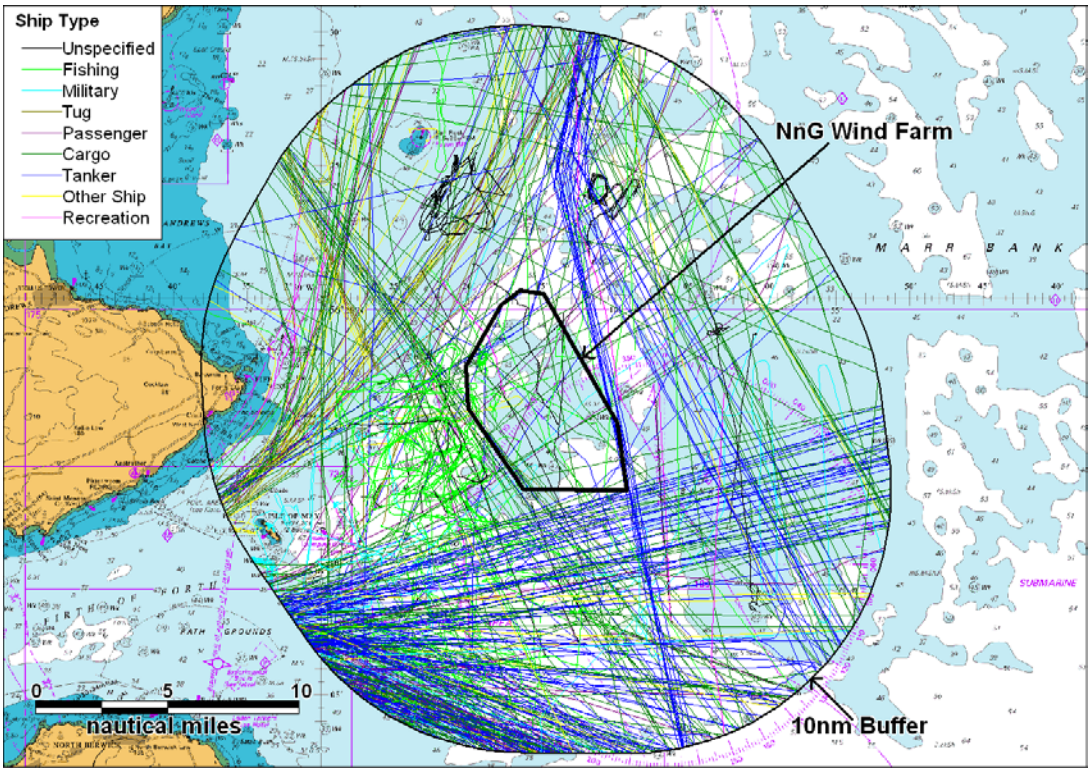


**Figure 8.3** ***Ocean Discovery*** **survey August to October 2010 (AIS & radar tracks)**

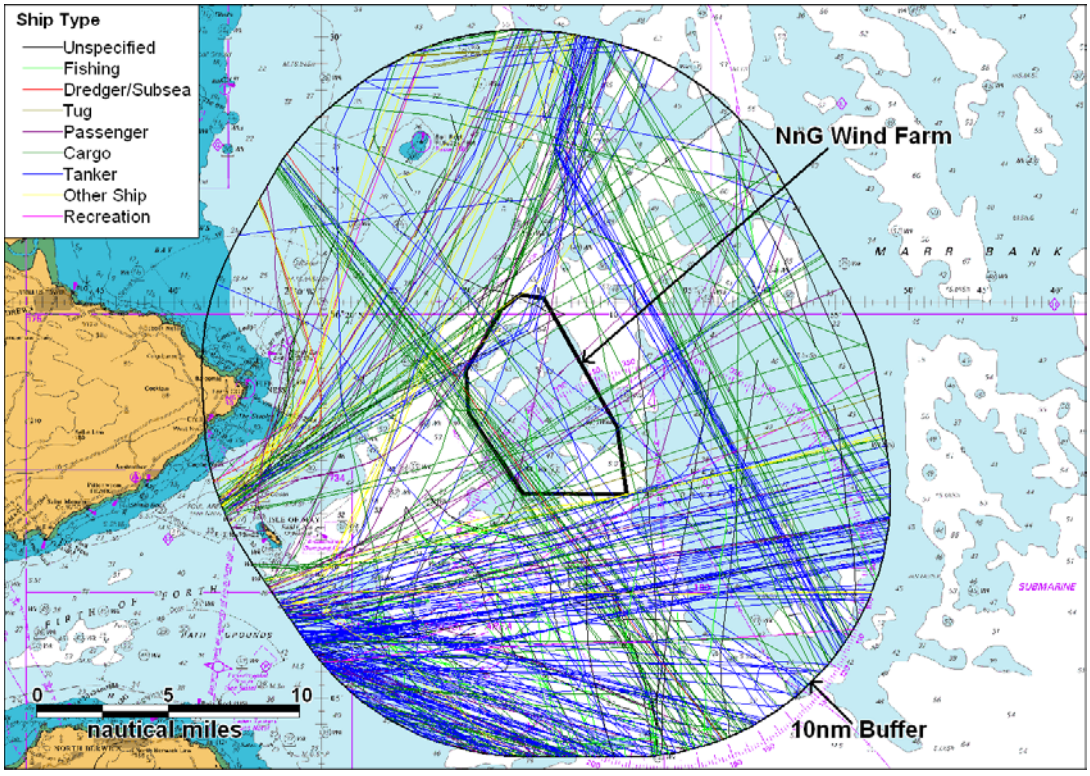


**Figure 8.4** **Coastal AIS data (July 2011)**

The number of unique vessels within 10NM of Neart na Gaoithe offshore wind farm averaged 17 vessels during the *Ocean Discovery* survey and 12 vessels per day in July 2011. As can be observed from the shipping plots, the majority of vessel tracks were associated with vessels in/outbound from the Firth of Forth.

To put the traffic into a daily context, the tracks recorded on the busiest days recorded from the two months are presented in Figure 8.5 and Figure 8.6.

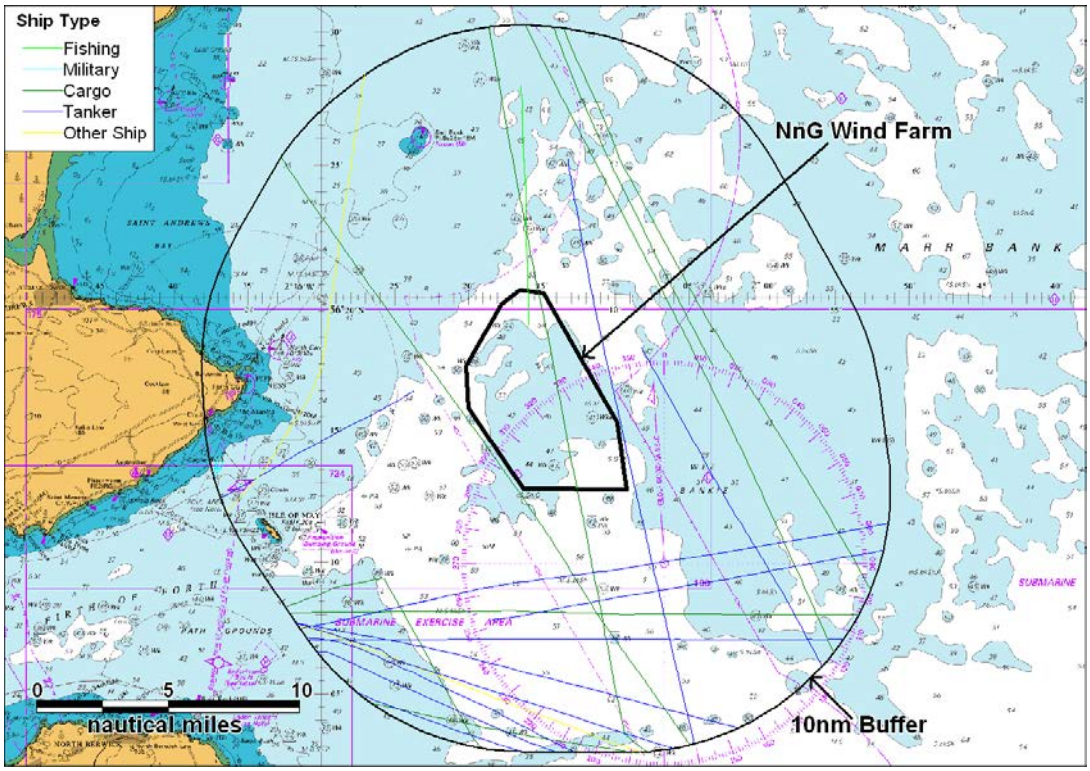


**Figure 8.5 *Ocean Discovery* data busiest day – 20 October 2010 (22 unique vessels)**

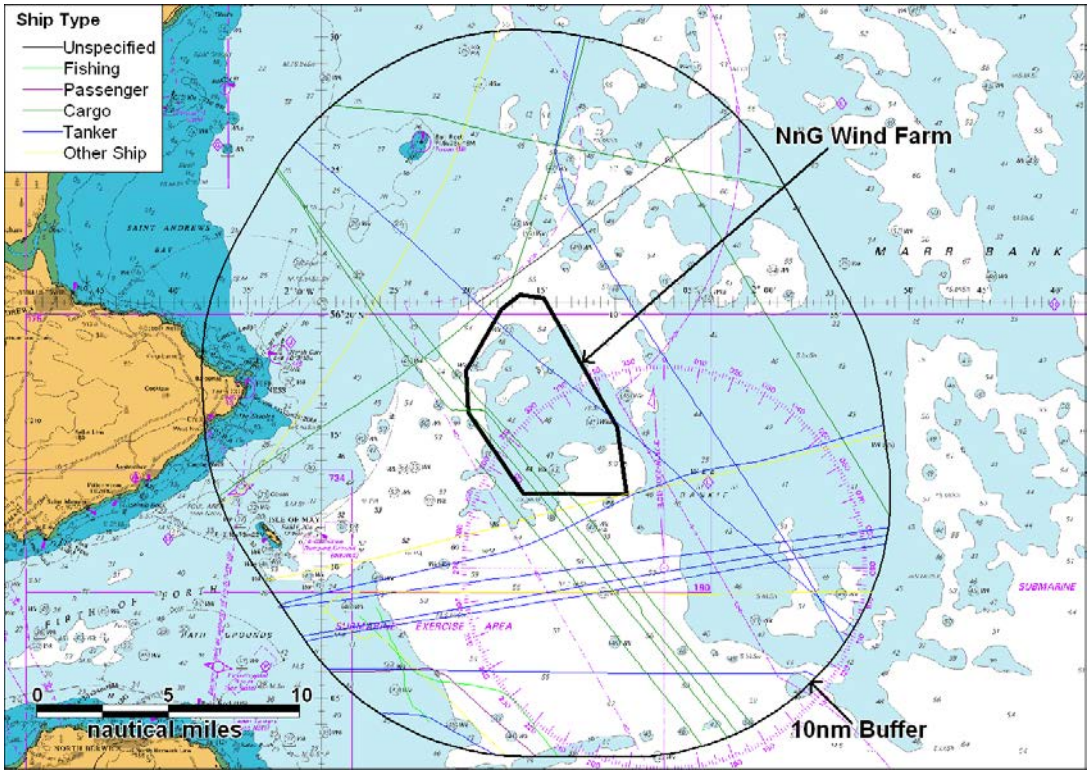


**Figure 8.6 Coastal AIS data busiest Day – 12 July 2011 (22 unique vessels)**

The breakdown of ships by type for vessels within 10NM of Neart na Gaoithe is presented in Figure 8.7. This considers all vessels recorded during the two survey periods (29 days from *Ocean Discovery* and 31 days from July 2011).

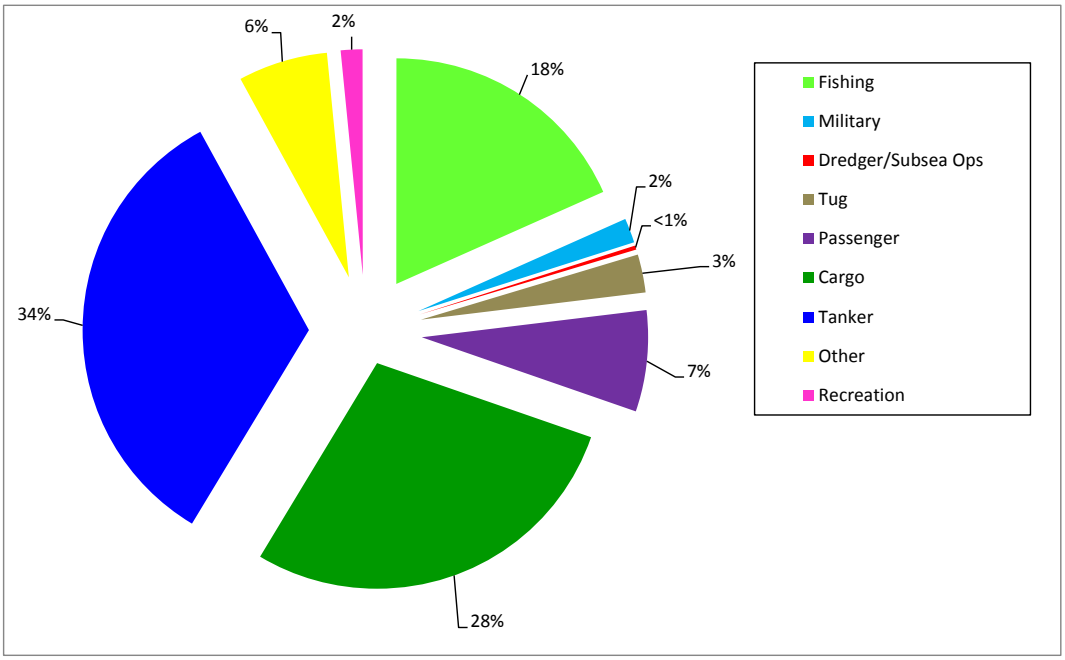


**Figure 8.7 Vessel types identified during the combined surveys (60 days)**

The most common vessel types recorded during the two surveys were tankers (34%), cargo ships (28%) and with fishing vessels the third most commonly tracked (18%).

### 8.3.1 Vessel Size (Length and Draught)

The distribution of vessels by draught (excluding unspecified) for the two survey periods is presented in Figure 8.8. It is noted that vessels with an unspecified draught are excluded from the analysis.

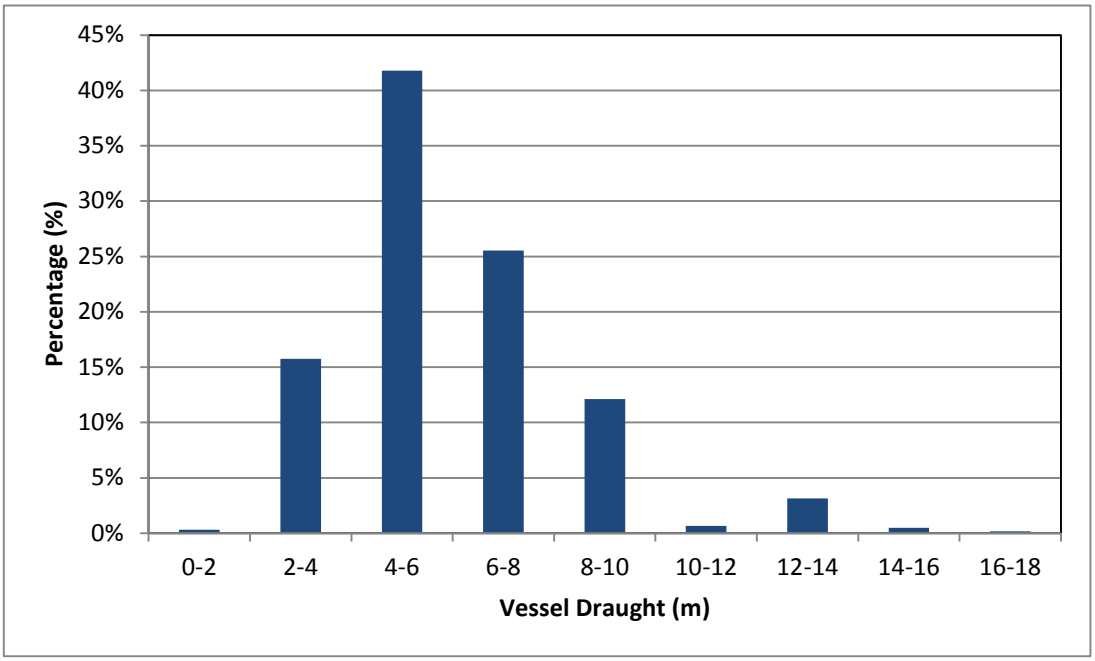


**Figure 8.8 Distribution of vessels by draught (60 days)**

It can be seen that the majority of vessels had draughts between 4-8m (67%). Ships broadcasting a draught of 12m or more (4% of vessels) were generally crude oil tankers headed to/from marine terminals within the Forth.

Plots of the tracks colour-coded by draught from the *Ocean Discovery* survey and July 2011 coastal data are presented in Figure 8.9 and Figure 8.10.

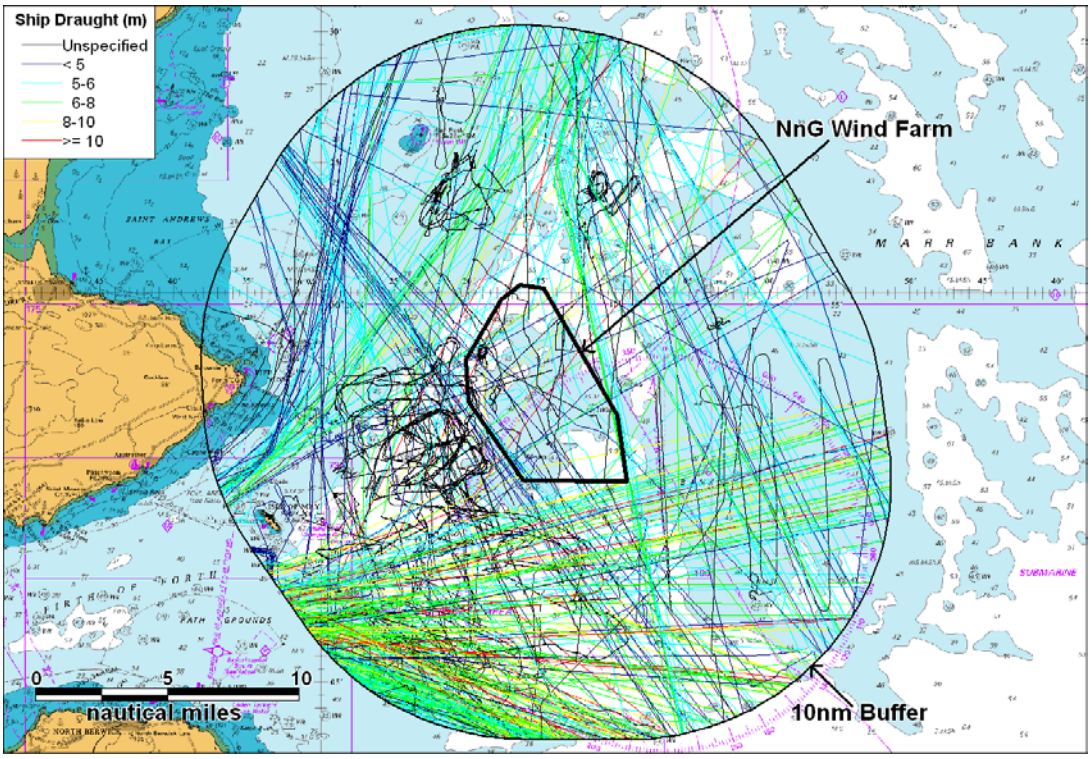


**Figure 8.9** ***Ocean Discovery*** **survey tracks by ship draught**

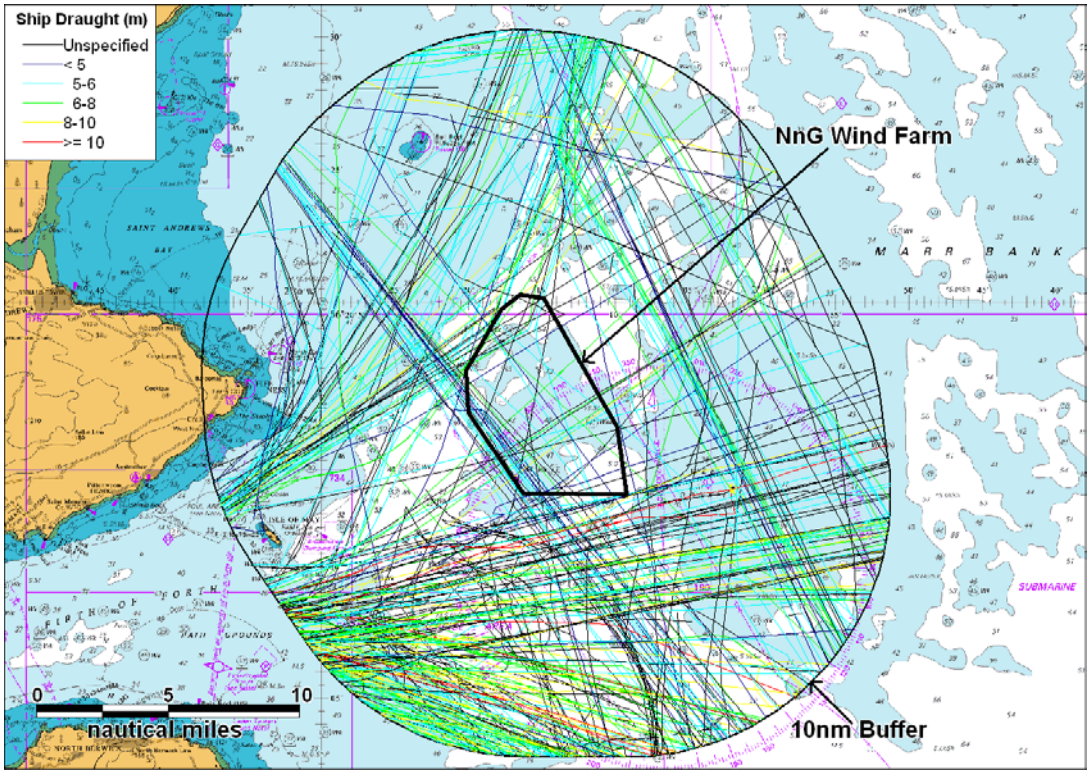


**Figure 8.10** **Coastal survey data July 2011 by ship draught**

The distribution of vessels by length (excluding unspecified) for the two combined surveys is presented in Figure 8.11.

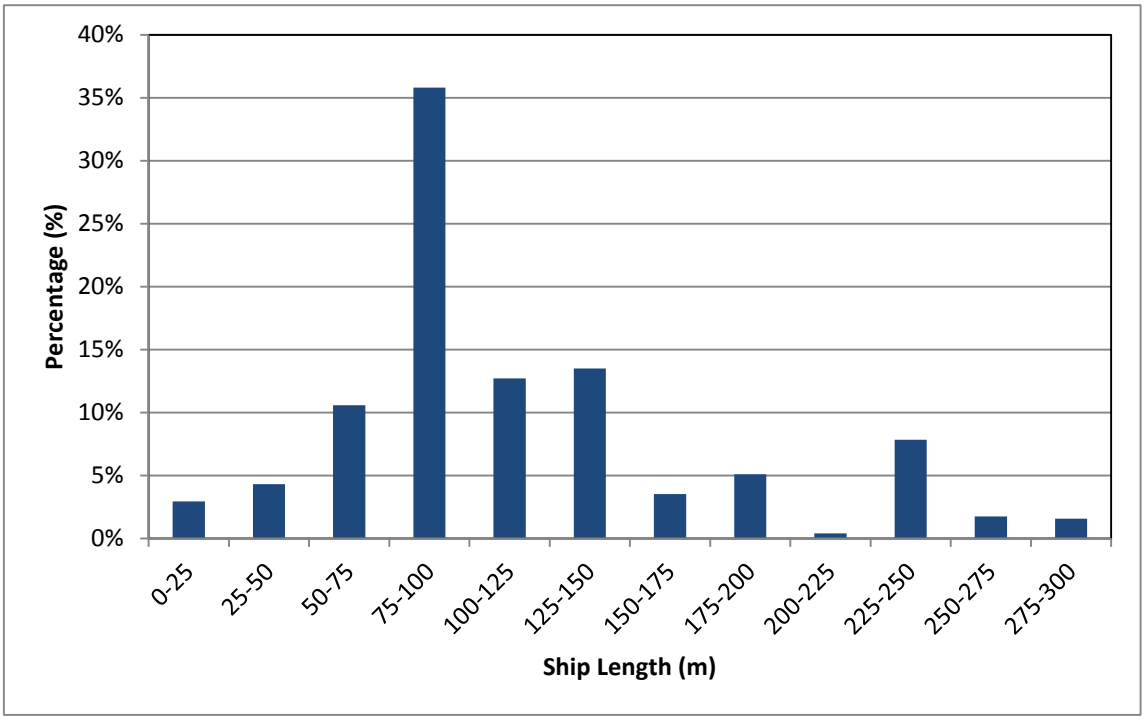


**Figure 8.11 Distribution of vessels by length for combined surveys (60 days)**

It can be seen that the majority of vessels had lengths between 75 and 150m (62%).

Plots of all the ship tracks colour-coded by length for the *Ocean Discovery* survey and the July 2011 data are presented in Figure 8.12 and Figure 8.13.

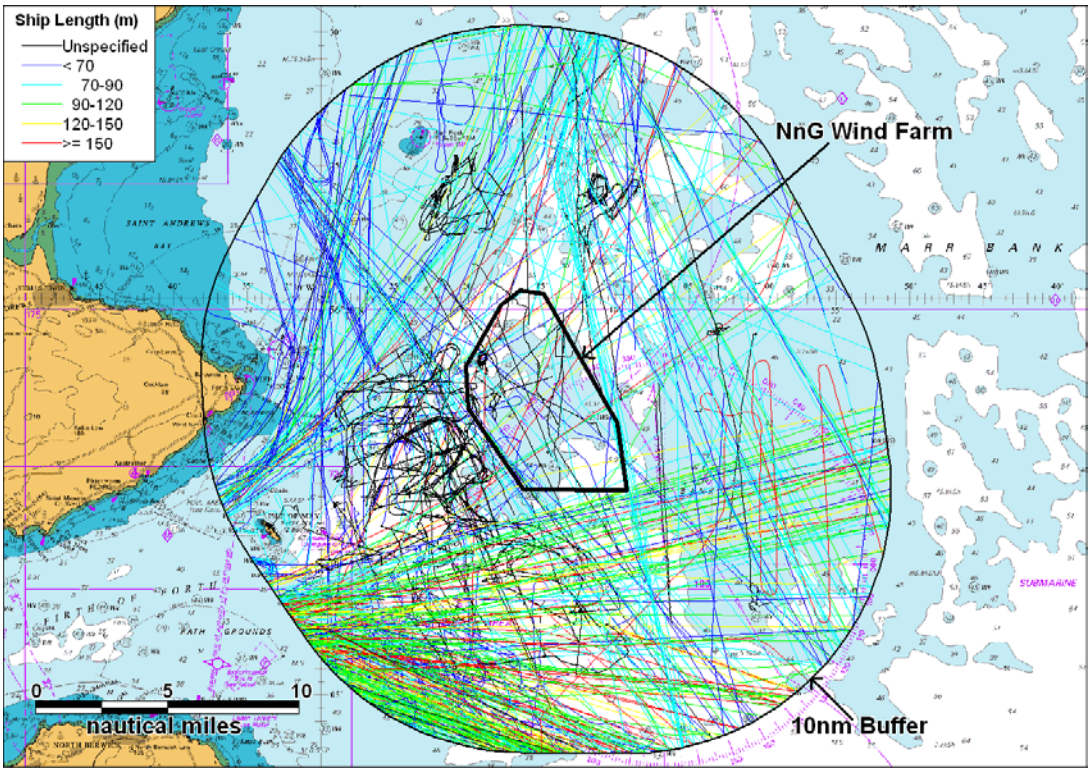


**Figure 8.12** ***Ocean Discovery*** **survey tracks by ship length**

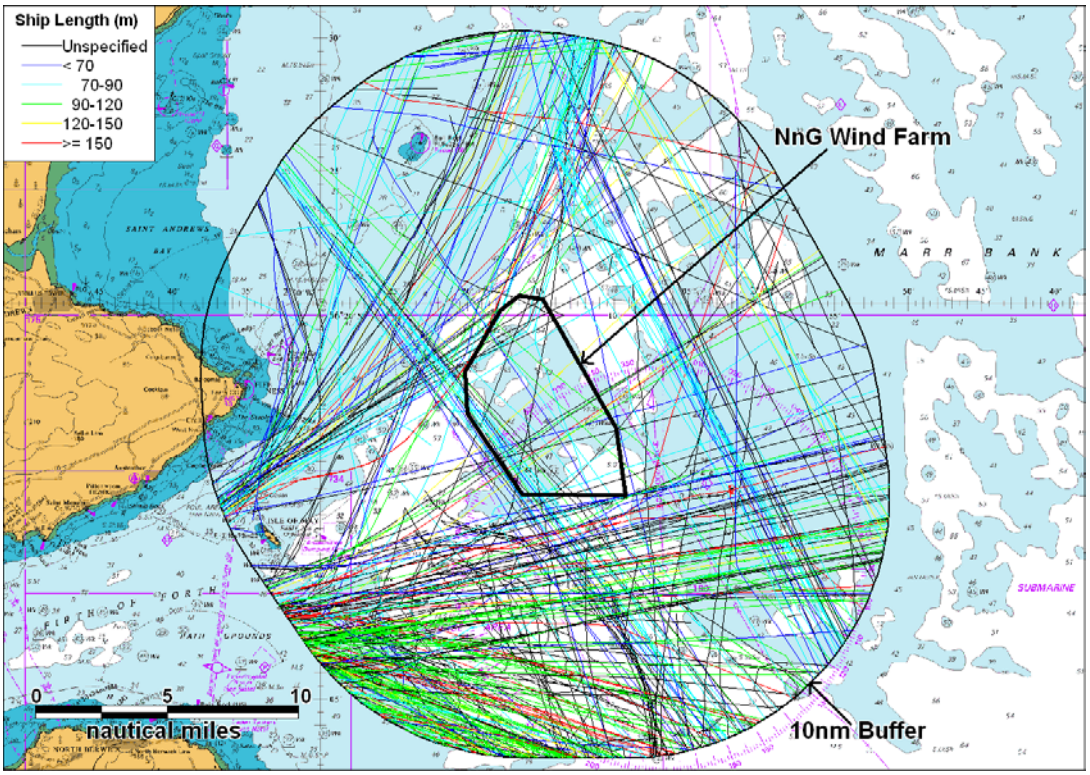


**Figure 8.13** **Coastal survey data July 2011 tracks by ship length**

### 8.3.2 Vessel Speed

Figure 8.14 presents the distributions of average speed for the two survey periods.

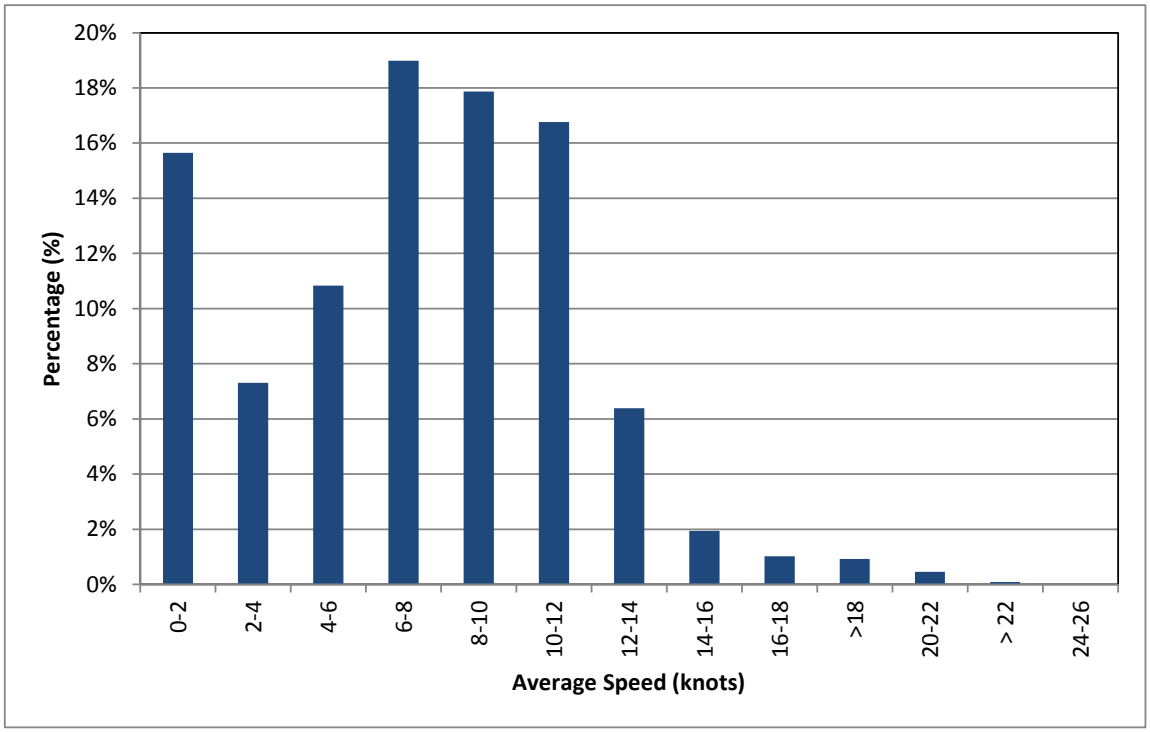


**Figure 8.14 Average speed distributions for *Ocean Discovery* and July 2011 surveys**

The average speed during the two survey periods was 9 knots. The relatively high mean speeds (> 10 knots) recorded within 10NM of Neart na Gaoithe is due to the large proportion of vessels on passage using north/south and east/west routes from the Firth of Forth (steaming as opposed to slowing down for port or waiting at anchor).

In addition, a number of vessels were recorded travelling under 4 knots; these were identified as fishing vessels operating in the area.

## *8.4 Neart na Gaoithe Site-Specific Review*

A combined plot of the *Ocean Discovery* and July 2011survey data (60 days) survey tracks passing near to the proposed Neart na Gaoithe turbines in indicative Layout A (worst case) is presented in Figure 8.15.

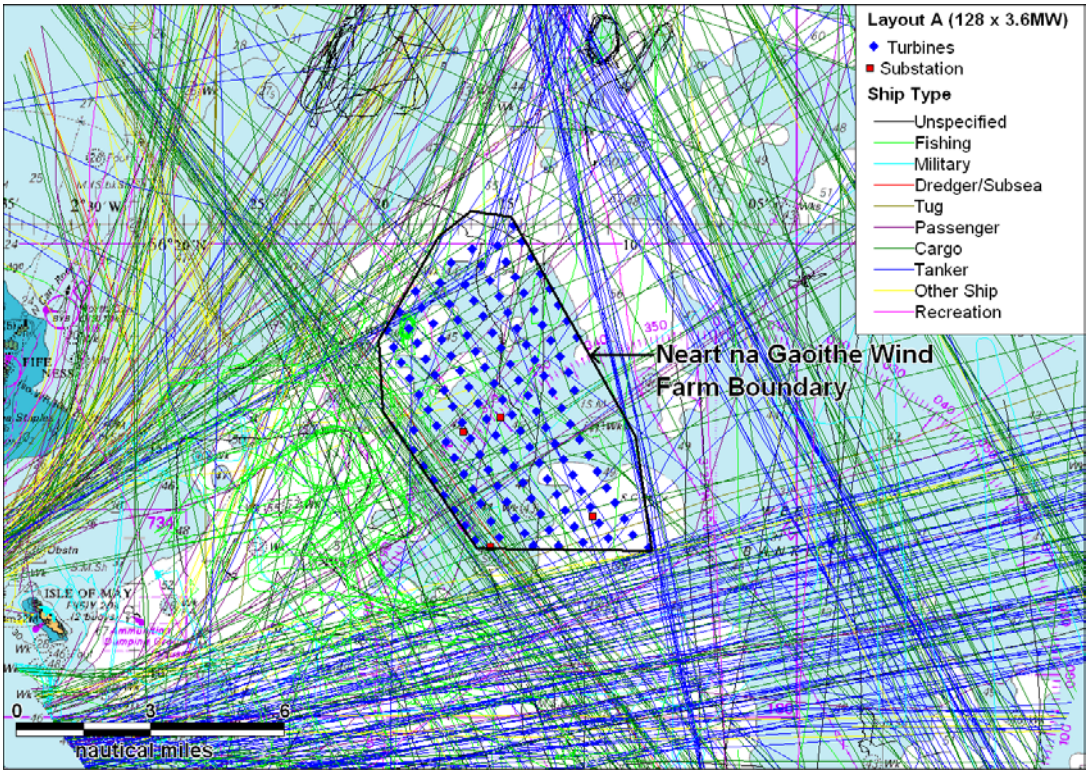


**Figure 8.15 Detailed plot of the combined surveys tracks (60 days)**

Charts of the main vessel types passing in close proximity to the turbines are presented in the following sub-sections. The vessel types considered are presented below:

- Tankers (Figure 8.16)
- Cargo vessels (Figure 8.17)
- Passenger ships (Figure 8.18)
- Other vessels (mainly offshore support vessels) (Figure 8.19)
- Fishing vessels (Figure 8.20)

### 8.4.1 Tankers

A plot of close passing tankers recorded within 10NM of Neart na Gaoithe over 60 days is presented in Figure 8.16.

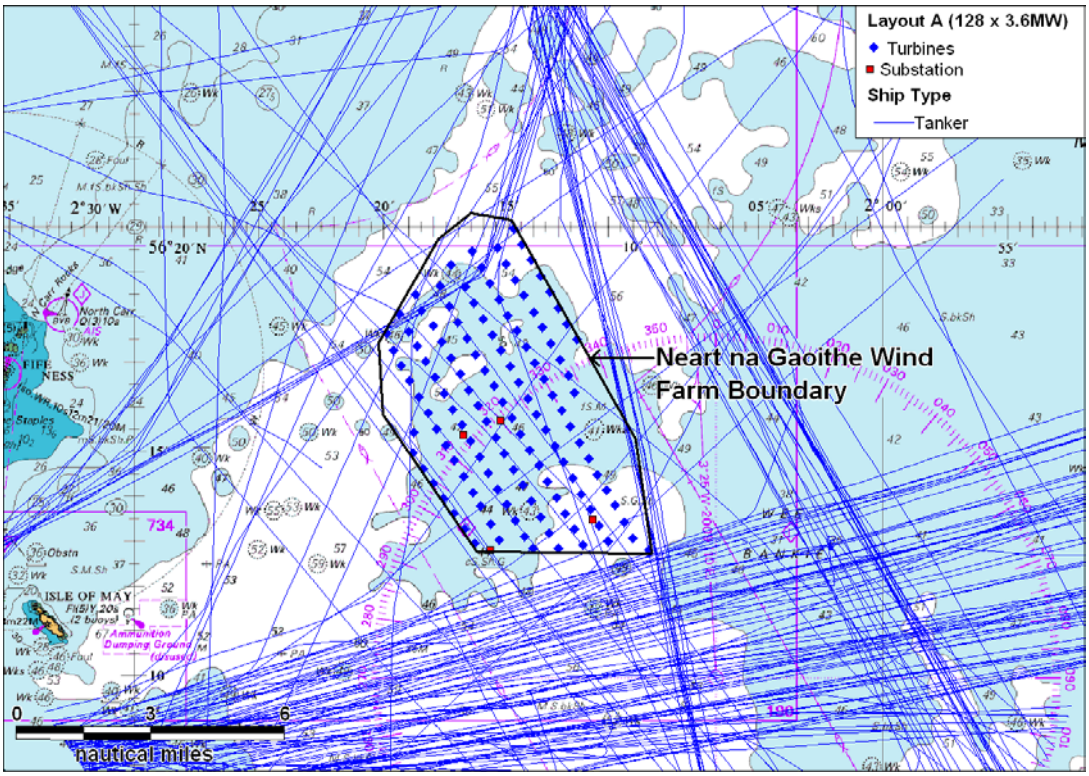


**Figure 8.16 Plot of tanker tracks passing close to indicative Layout A**

The vast majority of tankers were associated with the shipping route to the south of Neart na Gaoithe, headed/in out of the Firth of Forth.

Approximately 1 tanker every two days intersected the Neart na Gaoithe over the combined survey period. Most vessels were associated with the Firth of Forth and Northern Scottish ports including Aberdeen and Peterhead.

### 8.4.2 Cargo Vessels

A plot of close passing cargo vessels recorded within 10NM of Neart na Gaoithe over 60 days is presented in Figure 8.17.

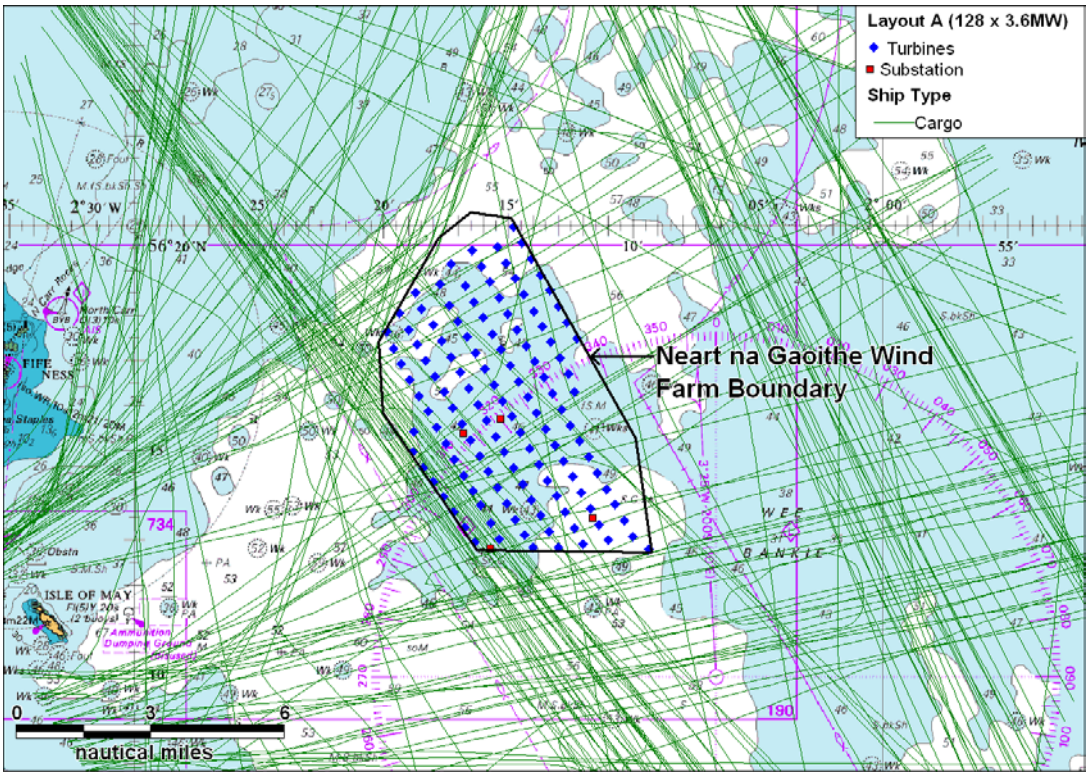


**Figure 8.17 Plot of cargo tracks passing close to indicative Layout A**

In terms of the wider study area, there are less cargo vessels passing through the area compared to tankers, however there were more passing through the Neart na Gaoithe site.

Approximately two cargo vessels per day intersected Neart na Gaoithe over the combined survey period. Most vessels were associated with the Firth of Tay (Dundee) and/or Northern Scottish ports including Aberdeen.

### 8.4.3 Passenger/Cruise Vessels

A plot of close passing passenger/cruise vessels recorded within 10NM of Neart na Gaoithe over 60 days is presented in Figure 8.18.

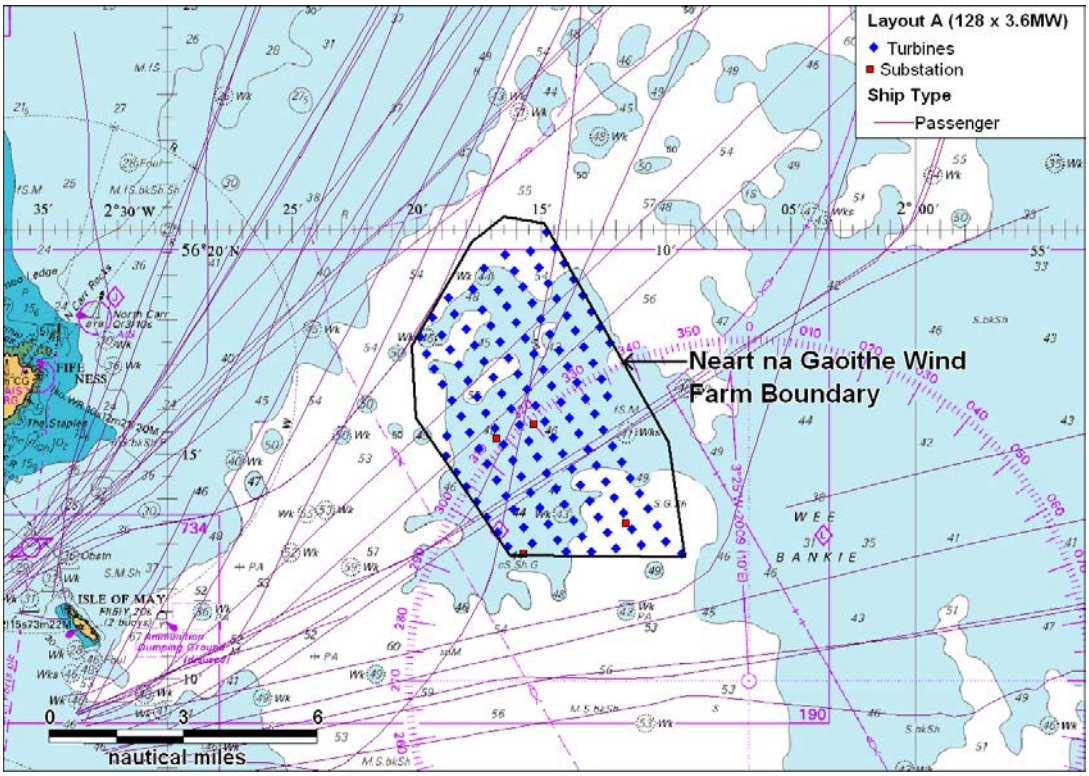


**Figure 8.18 Plot of passenger/cruise liner tracks passing close to indicative Layout A**

The large majority of passenger cruise vessels were recorded during the summer months (July and August), with vessels recorded passing between Fife Ness/Isle of May headed for the Northern Isle and Scandinavia.

Eight passenger cruise vessels intersected the Neart na Gaoithe area during August 2010 and July 2011. These vessels were recorded passing south and east of Isle of May from Leith to Scandinavia.

### 8.4.4 Other Vessels

A plot of close passing 'other' vessels recorded within 10NM of Neart na Gaoithe over 60 days is presented in Figure 8.19.

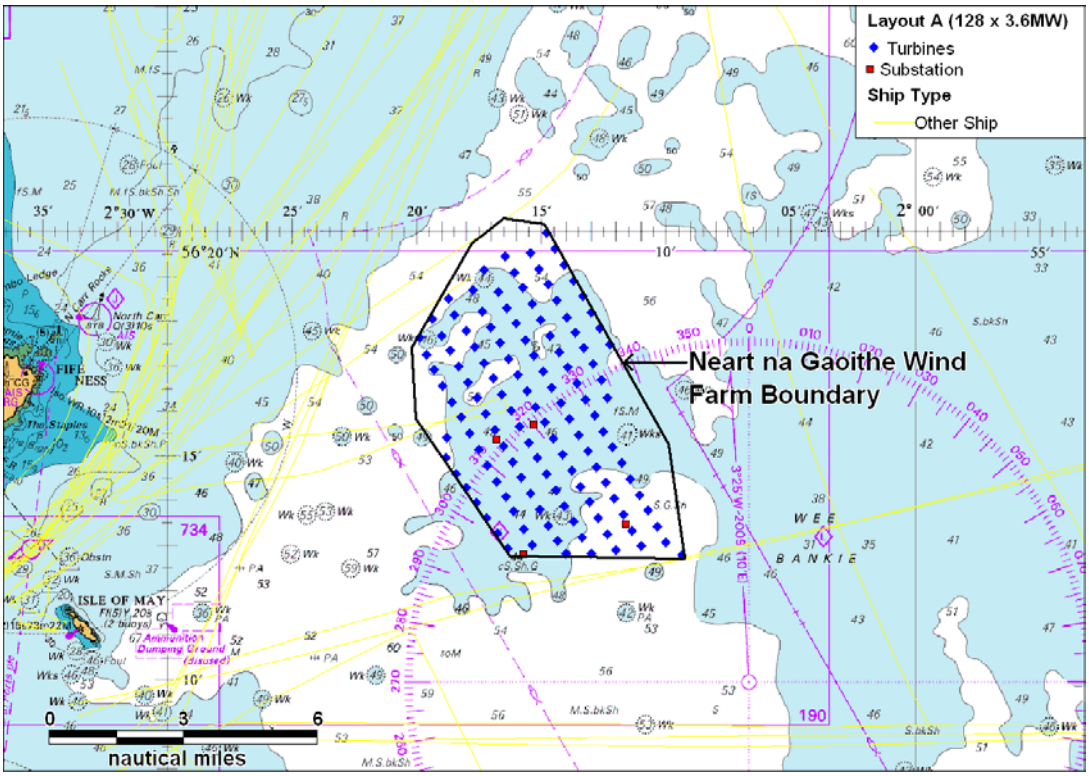


**Figure 8.19 Plot of other vessel tracks passing close to indicative Layout A**

The large majority of 'other' vessel tracks were made by buoy tenders, fisheries protection vessels and offshore support ships.

Four offshore operations vessels intersected the Neart na Gaoithe wind farm area during the combined survey.

### 8.4.5 Fishing Vessels

A plot of close passing fishing vessels recorded within 10NM of Neart na Gaoithe over 60 days is presented in Figure 8.20.

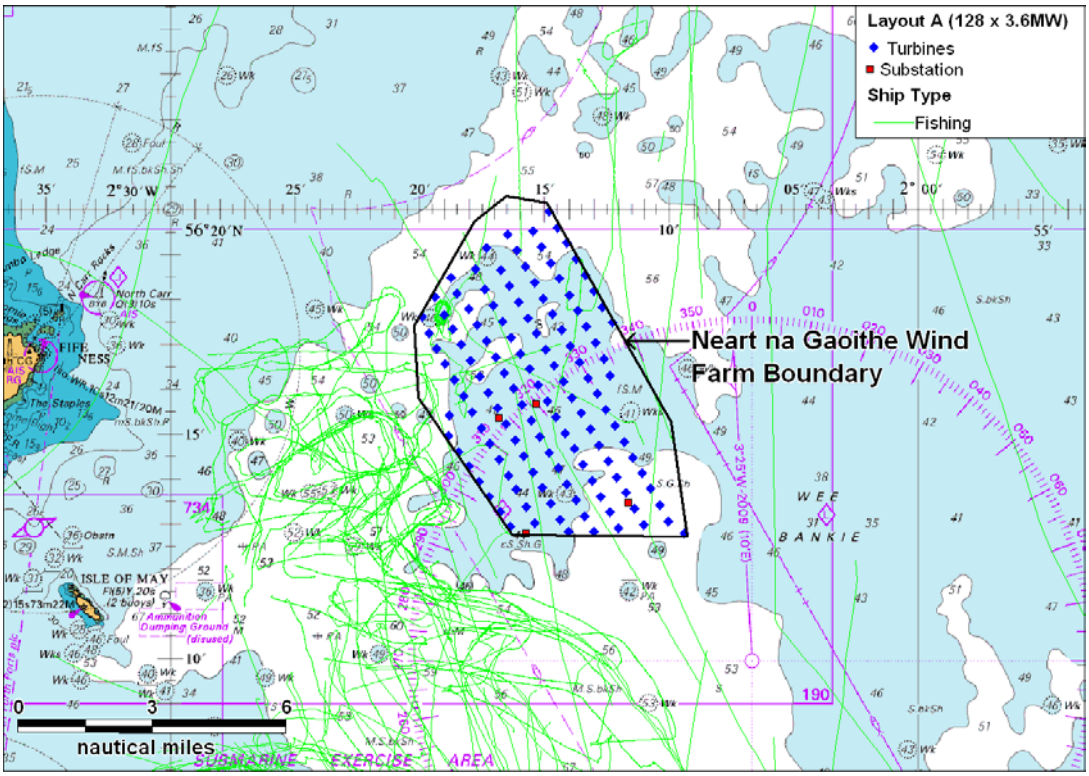


**Figure 8.20 Plot of fishing vessel tracks passing close to indicative Layout A**

The vast majority of 'fishing vessels were recorded 1 to 5NM south and west of Neart na Gaoithe. Approximately one fishing vessel intersected the proposed wind farm every five days during the combined survey.

Non-AIS vessels represented approximately 80% of fishing vessel tracks recorded intersecting Neart na Gaoithe.

### 8.4.6 Intersecting Vessels

Figure 8.21 presents the combined *Ocean Discovery* and July 2011 survey tracks which were identified to pass within the proposed wind farm perimeter during the 60 day period.

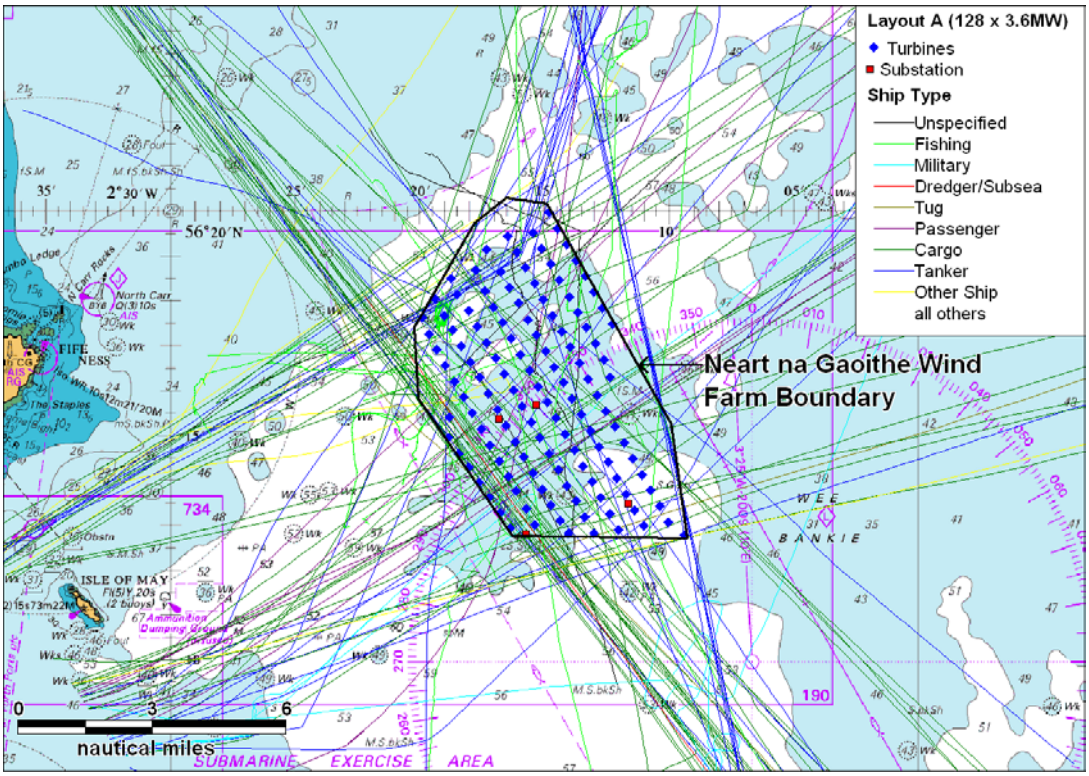


**Figure 8.21 Tracks passing within Neart na Gaoithe (60 days)**

A total of 103 AIS tracks and 17 non-AIS tracks were identified to pass within the proposed Neart na Gaoithe perimeter during the 60 day survey period, corresponding to an average of 2 vessels per day. Excluding unspecified vessels (mainly radar targets which were not identified visually); the most common types of ship passing through the area were cargo ships, mainly headed to the Firth of Forth (44%) and coastal tankers (24%).

In terms of AIS-equipped ships, vessels passing through Neart na Gaoithe on more than one occasion were mainly cargo vessels headed to Dundee or coastal tankers routeing from Northern Scotland into the Firth of Forth.

It is noted that a coastal tanker was also recorded passing through the proposed wind farm area on the same route on multiple occasions, between the Humber and Northern Scottish ports (Aberdeen, Peterhead and Lerwick).

The majority of non-AIS vessels intersecting Neart na Gaoithe were fishing vessels with a small number of recreational vessels passing through the area from marinas/harbours in northern Scotland and northern England.

## *8.5 Anchored Vessels*

The positions of vessels recorded at anchor during the complete survey period (November 2010 to July 2011) relative to the wind farm and a 10NM buffer of the proposed cable route are presented in Figure 8.22.

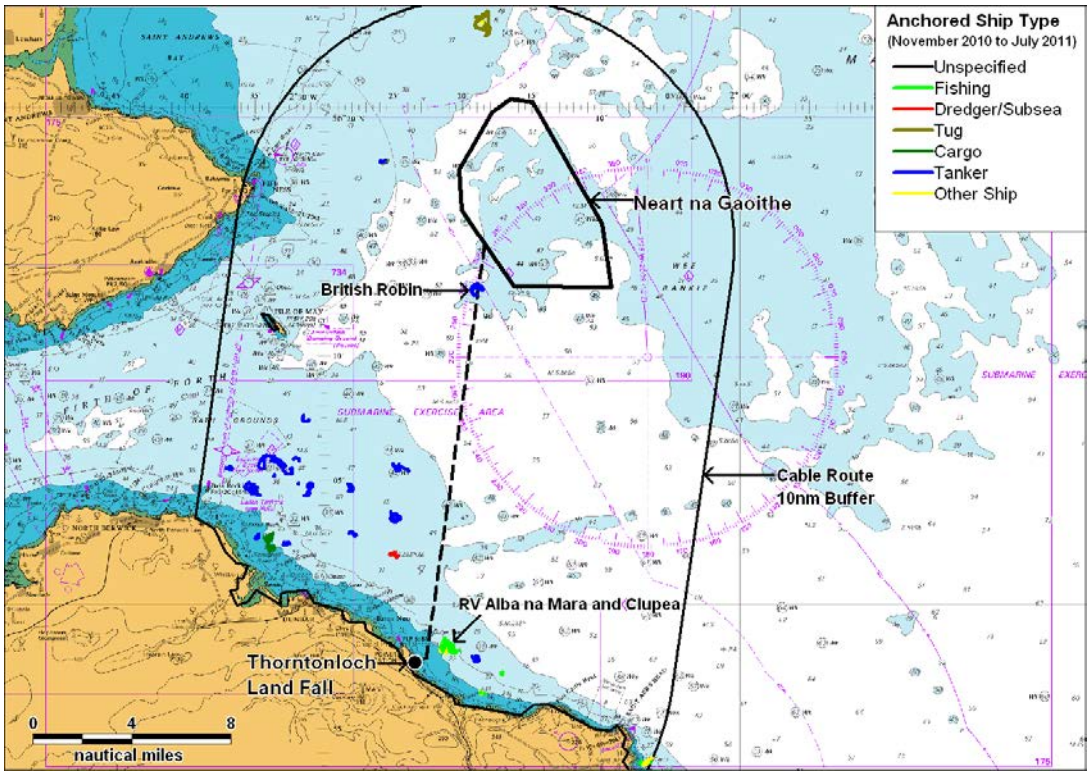


**Figure 8.22 Anchored vessels (November 2010 to July 2011)**

Tankers, one cargo vessel and one dredger were recorded at anchor within 8NM (east) of the Forth Ports Authority limit. One tanker was recorded south of the wind farm near to the cable route and a fisheries research vessel and bird survey vessel were anchored within 1.3NM (east) of the cable landfall.

A summary of the closest anchored vessels recorded during the survey is provided below:

- A crude oil tanker (250m in length) was anchored near the cable route for two days 1.7NM south of the wind farm.
- A fisheries research vessel (27m in length) was recorded anchored for a number of days off the coast, with the closest anchorage recorded 1.3NM east of the cable.
- The third closest vessel recorded at anchor was a survey vessel (32m in length) recorded approximately 1.3NM west of the cable.

It is noted that jack-up drilling rigs can moor in Dundee (e.g. for maintenance and service work). During the combined survey a jack-up and two support vessels were recorded at anchor approximately 3NM north of Neart na Gaoithe before been towed into Dundee.

## 8.6 Detailed Analysis of Main Shipping Lanes

The main impact on commercial shipping is the displacement of ships passing close to the wind farm area on approach/departure from the Firth of Tay and vessels on the coastal route from the north (Aberdeen, Peterhead and the northern Isle) to the Humber.

Figure 8.23 presents the aforementioned shipping routes and tracks (*Ocean Discovery* and July 2011 surveys) colour-coded by ship type.

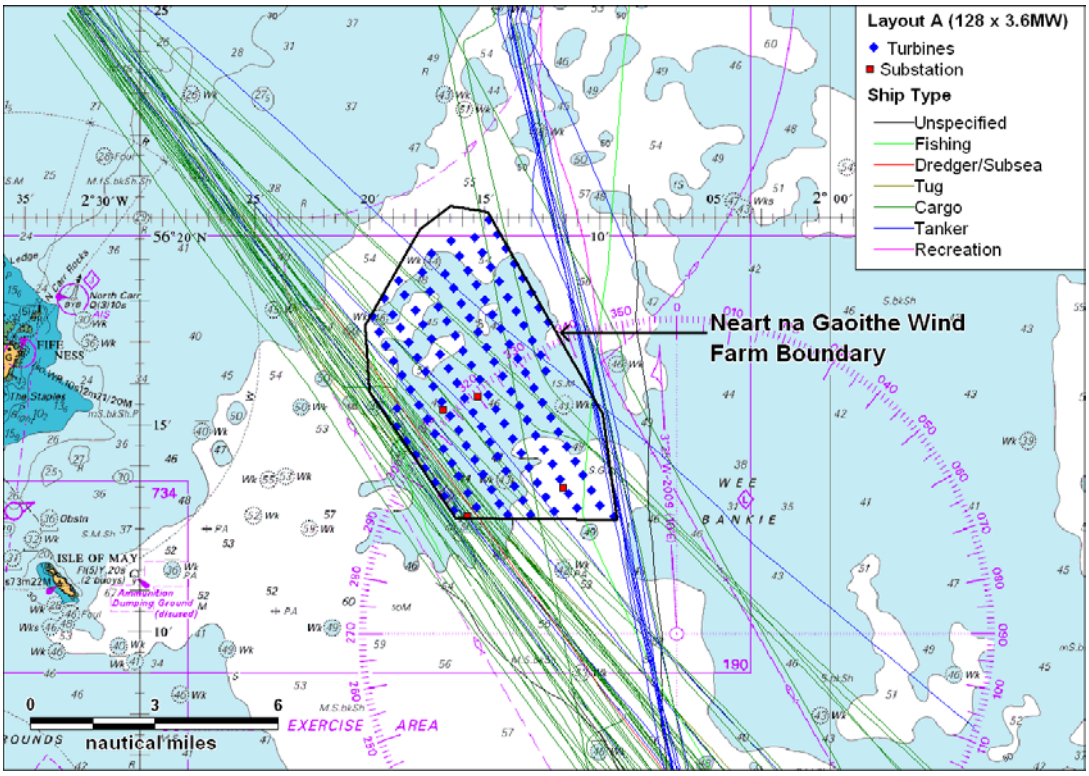


**Figure 8.23 Combined survey tracks by type on impacted routes**

During the combined surveys there was an average of just under one ship per day using the Firth of Tay route and one vessel every three days on the coastal tanker route.

Figure 8.24 presents the percentage distribution of the tracks recorded on the Firth of Forth and coastal tanker route.

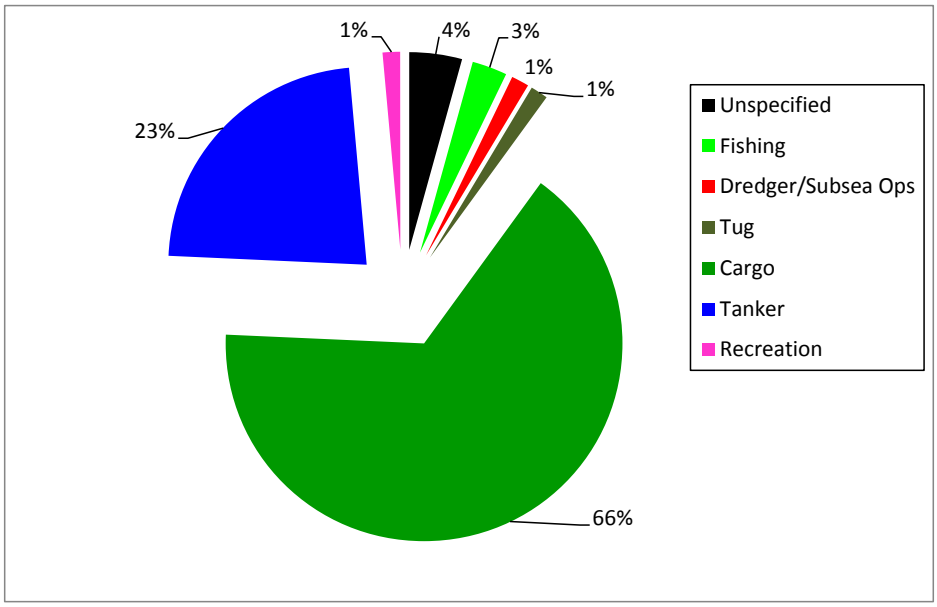


**Figure 8.24 Distribution of vessel types recorded on the impacted routes**

The majority of cargo vessels were recorded headed to Dundee (from Antwerp, Teesport and the Humber); with the remaining ship types using the coastal route passing through the western part of Neart na Gaoithe.

The tracks are analysed in more detail in Figure 8.25 to Figure 8.27.

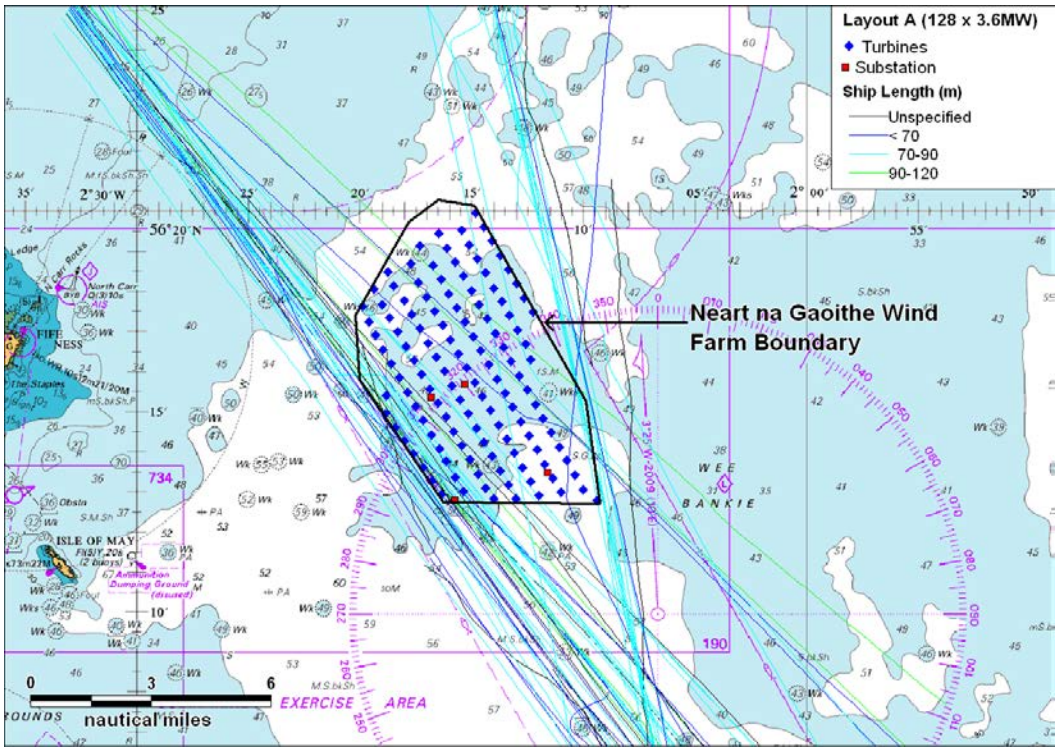


**Figure 8.25 Combined survey tracks by ship length on impacted routes**

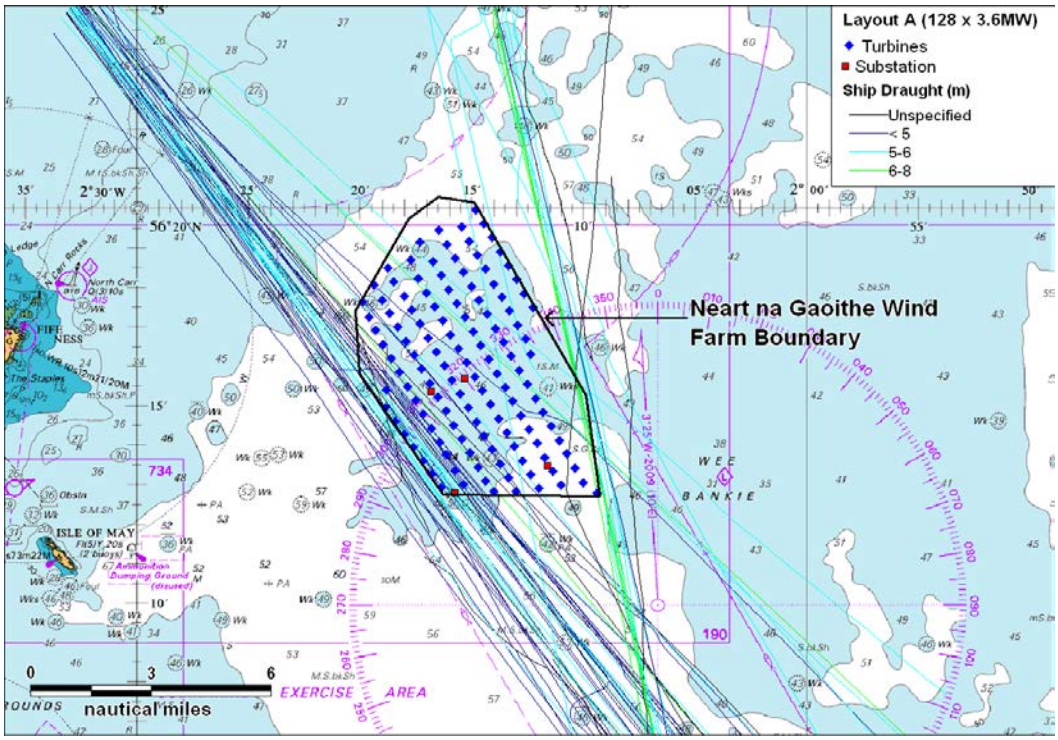


**Figure 8.26 Combined survey tracks by ship draught on impacted routes**

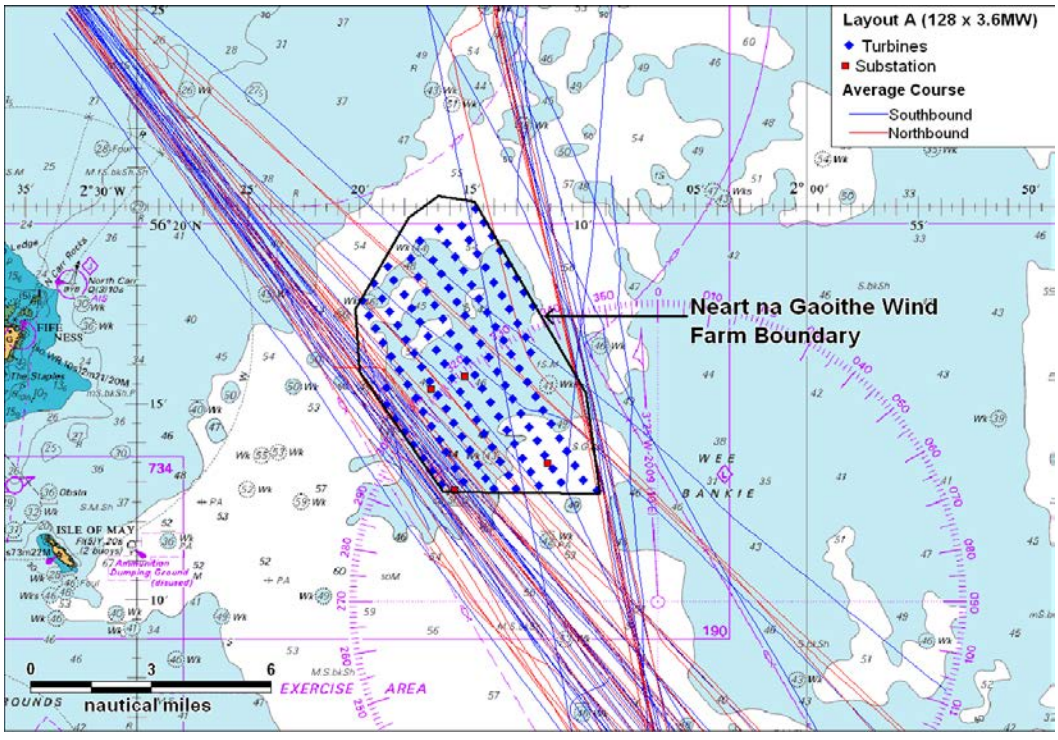


**Figure 8.27 Combined survey tracks by average course on impacted routes**

Approximately 54% of vessels were travelling southbound, while 46% of vessels were heading northbound.

# 9. IMPACT ON COMMERCIAL SHIPPING NAVIGATION

## *9.1 Passing Ships*

Based on the analysis of the shipping data presented in Section 8, it is considered that Neart na Gaoithe will not significantly affect passing ships as there is available sea room in the area to pass the wind farm at a safe distance, i.e. at least 1-1.5NM away.

In terms of nearby shipping, the majority of traffic also passes well clear of the site (shipping routes east/west from the Forth and coastal traffic off Fife Ness). The only routes that will be partly affected are the north west-south east shipping lane to/from Firth of Tay and coastal traffic between the Humber and northern Scottish Ports including Aberdeen, Peterhead and Lerwick.

One vessel per day on average uses the Firth of Tay route, with one vessel every three days on the coastal route from Humber to northern Scotland. The majority of vessels are coastal tankers and cargo vessels, and are likely to pass east and west of the wind farm when constructed.

The current position of the Firth of Forth and coastal tanker routes is analysed in Section 8.6. A portion of tracks currently pass through the site as the Dundee route is approximately 3NM wide, however there is available sea room to increase passing distance to the west. The CPA distribution for these vessels and other vessels passing within 10NM of the wind farm (excluding vessels passing through the turbine perimeter) is presented in Figure 9.1.

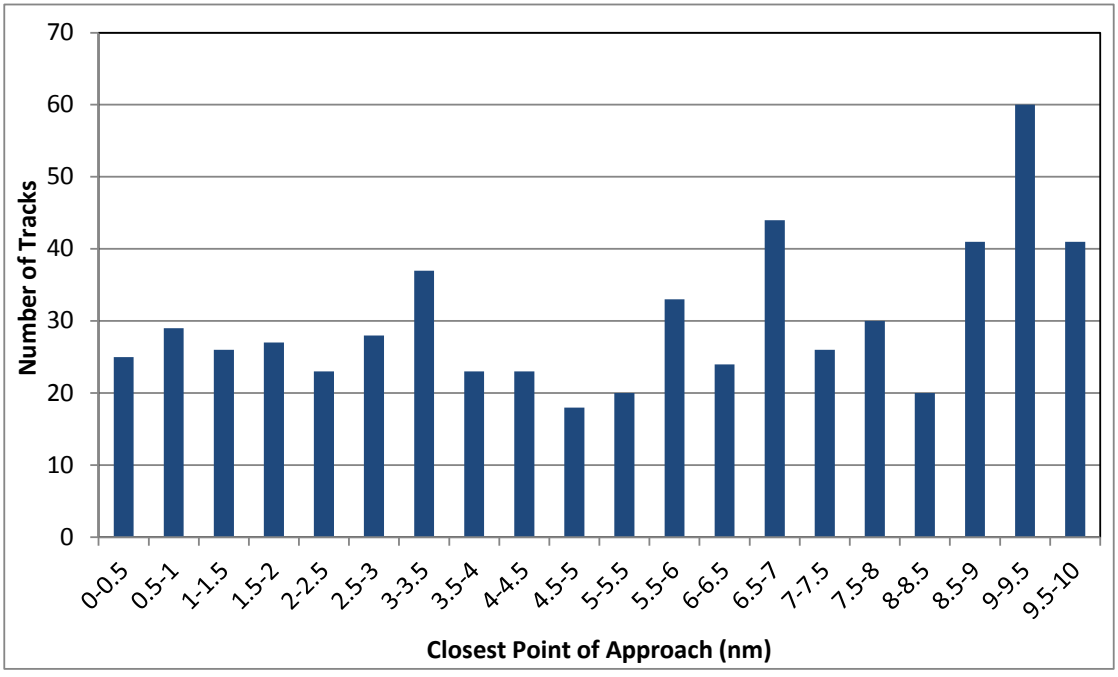


**Figure 9.1 CPA distribution of vessels passing within 10NM of Neart na Gaoithe (*Ocean Discovery* survey 29 days)**

The MCA has published draft "Guidance to Mariners Operating in the Vicinity of UK Offshore Renewable Energy Installations (OREIs)". It does not provide guidance on a safe distance at which to pass, as this depends upon individual vessels and conditions, but states that:

> *"In planning a voyage mariners must assess all hazards and associated risks. The proximity of wind farms and turbines should be included in this assessment. "*

Based on experience at other sites, the introduction of the Neart na Gaoithe wind farm is not expected to affect the majority of the Dundee bound traffic although vessels currently passing near the site are likely to increase passing distance to the west, which will result in an increased mean passing distance of approximately 1NM. There is sufficient sea room for vessels to make this change. The route is also expected to narrow slightly.

An average track estimated on each of the impacted routes prior to the construction of the wind farm is presented in Figure 9.2. This was calculated by finding the average position of tracks currently using the Firth of Tay and coastal tanker routes. The anticipated deviation is also shown in the chart.

Over the period of shipping data collection, vessels tracks on the coastal route from Humber to northern Scotland were recorded at various distances from the site, generally passing further east of Neart na Gaoithe. Therefore the mean ship route position was considered over the entire period of data collection (coastal and vessel survey) based on the data presented in the Baseline Shipping and Navigation report (Ref. xiii).

It is noted that shipping from the Forth to Egersund and other southern Norwegian ports pass within the edge of northern and southern boundaries of Neart na Gaoithe. However, given the available sea room and low number of ships on these routes vessels are likely to pass at least 1-1.5NM from the wind turbines and impact is considered to be minimal.

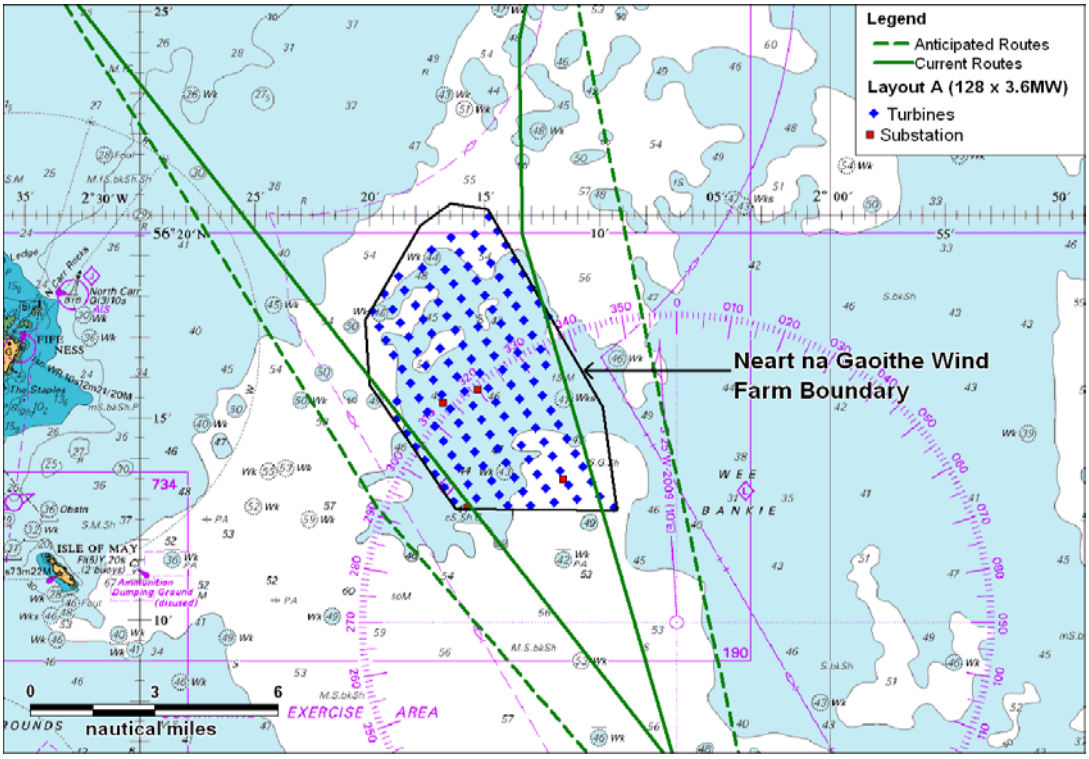


**Figure 9.2 Current and anticipated route positions relative to indicative Layout A**

The risks associated with the shipping changes anticipated due to the proposed wind farm have been quantified as part of the Formal Safety Assessment (see Sections 12 and 13).

The proposed wind farm may also have an effect on marine radar. This potential impact is discussed in Section 15.

# 10. RECREATIONAL VESSEL ACTIVITY

## *10.1 Introduction*

This section reviews recreational vessel activity at the Neart na Gaoithe offshore wind farm site based on information published by the RYA and AIS/radar tracking of recreational vessels during the maritime traffic surveys.

## *10.2 RYA Data*

### 10.2.1 Introduction

Historically there has not been a database of recreational use of the UK's marine environment. As a response to the lack of information, the RYA, supported by the Cruising Association (CA), who represent the interests of cruising sailors and motor-boaters world-wide, started to identify recreational cruising routes, general sailing and racing areas around the UK through consultation sent to berth holder associations and marinas. The results of this work were published in Sharing The Wind (Ref. xiv) and updated GIS layers published in the Coastal Atlas (Ref. xv). Data from 2010 has been used for this study.

This work was based on extensive consultation and qualitative data collection from RYA and CA members, through the organisations' specialist and regional committees and through the RYA affiliated clubs. The consultation was also sent to berth holder associations and marinas.

The results note that recreational boating, both under sail and power is highly seasonal and highly diurnal. The division of recreational craft routes into Heavy, Medium and Light Use is therefore based on the following classification:

- *Heavy Recreational Routes*: - Very popular routes on which a minimum of six or more recreational vessels will probably be seen at all times during summer daylight hours. These also include the entrances to harbours, anchorages and places of refuge.
- *Medium Recreational Routes*: - Popular routes on which some recreational craft will be seen at most times during summer daylight hours.
- *Light Recreational Routes*: - Routes known to be in common use but which do not qualify for medium or heavy classification.

### 10.2.2 Neart na Gaoithe Recreational Data

An overview and detailed plot of the recreational sailing activity and facilities in the outer Firth of Forth and Neart na Gaoithe is presented in Figure 10.1 and Figure 10.2.

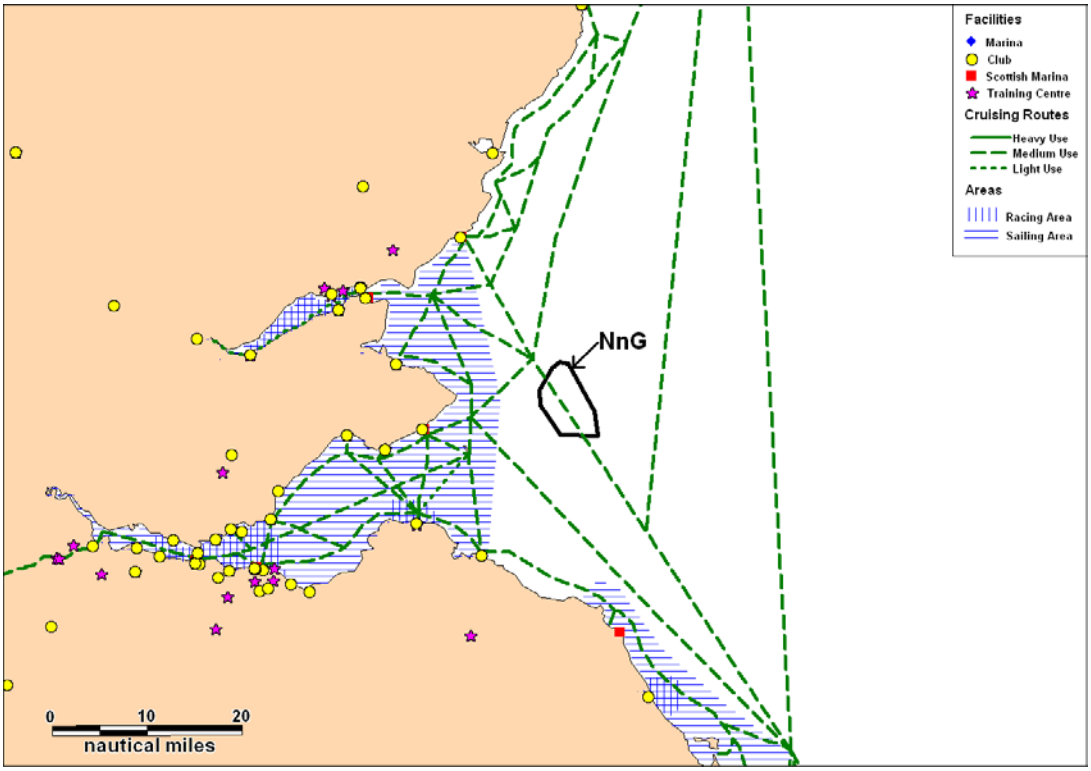


**Figure 10.1 Overview recreational information for the Outer Firth of Forth**

In terms of facilities, there are two marinas nearby at Anstruther and Arbroath and six clubs for recreational sailing located within 20NM of the wind farm (from Dunbar to Arbroath).

The nearest club is the Anstruther Sailing Club, 12NM west of the of Neart na Gaoithe, and the closest marina is also located in Anstruther.

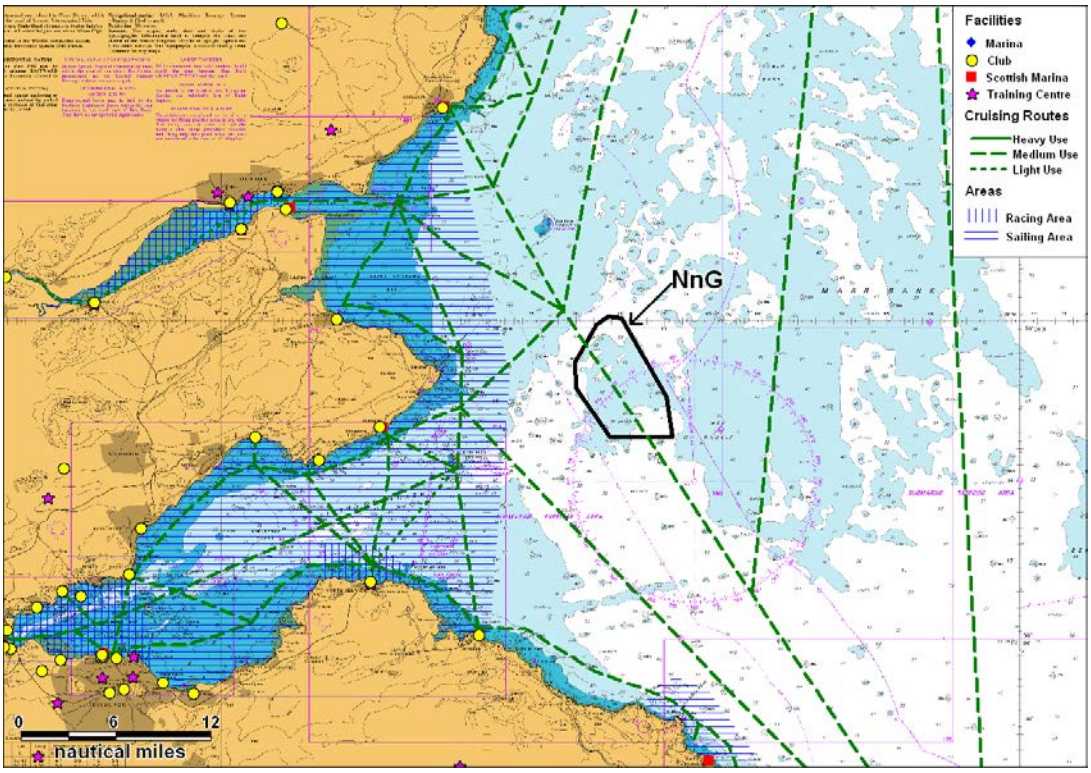


**Figure 10.2 Detailed recreational information for Neart na Gaoithe**

Based on the above figure, the wind farm is approximately 4NM west of the general racing and sailing areas off the Fife coast.

There is one 'medium use' cruising route passing through the wind farm, heading from the Tay, Arbroath and Scottish marinas to north eastern English marinas including Amble and South Shields.

## *10.3 Survey Data*

The maritime traffic survey identified recreational activity in the vicinity of the proposed wind farm area, as shown in Figure 10.3. The effective survey period was 29 days during August to October 2010.

Overall, 13 recreational vessel tracks were recorded during this period, an average of approximately one track every two days. It should be noted that sailing is influenced by sea / weather conditions and is highly seasonal and diurnal. In general recreational activity is highest during the summer months and during public / school holidays.

A plot of the recreation tracks (AIS and radar) is presented in Figure 10.3.

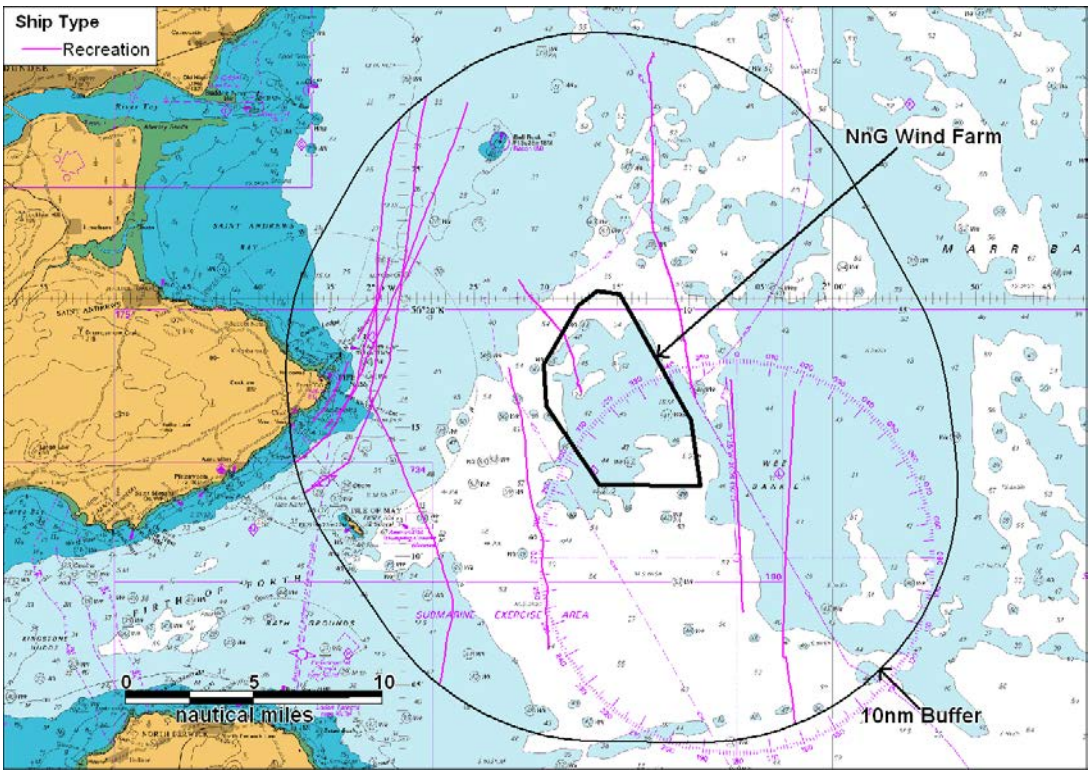


**Figure 10.3 All recreation vessel survey tracks (29 days)**

One recreation vessel was recorded passing through the Neart na Gaoithe wind farm boundary during the survey, headed north west. Recreational vessels were mostly using cruising routes off Fife Ness between north eastern marinas (Arbroath and Stonehaven) and the Firth of Forth. A small number of sailing yachts were also recorded passing east of the wind farm site, likely to be on longer sailing trips from the north east of Scotland to Eyemouth.

It should be noted that based on lower speeds (i.e. approximately 6-8 knots) a proportion of the unidentified vessels tracked on radar (non-AIS) are also likely to be recreation vessels.

An image of one of the sailing yachts recorded during the survey is presented in Figure 10.4.

**Figure 10.4 Library image of *Dawdle* sailing yacht (recorded on AIS in August & September 2010)**

## *10.4 Impact Assessment*

The air clearance between turbine rotors and sea level conditions at Mean High Water Springs (MHWS) will not be less than 22m, as recommended by the MCA. This minimises the risk of interaction between rotor blades and yacht masts.

In terms of vessel routeing, recreational vessels should be able to pass between turbines in suitable conditions, as well as being able to pass inshore and offshore. Based on the activity review, this is not expected to be a frequent event and hence the impact on recreational vessels is considered to be minor.

# 11. FISHING VESSEL ACTIVITY

## *11.1 Introduction*

This section reviews the fishing vessel activity at the Neart na Gaoithe offshore wind farm site based on the maritime traffic survey, surveillance data and the Commercial Fisheries Assessment (Ref. xvi).

## *11.2 Survey Tracks*

The fishing vessels tracked during the 29 days maritime traffic survey are plotted in Figure 11.1.

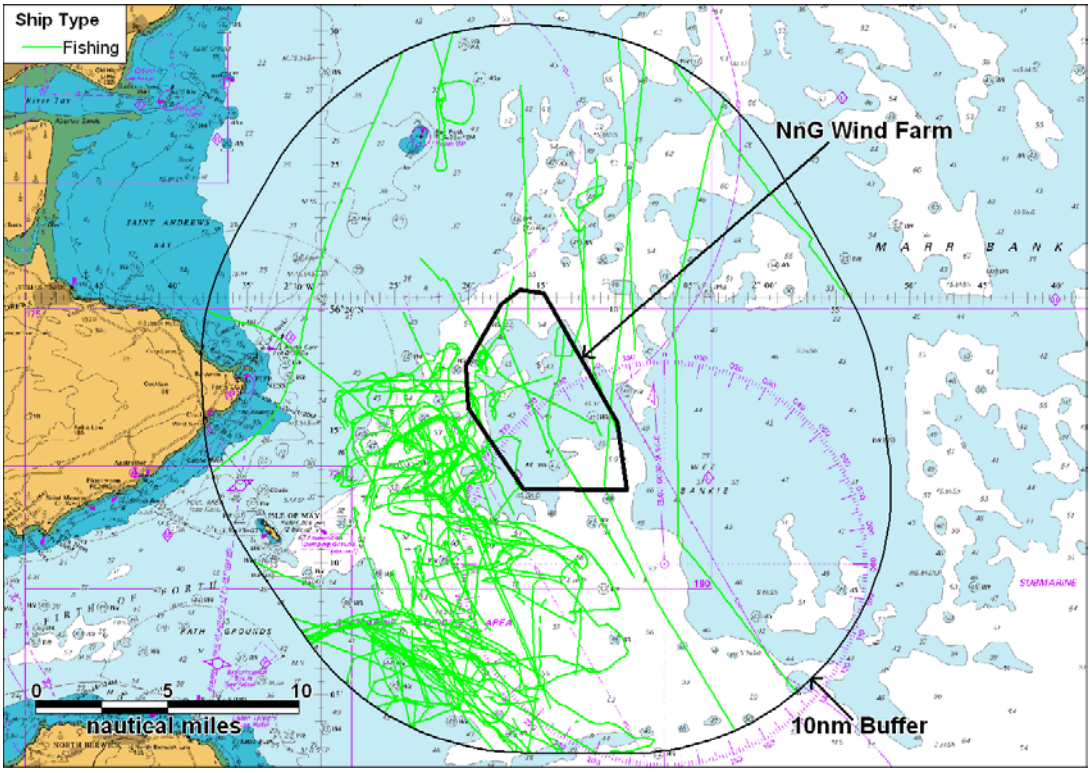


**Figure 11.1 All fishing vessel tracks (22 days of tracks)**

Fishing vessel activity was recorded on AIS (52%) and radar (48%), with most tracks to the west and south of the wind farm boundary. The majority of tracks appeared to be fishing as apposed to transiting through the area.

Overall 143 fishing vessel tracks were recorded during the *Ocean Discovery* survey, an average of 4 to 5 tracks per day. A total of 13 fishing vessel tracks were logged passing through the site during the survey period, averaging 1 every two days. It is noted that only two of these tracks were made by vessels with AIS installed.

An example image of fishing vessel recorded during the *Ocean Discovery* survey is presented in Figure 11.2.


**Figure 11.2 Library image of *Calisha* PD235 (recorded on AIS in August 2010)**

## *11.3 Fishing Surveillance Data*

### 11.3.1 Surveillance Patrols

The Neart na Gaoithe wind farm is located within International Council for the Exploration of the Seas (ICES) Rectangle (41E7) Subsquares 41E7/2 & 41E7/4.

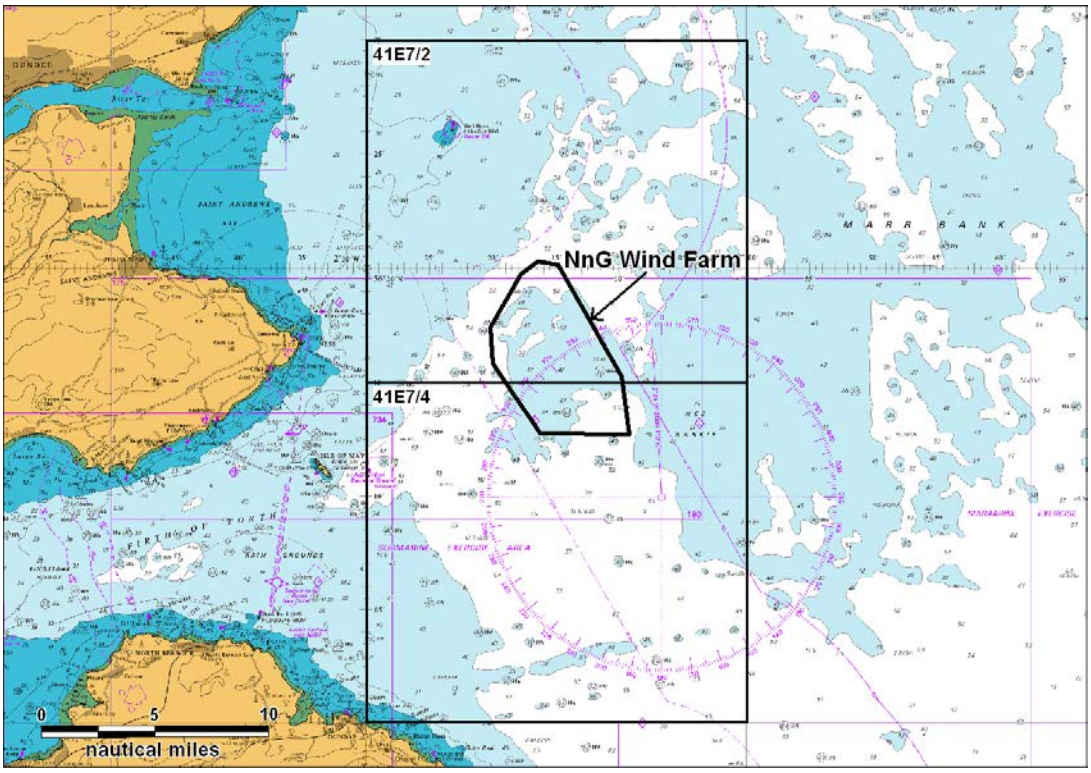


**Figure 11.3 Overview of ICES rectangles relative to Neart na Gaoithe**

The following subsections summarise the main findings relevant to the navigation assessment.

### 11.3.2 Sightings Gear and Activity

The fishing vessel sightings colour-coded by gear type are presented in Figure 11.4.

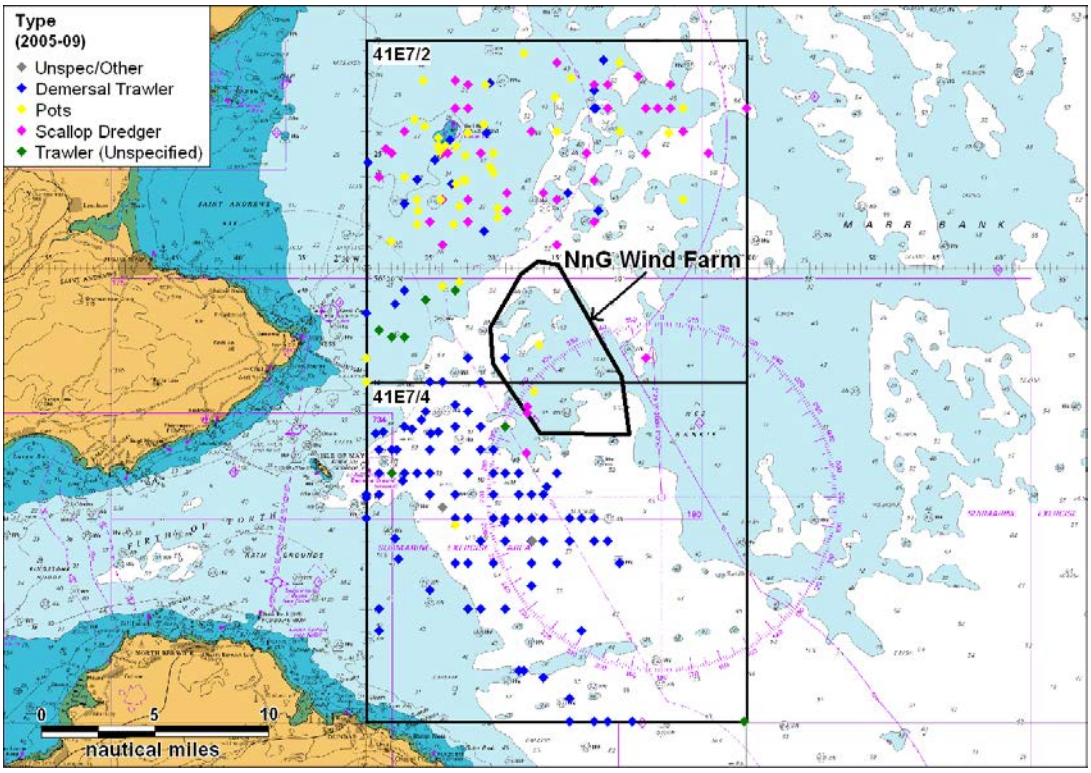


**Figure 11.4 Fishing vessel gear types**

The main fishing method overall was demersal stern trawling, accounting for approximately 55% of all sightings with potter/whelkers accounting for 21% and scallop dredgers accounting for 20% of sightings.

There were two potters, two scallop dredgers and one demersal trawler recorded within the wind farm boundary.

The fishing vessels colour-coded by activity when sighted are presented in Figure 11.5.

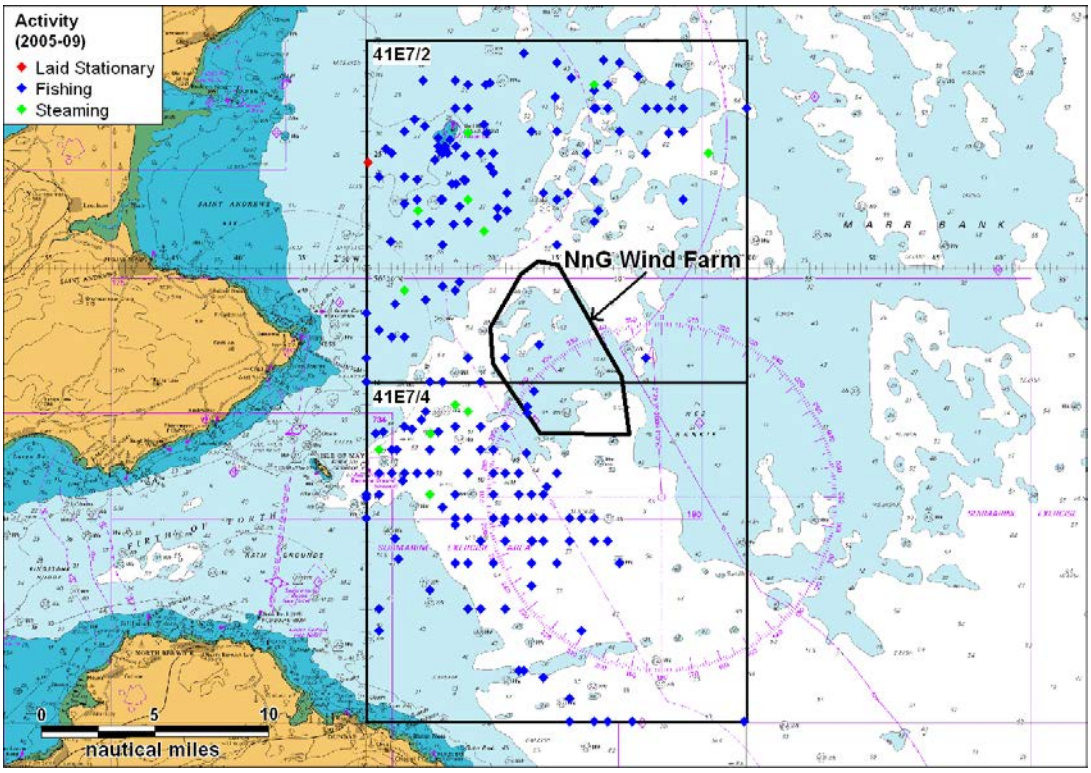


**Figure 11.5 Fishing vessel by activity**

Excluding unspecified, 94.1% of vessels sighted were engaged in fishing, i.e., gear deployed, 5.5% were steaming (transiting to/from fishing grounds) and less than 0.4% were laid stationary (vessels at anchor or pair vessels whose partner vessel is taking the catch whilst the other stands by).

Within the proposed wind farm boundary, all of the vessels sighted were engaged in fishing.

### 11.3.3 Satellite Tracking

From the sightings data, it is clear the majority of fishing vessels in the area are registered in the UK, with six foreign vessels recorded in the area during 2009, (six French and one Swedish) with the closest position 0.5NM south of the wind farm. However foreign vessels represented less than 0.2% of the fishing vessels recorded (gear type was unspecified).

The fishing vessel satellite VMS positions recorded in 2009, colour-coded by vessel type (where available), is presented in Figure 11.6.

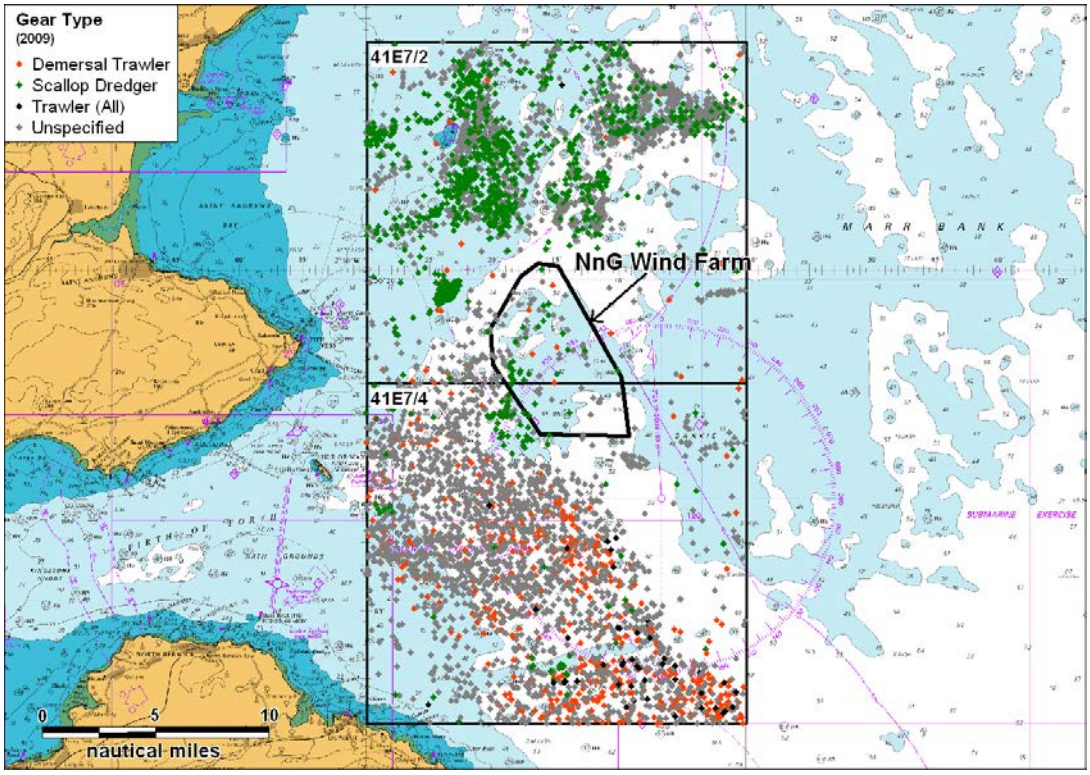


**Figure 11.6 Chart of UK and non-UK fishing vessel positions by type (2009)**

Excluding unspecified (65.2%), the majority of vessels logged by satellite were scallop dredgers (22.3%), and demersal trawlers (11.5%), and other vessels were made up of unspecified trawlers (1%).

The main vessel gear types identified within the proposed Neart na Gaoithe area were unspecified (63%). The remaining vessels were scallop dredgers (32%) and demersal trawlers (5%).

## *11.4 Commercial Fisheries Assessment*

A detailed assessment of the fishing activity in the vicinity of the Neart na Gaoithe offshore wind farm has been performed as part of the Environmental Statement (Ref. xix).

## *11.5 Impact Assessment*

Based on the current fishing activity in the area, and the assumption that this will continue after the wind farm is built, there will be a limited risk of collision between fishing vessels and turbines. This risk is reviewed in the Hazard Review workshop (Section 12) and Risk Assessment (Section 13).

There is also potential to impact on the navigation of vessels to and from fishing grounds, for example, increased steaming distances and times. This is mainly an issue during the construction and decommissioning phases when there will be a safety zone and hence there may be some increased steaming distances. During operation there should be sufficient spacing between turbines for vessels to steam through the site if the conditions are considered suitable.

In addition any risk associated with vessels exiting Neart na Gaoithe into shipping lanes passing around the wind farm (i.e. increase in ship-to-ship encounters) should be reduced by an increased uptake of AIS by fishing vessels.

Directive 2009/17/EC of the European Parliament and of the council of April 23 2009 amended Directive 2002/59/EC states the following time table for AIS carriage by fishing vessels:

- fishing vessels of overall length 24 metres and upwards but less than 45 metres: not later than 31 May 2012;
- fishing vessels of overall length 18 metres and upwards but less than 24 metres: not later than 31 May 2013; and
- fishing vessels of overall length exceeding 15 metres but less than 18 metres: not later than 31 May 2014.

The risk of interaction between fishing gear and subsea cabling associated with the development is discussed in Section 13.4.

# 12. FORMAL SAFETY ASSESSMENT

## *12.1 Introduction*

The IMO Formal Safety Assessment process (Ref. xvii) as approved by the IMO in 2002 under SC/Circ.1023/MEPC/Circ392 has been applied within this study. This is a structured and systematic methodology based on risk analysis and cost benefit assessment (if applicable). There are five basic steps within this process:

1. Identification of hazards (a list of all relevant accident scenarios with potential causes and outcomes);
2. Assessment of risks (evaluation of risk factors);
3. Risk control options (devising regulatory measures to control and reduce the identified risks);
4. Cost benefit assessment (determining cost effectiveness of risk control measures); and
5. Recommendations for decision-making (information about the hazards, their associated risks and the cost effectiveness of alternative risk control measures).

Figure 12.1 is a flow diagram of the FSA methodology applied.

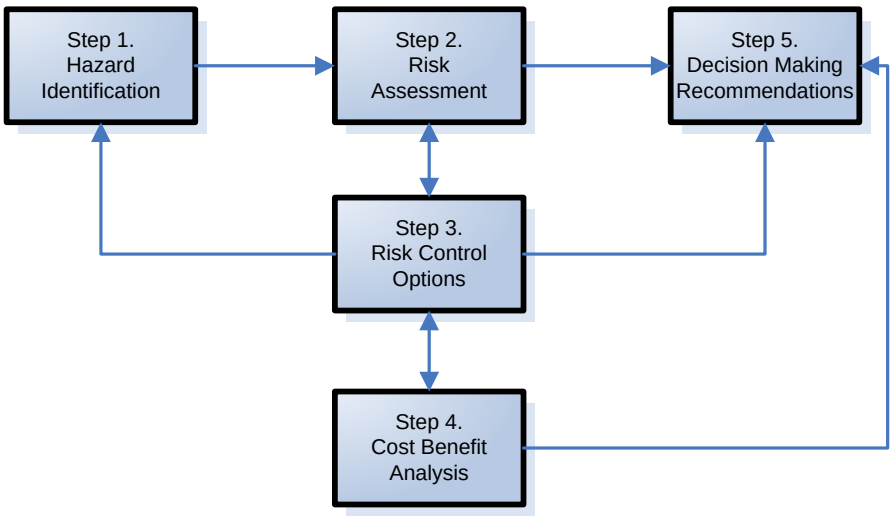


**Figure 12.1 Overview of formal safety assessment**

As indicated within the IMO FSA guidelines and the DECC guidance on risk assessment methodology (Ref. i) for offshore renewable projects, the depth of the assessment should be commensurate with the nature and significance of the problem. Within the assessment of proportionality consideration was given to both the scale of the development and the magnitude of the risks/navigational impact.

From review it was concluded that the Neart na Gaoithe offshore wind farm project is a large scale development with the potential to impact navigational safety. As a result, the content and methods of the risk assessment were responsive to this and included the following:

- Comprehensive Hazard Log
- Risk Ranking
- Detailed and quantified Navigational Risk Assessment for selected hazards
- Preliminary search and rescue overview
- Preliminary emergency response overview
- Comprehensive risk control/mitigation measures log

## *12.2 Hazard Identification*

A Hazard Review workshop was held in Rosyth the on 4th November 2011 attended by local stakeholders, as outlined in Table 12.1. Representatives from British Chamber of Shipping (CoS), Cruising Association and operators of shipping routes passing through the area were also invited to the workshop, but could not attend.

**Table 12.1 Hazard review workshop attendees**

| Attendee | Position | Company/Organisation |
|---|---|---|
| Peter Douglas | Navigation Manager | Northern Lighthouse Board (NLB) |
| Pete Thomson | Offshore Energy Liaison Officer | Marine Coastguard Agency (MCA) |
| Ian Miller | Fife Sea Kayak Club | Scottish Canoe Association (SCA) |
| Rob Burgess | Lothian Sea Kayak Club | Scottish Canoe Association (SCA) |
| Bill Hughes | Manager of Fisherman's Mutual Association (FMA) (Pittenweem) Ltd | Kingdom Seafood/FMA Ltd |
| Sandy Ritchie | Secretary | Anglo-Scottish Fisherman's Federation |
| John Watt | Fishing Industry Advisor | Scottish Fisherman's Federation |
| Paul Jennings | Divisional Inspector (Scotland) | Royal National Lifeboat Institute (RNLI) |
| Paul Wibberly | Lifeboat Operations Manager & Forth Pilot | RNLI – Kinghorn Lifeboat |
| Ashley Nicholson | Assistant Marine Manager | Forth Ports Plc. |
| Leanne Fisher | Marine Officer | Forth Ports Plc. |
| Graham Russell | Planning and Environment Officer | Royal Yachting Association (Scotland) |
| Alison Duncan | Senior Consultant | EMU |

| Attendee | Position | Company/Organisation |
|---|---|---|
| Zoe Crutchfield | Offshore Environmental Manager | Mainstream Renewable Power |
| Ewan Walker | Environmental Developer | Mainstream Renewable Power |
| Ali MacDonald | Senior Risk Analyst | Anatec |
| Robert Jones | Risk Analyst | Anatec |

## *12.3 Key Findings*

The focus of the workshop was on shipping navigational hazards and the key findings from the meeting are summarised in the following subsections.

Search and Rescue/Emergency Response:

- Tugs are on 24 hour stand-by (5-10 minute call out time with a 120 tonne bollard pull) at the Hound Point and Braefoot Bay marine terminals.
- Tugs in the Firth of Forth can steam at approximately 13 knots with the possibility of responding to a drifting or ship collision incident at the proposed offshore wind farm within approximately two hours of mobilisation.
- In terms of a man overboard incident at the proposed wind farm, the use of PLBs could be investigated.

Commercial Vessels

- Drifting and machinery failures east of the Forth Ports limit were highlighted during the workshop as they can be a frequent event.
- As noted above, tugs are station at the Hound Point and Braefoot Bay marine terminals and could potentially be used during a drifting incident.
- During a south westerly wind a drifting vessel could be blown towards the proposed Neart na Gaoithe wind farm area.

Recreational Vessels/Activities:

- A number of incidents in the area (for example, machinery failures and during adverse weather conditions) involved foreign recreational craft from Scandinavian that had sailed off course when heading to Northern and Eastern Scotland.
- Liaison should be carried out with local harbour masters on developments to share information amongst smaller ports and non-commercial vessel users.

Fishing Issues:

- An operational plan could be formed to liaise with fishing vessels regarding the operational issues for vessels so that they don't interfere with fishing gear including nets and static gear/pots. For example, channels in and out of ports, and areas where vessels lay-up.
- The expected export cable route was initially identified (during the workshop) as posing higher risk to fishing gear interaction; however good burial properties are predicted for the export cable area due to more favourable sea bed type.

- The inter-array cables are likely to be more difficult to protect due to harder sea bed conditions within the proposed wind farm.
- Around turbines and substation(s) there are J-tubes where the cables come out of the substrate. J-tubes could be protected by rock dumping or mattresses when protecting against scour.
- Fisherman noted a preference for rock dumping as mattresses can pose greater risk to gear. There will be 500M safety zones proposed around the major installation/construction vessels, excluding fishing vessels from the area and reducing the risk of vessels interacting with exposed J-tubes.
- If a problem is identified with cable burial during surveying (for example cable movement) this should be reported to the fishing industry.

Vessel Monitoring:

- Combined vessel monitoring in the area could be explored, with the possibility of other developers collaborating with Forth Ports.

Cumulative Issues:

- Smaller merchant vessels and coastal tankers re-routeing east of the Round 3 Zone 2 are likely to be operating to tight time and fuel margins and need to take the shortest routes (for example west of the wind farm developments).

## *12.4 Risk and Mitigation Measures*

The risks involved with the development and the associated mitigation measures are summarised in the following table. In all cases, the competency of mariners has been assumed when assigning the risk of each hazard.

| Hazard | Key Points | Mitigation |
|---|---|---|
| Commercial ship (powered) collision with turbine. | The vast majority of commercial vessels passing the site tends to be on the southern Firth of Forth route and vessels passing offshore (east) of Neart na Gaoithe.<br><br>Tugs are stationed within the Firth of Forth and Offshore support/anchor handlers pass through the area. (Mainstream to discuss with other developers and Forth Ports the possibilities of joint vessel monitoring in the area.)<br><br>Forth ports VTS monitoring may pick up vessels on collision course. Have picked up errant vessels headed towards the coastline in the past and can recommend areas to shelter e.g. Saint Andrews Bay.<br><br>Competent mariners and the "rules of the road" will contribute to risk reduction.<br><br>Overall the risks were identified as **LOW**. | Marking and Lighting<br>Sound signal<br>Chart Markings<br>Guard Vessel during Construction<br>Notices to Mariners<br>Consultation with Local Users<br>Compliance with Colregs |
| Man overboard during work activities at the site | Helicopter access, for search and rescue, importance of working with the MCA on Emergency Response Plans, and to note that helicopter SAR operations may not always be possible within the site, i.e. RNLI lifeboats would be used.<br><br>The use of PLBs could be investigated. | Very High Frequency (VHF) carriage<br>Site personnel trained in fire fighting first aid and offshore survival<br>Safety Management System (SMS) |

| Hazard | Key Points | Mitigation |
|---|---|---|
| | Vessel(s) working on their own could report to coastguard - procedures to capture this. | Procedures for all vessels working in the site<br>Personnel Training<br>Personal Protective Equipment (PPE)<br>Emergency Response Cooperation Plan (ERCoP)<br>Control of Work Procedure<br>Adverse weather working policy and procedures. |
| Deliberate unauthorised boarding of turbine or mooring structure (possible damage to the device) | It was highlighted that it would have to be serious industrial sabotage and unlikely given the distance from shore. | SMS<br>Promulgation of information to local users<br>Inspection and maintenance procedures<br>ERCoP |
| Vessel anchoring / dragging anchor (on and/or over subsea | Hound Point and/or Braefoot Bay tugs available on permanent standby.<br>MCA should be notified and a broadcast to shipping for tugs in the area. | Chart Markings (cables)<br>Notices to Mariners |

| Hazard | Key Points | Mitigation |
|---|---|---|
| equipment and/or cables) | Vessel could drop anchor to slow down and reduce drift (two anchors onboard).<br><br>Breakdowns happen relatively frequently in and around the eastern limit of the Forth Ports.<br><br>If wind is strong from SW then vessel could drift towards the wind farm.<br><br>On approaching port limits vessels will have anchors prepared as per port regulations.<br><br>Overall risks were identified as **LOW (Most Likely/Probable Outcome)** and **MEDIUM (Residual/Worst Case)**. | Consultation with Local Users<br><br>Cable route away from shipping<br><br>Appropriate cable protection/burial |
| Vessel-to vessel-collision due to avoidance of site (includes fishing, recreational and attendant/construction/ maintenance vessels) | Neart na Gaoithe wind farm development relatively benign from a commercial shipping perspective.<br><br>More concerned that vessel-to vessel encounters will be an issue with cumulative impacts of other Forth and Tay projects.<br><br>Considering the Neart na Gaoithe in isolation and with competent crew/seamanship it was agreed that the risks of vessel-to vessel collision were still likely to be **LOW**. | VTS Coverage of area<br><br>Routeing Measures - New or Amended<br><br>Marking and Lighting<br><br>Continuous Watch by multi-channel VHF, including Digital Selective Calling (DSC); |

| Hazard | Key Points | Mitigation |
|---|---|---|
| | | Compliance with Colregs. |
| Fishing Gear interaction with subsea equipment, inter-field and/or export cabling | Export cable route sea bed area is predicted to have good burial properties, whereas inter array cables may be more exposed as sea bed is harder to trench in the Neart na Gaoithe site. It was considered that burial depths are likely to be 1-2m.<br><br>If a problem is identified with a cable, then this needs to be reported to the fishing industry.<br><br>Potentially look at AIS coverage of cable route to alarm for vessels anchoring within a certain distance.<br><br>Vessels should contact the coastguard to report they have lost their gear.<br><br>Overall risks were identified as **LOW (Most Likely/Probable Outcome)**. | Notices to Fishermen<br>Notice to Mariners<br>Navigational information broadcasts<br>Installation procedures<br>Inspection and maintenance procedures<br>Fisheries Liaison<br>Chart Markings<br>Cable protection, e.g., burial; Abandon gear. |
| Recreational vessel collides with wind farm structure | Recreational vessels pass through the area from Scandinavia and can get into trouble when navigating, e.g., off course when headed towards Northern and Eastern Scotland (Peterhead and Caledonian Canal).<br><br>Local RNLI stations to be provided with charts of the wind farm with turbines identified in a numbering system.<br><br>Liaison with local harbour masters on developments to share information. | Promulgation of information to local users<br>Notice to Mariners<br>Navigational information broadcasts<br>Minimum Blade Clearance<br>Marking and Lighting |

| Hazard | Key Points | Mitigation |
|---|---|---|
| | Overall risks were identified as **LOW (Most Likely/Probable Outcome)**. | Chart Markings. |
| Drifting Vessel Collision | Tugs are stationed within the Firth of Forth and Offshore support/anchor handlers pass through the area.<br><br>All-weather Lifeboats (ALBs) can also tow small fishing and merchant vessels in the event of a possible collision with a wind turbine.<br><br>There is generally no option for smaller vessels to anchor in an emergency situation in the area of the proposed wind farm given that the water depth adjacent to the Neart na Gaoithe site is approximately 45m. In addition, during a south westerly wind a drifting vessel could be blown towards the proposed wind farm.<br><br>Drifting and machinery failures east of the Forth Ports limit can be a frequent event (possibly due to switching over engines, heavy fuel oil to marine diesel oil).<br><br>Overall risks were identified as **LOW (Most Likely/Probable Outcome)**. | Tug Availability<br>ERCoP<br>Anchoring by drifting vessel. |
| Fishing Vessel Collision | Damage is likely to occur to the fishing vessel as apposed to turbine, likely to be glancing vessel collision. | Promulgation of information to local users |

| Hazard | Key Points | Mitigation |
|---|---|---|
| | Operational plan to liaise with fishing vessels regarding the operational issues for vessels so that they don't interfere with fishing vessels, e.g. routes in and out of ports and areas where vessels lay-up.<br><br>Seasonal squid fisheries are becoming more active in the North Sea due to squid not been a quota controlled species.<br><br>Overall risks were identified as **LOW (Most Likely/Probable Outcome)**. | Notices to Fishermen<br>Notice to Mariners<br>Navigational information broadcasts Marking and Lighting<br>Marine Coordinator on site during works<br>Kingfisher publications<br>Fisheries Liaison<br>Compliance with Colregs<br>Chart Markings. |

## 12.5 Risk Analysis

Following identification of the key navigational hazards, risk analyses were carried out to investigate selected hazards in more detail. This allowed more attention to be focused upon the high risk areas to identify and evaluate the factors which influence the level of risk with a view to their effective management. Four risk assessments were carried out as per the DECC guidelines:

1. Base case without wind farm level of risk
2. Base case with wind farm level of risk
3. Future case without wind farm level of risk
4. Future case with wind farm level of risk

The following scenarios were investigated in detail, quantitatively or qualitatively.

Without Wind Farm:
- Vessel-to-vessel collisions

With Wind Farm
- Vessel-to-vessel collisions
- Vessel-to-wind farm collisions (powered and drifting)
- Cable interaction

All the quantified risk assessments were carried out using Anatec's COLLRISK software which conforms to the DECC methodology as outlined in Annex D3 in the Guidance (Ref. i). In line with this, Anatec makes the declaration that the models used within this work have been validated and are appropriate for the intended use. As required the following have been considered and justified:

- Tuning of parameters
- Consistency checks
- Behavioural reasonableness
- Sensitivity analysis
- Comparison with the real world

The results of the detailed risk analyses are presented in Section 13. Where considered appropriate in high risk scenarios, the change in individual and societal risk (based on Potential Loss of Life), as well as the risk of pollution, were calculated and compared to background risk levels in the UK.

## 12.6 Risk Control Measures

A summary of measures is presented in Section 20.

# 13. RISK ASSESSMENT

## *13.1 Introduction*

This section assesses the risks identified from the hazard review to require more detailed assessment. This is divided into without wind farm (pre-installation) and with wind farm (post-installation) risks.

The base case assessment uses the present day vessel activity level identified from the maritime traffic surveys, consultation and other data sources. The future case assessment makes conservative assumptions on shipping traffic growth over the life of the wind farm.

Two indicative layouts of the Neart na Gaoithe offshore wind farm are modelled (refer to Section 3.3 for more details), based on 128 turbines in indicative layout A and 64 turbines in Layout B, assuming the Rochdale Envelope (maximum) jacket top side dimensions of 15 x 15m.

## *13.2 Without Wind Farm Risk*

### 13.2.1 Encounters

An assessment of current ship-to-ship encounters has been carried out by replaying at high-speed the AIS data recorded from the *Ocean Discovery* (29 days).

An Encounter distance of 1NM has been considered. The tracks of vessels during encounters, and heat maps based on the geographical distribution of encounters within a grid of cells, are presented in Figure 13.1 and Figure 13.4. This helps to illustrate where existing shipping congestion is highest and therefore where offshore developments, such as a wind farm, could potentially exacerbate congestion and hence increase the risk of encounters / collisions.

It can be seen that in all cases, the density of encounters in the vicinity of the proposed wind farm is minimal.

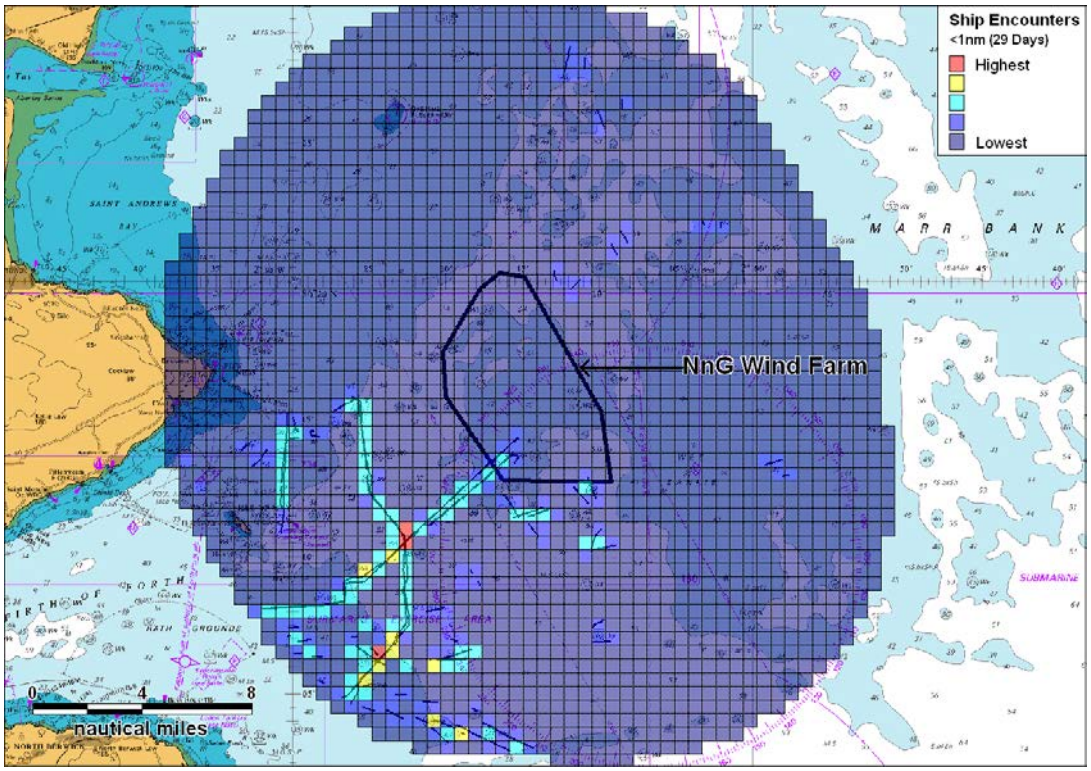


**Figure 13.1 Ship-to-ship encounters within 1NM (29 days)**

Due to the location of the Neart na Gaoithe site (in open seas with ample sea room), an encounter distance of 1NM has been used for further analysis of encounters.

There were 32 encounters during the 29-day period. Figure 13.2 presents the number of encounters per day.

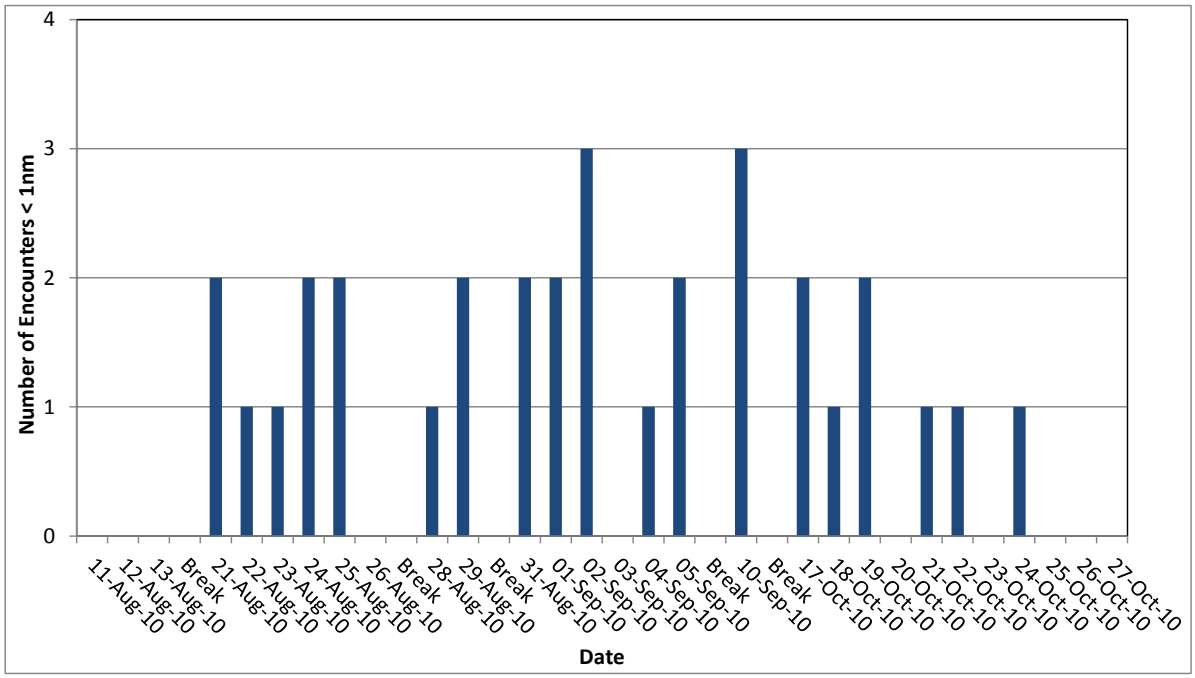


**Figure 13.2 Number of ship-to-ship encounters per day**

The average number of encounters was 1 per day, with the highest number (3 encounters) observed on 2nd and 10th of September 2010.

Figure 13.3 presents the distribution of vessel types involved in encounters (excluding unspecified).

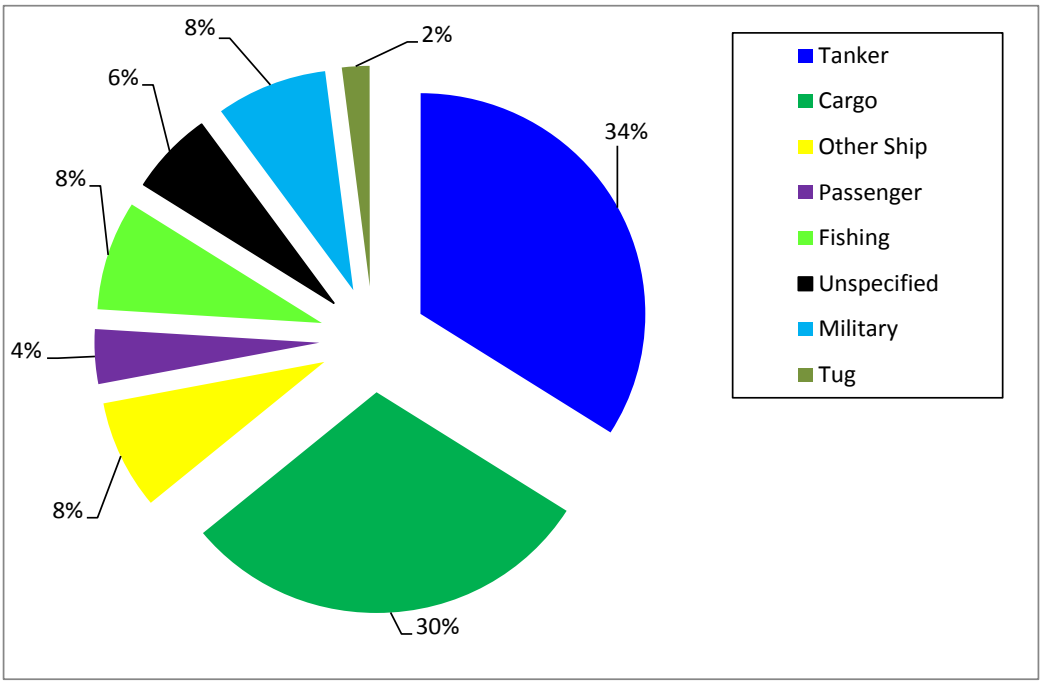


**Figure 13.3 Vessel types involved in encounters**

It can be seen that the majority of encounters involved 'other ships' (46%) and cargo vessels (31%). The majority of both are offshore industry support vessels.

The locations of encounters colour-coded by ship type during the 14 day period are presented in Figure 13.4.

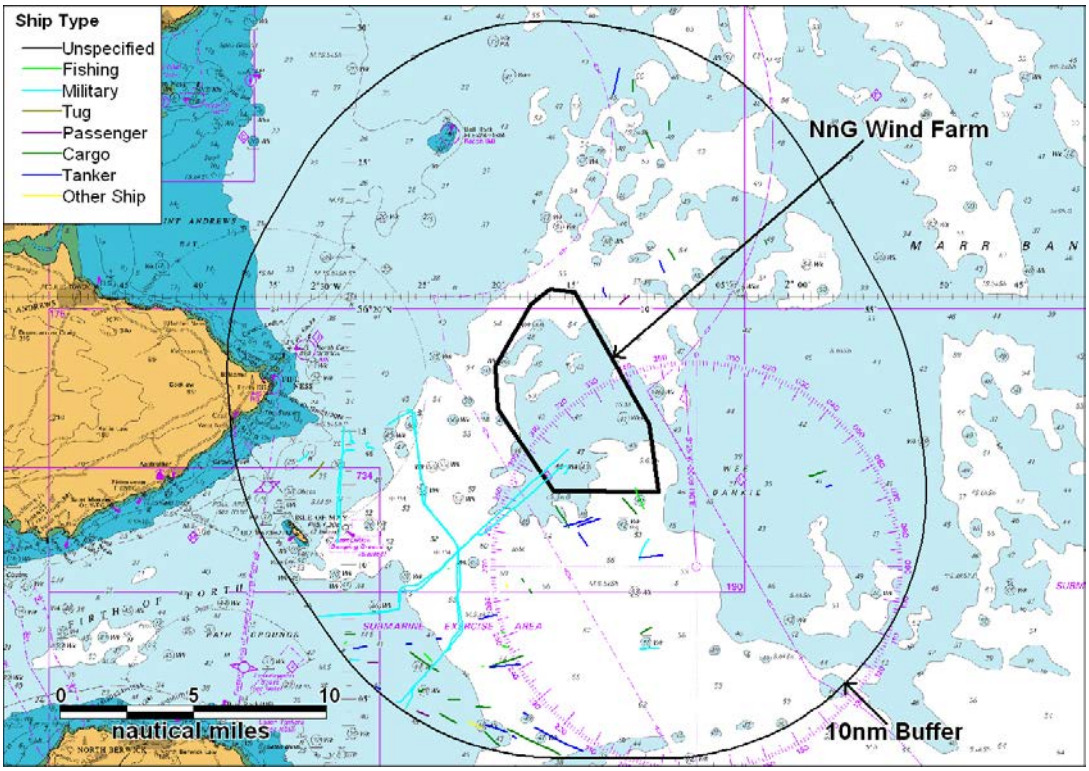


**Figure 13.4 Overview of ship-to-ship encounters during 29 days (AIS)**

The vast majority of encounters occurred where ships converge on approach to or departure from firth of Forth to the south of Neart na Gaoithe. It is noted that a number of military vessels were recorded encountering which may have been on military practice exercises, with one encounter under 1NM occurring within the proposed wind farm.

The other encounter recorded within the wind farm involved a cargo vessel and a fishing vessel on the southern boundary of the site.

### 13.2.2 Vessel-to-Vessel Collisions

Based on the existing routeing and encounter levels in the area, Anatec's COLLRISK model has been run to estimate the existing vessel-to-vessel collision risks in the local area around the Neart na Gaoithe site. The route positions and widths are based on the survey analysis with the annual densities based on port logs and Anatec's ShipRoutes database, which take seasonal variations into consideration.

Based on the model run for the area, the baseline vessel-to-vessel collision risk level pre-wind farms is in the order of 1 major collision in just under 1,020 years.

It is emphasised the model is calibrated based on major incident data at sea which allows for benchmarking but does not cover all incidents, such as minor impacts, or incidents occurring within port. Other incident data from RNLI and MAIB is presented in Section 7. This includes other minor incidents including collisions in port.

## *13.3 With Wind Farm Risk (Base Case)*

### 13.3.1 Vessel-to-Vessel Collisions – Change in Risk

The revised routeing pattern following construction of the wind farm has been estimated based on the review of impact on navigation (see Section 9). The main change is displacement of ships passing close to the wind farm area on approach/departure from the Firth of Tay and vessels on the coastal route from the north (Aberdeen, Peterhead and the northern Isle) to the Humber. It is assumed that ships will be able to pre-plan their revised passage in advance of encountering the wind farm due to effective mitigation in the form of information distribution about the development to shipping through Notices to Mariners, updated charts, liaison with ports, etc. Fishing vessels may also be displaced from the site to other areas, which could increase the frequency of encounters.

Based on vessel-to-vessel collision risk modelling of the revised traffic pattern, the collision risk was estimated to increase to 1 major collision in approximately 970 years. The change in collision frequency due to the wind farm was estimated to be $4.6 \times 10^{-5}$ per year (approximate 5% increase).

As noted earlier, the model is calibrated based on major incidents at sea which allows for benchmarking but does not cover all incidents, such as minor impacts, or incidents occurring within port.

The following potential affects have not been quantified but may indirectly influence the vessel-to-vessel collision risk:

- Radar interference
- Visual obscuration when ships approach each other.

The radar interference issue is discussed in Section 15. It is noted that any potential impact is only likely to be a problem during bad visibility and this is mitigated to an extent by the widespread adoption of AIS which will assist vessels in discriminating genuine targets (although AIS is not currently mandatory for smaller vessels, e.g., fishing vessels under 45m and recreational vessels). It is noted that by 2014 it will be mandatory for fishing vessels over 15m in length or greater, to carry AIS.

The visual issue is reviewed in Section 19.2 and is not considered a significant factor for the Neart na Gaoithe site due to its position and orientation relative to the shipping lanes and the other navigational features in the area.

### 13.3.2 Ship Collision with Structure

There are two main scenarios for passing ships colliding with offshore structures such as wind farm turbines:

- Powered Collision: Where the vessel is under power but errant
- Drifting Collision Where a ship on a passing route experiences propulsion failure and drifts under the influence of the prevailing conditions.

Each scenario is assessed below.

**Powered Ship Collision**

Based on the ship routeing identified for the area and the anticipated change in routeing due to the site, and assuming effective mitigation in terms of making mariners aware of the site through Notices to Mariners, charts, lights and markings, etc., the frequency of an errant ship under power deviating from its route to the extent that it comes into proximity with the Neart na Gaoithe wind farm is not considered to be a likely event.

From consultation with the shipping industry it is assumed that merchant ships will not attempt to navigate between turbines due to the restricted sea room and will be directed by the navigational aids in the area.

The main risk of powered collision with a wind farm structure is from human error on the bridge of the ship, however, the proximity to the coastline and nearby ports (within the Forth and Tay) should mean that mariners are already very attentive to their vessel's position and proximity to other vessels and obstructions in this area.

Based on modelling the revised ship routeing pattern (Figure 9.2) and using local metocean data, the risk of a passing powered ship collision is presented in Table 13.1.

**Table 13.1 Powered ship-to-structure collisions – Base Case with wind farm**

| Turbine Layout | Annual Collision Frequency | Collision Return Period |
|---|---|---|
| Layout A | 1.2E-04 | 8,200 years |
| Layout B | 8.6E-05 | 11,600 years |

These collision frequencies are well below the historical average of 5.3 x $10^{-4}$ per installation-year for offshore installations on the UKCS (1 in 1,900 years). The risk to the Neart na Gaoithe wind farm is estimated to highest for the indicative layout A which comprises the highest number of turbines and hence, largest area of sea room. However the relatively low ship-to-structure collision frequency is generally reflective of low level of close passing shipping.

The individual collision frequencies ranged from 2.6 x $10^{-5}$ for the turbine on the south eastern tip of the wind farm, to negligible for turbines within the centre and north east of the wind farm.

Charts showing the passing powered collision frequency for each turbine in the two indicative layouts, as well as the substations and met mast are presented in Figure 13.5 and Figure 13.6.

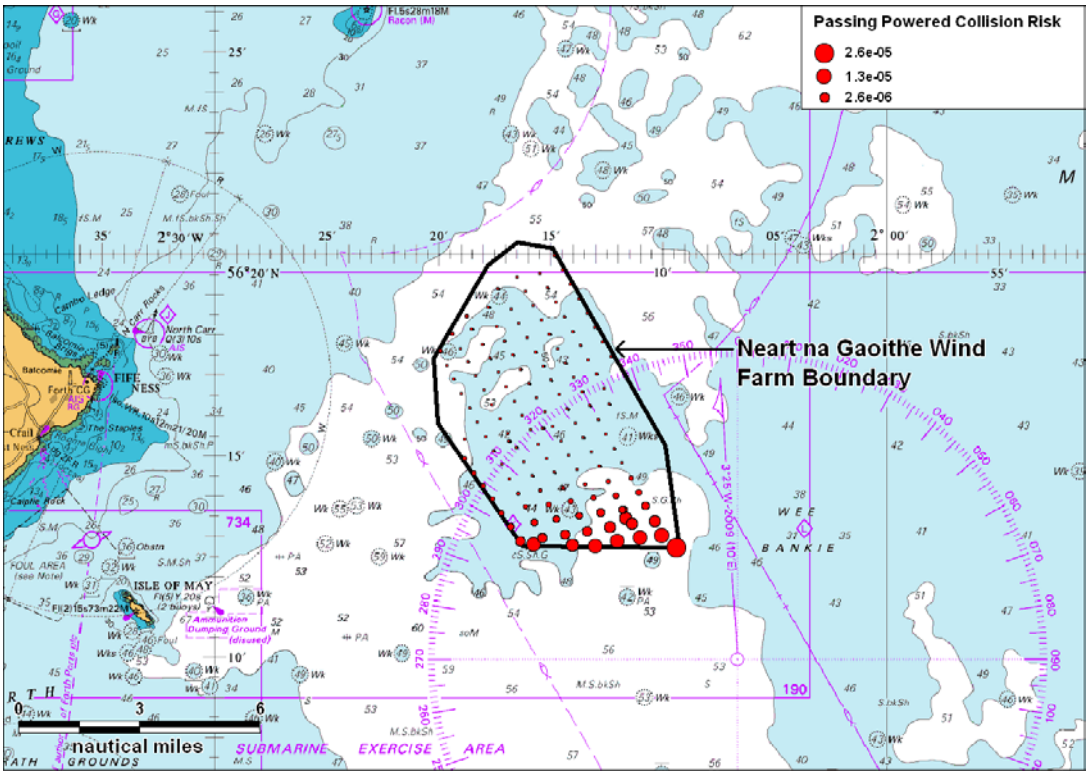


**Figure 13.5 Annual passing powered collision frequency for indicative Layout A**

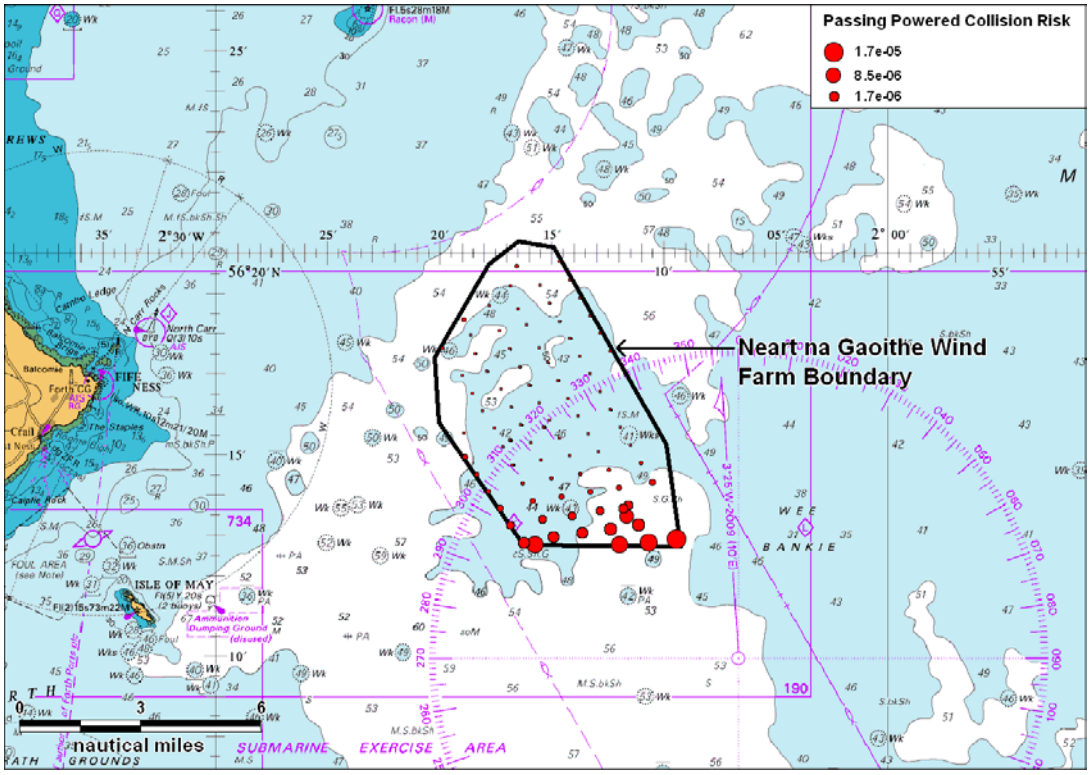


**Figure 13.6 Annual passing powered collision frequency for indicative Layout B**

## Drifting Ship Collision

The risk of a ship losing power and drifting into a Neart na Gaoithe structure was assessed using Anatec's COLLRISK model. This model is based on the premise that propulsion on a vessel must fail before a vessel will drift. The model takes account of the type and size of the vessel, number of engines and average time to repair in different conditions.

The exposure times for a drifting scenario are based on the ship-hours spent in proximity to the proposed Neart na Gaoithe wind farm (up to 10NM from perimeter). These have been estimated based on the traffic levels, speeds and revised routeing pattern. The exposure is divided by vessel type and size to ensure these factors, which based on analysis of historical accident data have been shown to influence accident rates, are taken into account within the modelling.

Using this information the overall rate of breakdown within the area surrounding the wind farm was estimated. The probability of a ship drifting towards a structure and the drift speed are dependent on the prevailing wind, wave and tide conditions at the time of the accident.

The following drift scenarios were modelled:

- Wind
- Peak Spring Flood Tide
- Peak Spring Ebb Tide

The probability of vessel recovery from drift is estimated based on the speed of drift and hence the time available before reaching the wind farm structure. Vessels that do not recover within this time are assumed to collide.

After modelling the three scenarios it was established that wind-dominated drift produced the worst case results for the Neart na Gaoithe wind farm, therefore, this result is presented in Table 13.2.

**Table 13.2 Drifting ship-to-structure collisions – Base Case with wind farm**

| Turbine Layout | Annual Collision Frequency | Collision Return Period |
|---|---|---|
| Layout A | 2.9E-05 | 34,000 years |
| Layout B | 2.1E-05 | 48,300 years |

The worst case drifting collision risk has been identified as 1 every 34,000 years. Drifting collisions are assessed to be less frequent than powered collisions, which is reflective of historical data.

There have been no reported 'passing' drifting ('Not under Command') ship collisions with offshore installations on the UKCS in over 6,000 operational-years. Whilst a large number of drifting ships have occurred each year in UK waters, most vessels have been recovered in time, e.g., anchored, restarted engines or taken in tow. There have also been a small number of 'near-misses'.

The majority of the drifting vessel collision frequency is associated with the more southerly structures, (e.g., the turbines on the southern edge of the wind farm boundary) since the predominant wind direction is south westerly and the higher density of shipping headed in/out of the Firth of Forth.

### 13.3.3 Fishing Vessel Collision

Anatec's COLLRISK fishing vessel risk model has been calibrated using fishing vessel activity data along with offshore installation operating experience in the UK (oil and gas) and the experience of collisions between fishing vessels and UKCS offshore installations (published by Health and Safety Executive [HSE]).

The two main inputs to the model are the fishing vessel density for the area and the structure details. The fishing activity in the area of the site was observed during the AIS and radar surveys during August to October 2010. Based on the survey data, the average density of fishing vessels operating in the survey region at any one time was estimated to be just over 5 vessels per $100NM^2$.

Using the above site-specific data as input to the model, the annual fishing vessel collision frequency with wind farm structures was estimated for each of the two turbine layouts.

**Table 13.3 Fishing vessel collisions – Base Case with wind farm**

| Turbine Layout | Annual Collision Frequency | Collision Return Period |
|---|---|---|
| Layout A | 1.7E-02 | 57 years |
| Layout B | 1.5E-02 | 67 years |

The worst case fishing vessel collision risk has been identified as 1 every 57 years. The estimated collision frequencies are high and reflect the maximum target area assumed for all the structures based on jacket foundations. It also assumes the fishing vessel density following development will remain the same as current levels.

### 13.3.4 Recreational Vessel Collision

There are two main collision hazards from recreational vessels interacting with wind farms:

1. Turbine Rotor Blade to Yacht Mast Collision
2. Vessel Collision with Main Structures

**Blade/Mast Collision**

A collision between a turbine blade and the mast of a yacht could result in structural failure of the yacht.

For a blade/mast collision to occur, the air draught of the yacht (from water-line to top of masthead) must be greater than the available clearance under the area swept by the rotating blade.

The planned minimum rotor blade clearance for the turbines is at least 22m above Mean High Water Springs (MHWS), which matches the MCA minimum. This is the clearance when the blade is in its lowest (‘6 o’clock’) position. The actual clearance at a given time will depend upon the prevailing tide and wave conditions, i.e., lower clearance at High Water (HW) and rough seas, greater clearance at low water and calm seas.

To determine the extent to which yacht masts could interact with the rotor blades, details on the air draughts of the IRC fleet are provided in Figure 13.7 based on a fleet size of over 3,000 vessels. IRC is a rating (or ‘handicapping’ system) used Worldwide which allows boats of different sizes and designs to race on equal terms. The UK IRC fleet, although numerically only a small proportion of the total number of sailing yachts in the UK, is considered representative of the range of modern sailing boats in general use in UK waters.

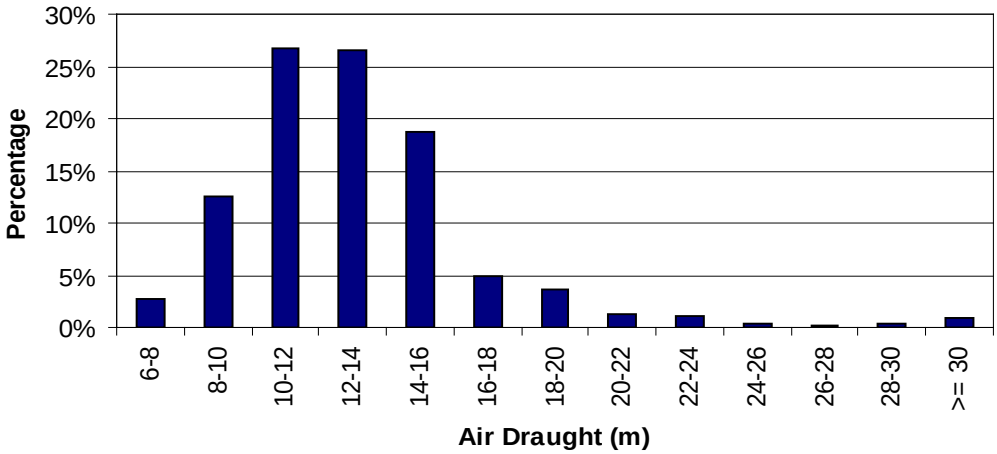


**Figure 13.7 Air draught data – IRC Fleet (2002)**

From this data, just under 3% of boats have air draughts exceeding 22m. Therefore, only a fraction of vessels could potentially be at risk of dismasting if they were directly under a rotating blade in the worst-case conditions.

It is further noted that the wind farm will be designed and constructed to satisfy the requirement of the Maritime & Coastguard Agency in respect of control functions and safety features, as specified in the MCA standards (Ref. ii).

The most likely reason for the Emergency Management System being ineffective is considered to be the mariner failing to alert the Coastguard either directly or indirectly using VHF, mobile phone, flares, etc. It is noted that very large yachts, which are the only boats that could potentially interact with the rotor blades, are also most likely to be equipped with VHF radio and other safety equipment.

Based on the information presented in this section, the risk of dismasting of a yacht by a rotating blade of a Neart na Gaoithe wind turbine is assessed to be minimal, and has not been further quantified.

**Vessel/Structure Collision**

In good conditions the wind farm should be visible, especially as most activity occurs during daylight hours. In this case, vessels, if competently skippered, will be able to navigate safely to avoid the structures. Even if a vessel were to get into difficulty, most should be able to keep clear of the structures or anchor or moor if necessary to avoid drifting closer to the wind farm whilst they fix the problem or call for assistance.

The main risk of collision is considered to be in bad weather, especially poor visibility, where a small craft could fail to see the wind farm and inadvertently end up closer than intended.

If there were poor visibility combined with adverse weather and/or strong tides, the vessel may not be able to anchor.

The risk of small craft being in the area during bad weather is reduced by the fact that most craft are fitted with radio receivers and VHF so will be able to listen to regular broadcasts of the weather forecast by the BBC and Coastguard. It is also standard practice for local clubs to post weather forecasts on notice boards.

Given the ready availability of weather forecasts and growing use of GPS, the risk of a vessel being in proximity to the wind farm in bad weather is considered to be low but not negligible. In this scenario, a vessel unable to make way from the wind farm and at risk of collision may alert the nearby Forth Ports VTS and the Coastguard using mobile phone, VHF or flares.

To minimise the risk of collision in this worst-case scenario, mitigation in line with regulator guidance will be put in place. It will be ensured, consistent with the requirements of NLB, that the structures are marked in such a way as to enhance the prospect of visual observation by passing recreational craft even in adverse conditions.

The Operator will also ensure notification of the development to the recreational craft community is widespread and effective throughout all phases.

These measures mean that whilst the collision risk cannot be completely eliminated it will be reduced to a level as low as reasonably practicable. In terms of consequences, most collisions with the turbines should be relatively low speed and hence low energy. If the seaworthiness of the recreational craft was threatened by the impact, the turbines will be equipped with access ladders for use in emergency, placed in the optimum position taking into account the prevailing wind, wave and tidal conditions, as required by the MCA. This should provide a place of safety/refuge until such time as the rescue services arrive.

### 13.3.5 Final Layout Assessment

The NRA and collision risk modelling has assessed two indicative layouts of the smallest and largest possible wind turbines. In the final layout the position of the turbines could move up-to 500m from the indicative positions.

The revised ship routeing pattern around the wind farm is based on the application site boundary and that vessels will pass approximately 1-1.5NM from the site. If the turbine positions move up-to 500m from the indicative layouts then they will remain inside the application site boundary and therefore are unlikely to have any additional impact on shipping and navigation.

In terms of ship-to-turbine collision risk, the majority of passing (powered) and drifting (not under command) vessel collision frequency is associated with the southerly structures, (e.g., the turbines on the southern edge of the wind farm boundary). This is due to the predominant wind direction been from the south west and the higher density of shipping headed in/out of the Firth of Forth.

If the turbines in the southern part of Neart na Gaoithe move to the south of the application site boundary, there could be a small increase in the ship-to-turbine collision frequency for

the outer most turbines (which could present a larger target area for ship collision). However, it is considered that the increase in collision frequency will small given the turbines will move no more than 500m south and there a number of turbines already located within 300m of the site boundary.

Furthermore, it was noted that the eastern boundary of the wind farm does will not have turbines up-to the lease area due to the 5NM separation distance required between Neart na Gaoithe and the Firth of Forth Round 3 Zone 2.

## *13.4 Cable Interaction – Anchor and Trawl*

All the subsea cables will be buried or trenched where sea bed conditions allow, providing protection from all forms of hostile seabed interaction, such as fishing activity, dragging of anchors and dropped objects. There will be periodic inspections and surveys to ensure they do not become exposed. They will also be marked on Admiralty Charts, although whether all submarine cables are charted depends upon the scale of the chart; in some cases only the export cable may be shown.

### 13.4.1 Commercial Shipping

The proposed export cable route to shore runs from the southern boundary of the Neart na Gaoithe wind farm to landfall at the Thorntonloch. The route is crossed by a busy shipping lane associated with the Firth of Forth. Due to the draughts of these ships and water depth, vessels tend to keep at least 2-2.5NM north of the East Lothian coast, well clear of shallower areas where there may be the possibility of a grounding impact.

Anchoring activity was recorded during the shipping surveys within 10NM of the proposed export cable route, with vessels anchoring east of the Forth Ports authority limit (approximately 4NM west of the cable corridor). In terms of the impact to vessel anchoring, displacement and risk of dragging anchor, it is expected that following installation of the export cable and marking on admiralty charts, vessel anchoring activity is likely to migrate east and/or west of the cable. Therefore there will be a shift in anchoring activity, and the overall risk of dragging anchors onto the cable is considered to be low. It is also noted that there are a number of alternative anchorages marked on admiralty charts.

The proposed export cable route passes in close proximity to areas where smaller vessels can anchor during adverse weather (i.e. South westerly onshore winds). It is expected that following installation of the cable and marking on admiralty charts, vessel anchoring activity is likely to migrate east (i.e. Pease Bay off Cove Harbour) and/or west (i.e. Dunbar Roads anchorage off Dunbar) of the export cable. Therefore, the overall risk of dragging anchor onto the cable is considered to be small.

### 13.4.2 Fishing

The impact of the export cable works on fishing ground will be assessed as part of the Commercial Fisheries Assessment.

In terms of vessels safety the main risk is related to gear snagging on unprotected cables or those running over spans. The predominant fishing activity in the vicinity of the wind farm and cable corridor is demersal trawling and scallop dredging; with the highest density of fishing activity recorded to the south west of Neart na Gaoithe. The level of fishing vessel activity along the export cable route is generally higher towards the coast. There is risk to fishing vessels should they snag their gear on unprotected or cables running over spans. However with cable protection/burial and liaison with the fishing industry, it is considered to be a low risk.

### 13.4.3 Recreation Vessels

In terms of recreational vessels there could be an impact from electromagnetic interference on ship-borne equipment including compasses when in close proximity to ferrous structures or high voltage cables. However, the export cables will be buried (where possible) and any generated electromagnetic fields will be very weak and the impact on navigation or electronic equipment is considered to be not significant.

### 13.4.4 Summary

It is therefore assumed the cable will be suitably protected for the sea bed conditions (assessed separately) and principally the fishing activity and anchoring in the area through burial and trenching, information promulgation and periodic inspection.

## *13.5 Future Case Level of Risk*

### 13.5.1 Shipping

The main factor that is likely to influence the future levels and composition of shipping in the vicinity of the proposed wind farm is the traffic using the Forth and Tay Ports and vessels headed to Aberdeen.

A description of the main features and developments at the Forth/Tay Ports and Aberdeen Harbour are provided in the following subsections.

**Forth and Tay Ports**

A number of ports and harbour facilities are located within the Firth of Forth and Tay (described in Sections 6.3.4 and 6.3.6), the main activities and planned works which could lead to increased level of shipping through the area are summarised below:

- Forth Ports can serve forest products for a range of trade routes to and from the Baltic, North America and the Far East, including undercover storage transit sheds and distribution facilities. There are also specialist facilities for newsprint and paper at Dundee and Grangemouth and in-port timber treatment plants at Dundee and Rosyth.

- Grangemouth is Scotland's largest container port specialising in short-sea feeder operations linking Scotland to UK and European deep sea ports. The container terminal was modernised in 2006 with new cranes and secondary handling equipment. The Grangemouth Container Terminal offers trade routes to Netherlands, Belgium, St

Petersburg and UK ports and facilities for all container types and size. The container terminal rail linked to main East and West Coast lines which are free of any gauge constraints, with regular train connections to Glasgow, Aberdeen and North of England.

- The Forth Ports have considerable Roll-on Roll-off (Ro-Ro) expertise with facilities at Dundee, Leith and Grangemouth. The main specialist facility is at Rosyth where there is a regular Ro-Ro service to Zeebrugge which is served by a ferry terminal and offers passenger and freight facilities for freight vehicles, cars, wheeled cargoes in any format and unit loads of all kinds. Ro-Ro services are three times per week to Zeebrugge, with 24/7 access irrespective of weather or tidal conditions. In addition Rosyth acts as a port of refuge when other ferry ports are closed (e.g. Northlink Aberdeen/Northern Isle ferries).

- The ports of Leith, Grangemouth, Rosyth and Dundee have the capability to handle a wide range of mineral dry bulks and agri-bulks. All the ports are equipped with grabbing cranes and load-out elevators, and there is a specialised ship discharger dedicated to cement discharge located at Leith. At Dundee there are also facilities for agri-bulks.

- Liquid bulks are imported at Dundee, imported and exported at Grangemouth, and exported from two Marine Terminals on the Forth. The main liquid bulks handled are crude oil, petroleum and oil derivatives, chemicals, vegetable and animal feeds and molasses.

- The Scottish Ports Division offers dedicated cruise facilities at Leith, Dundee and Rosyth that serve turn around and transit cruises for round UK, Scandinavian and Baltic cruises. Vessels up to 220m (length overall) can be accommodated.

- The Forth Ports can act as centres where goods are transferred between transport modes but can also be stored, processed and distributed. All Ports have transit sheds and Rosyth and Grangemouth offer specialist storage facilities. Other services including rail linked warehouses.

- The ports of Leith, Dundee and Rosyth provide offshore support facilities, including marine bases, offshore equipment, inspection, repair and maintenance facilities.

- Consultation with Forth Ports (Section 5.4.2) identified that there are proposals for 3-4 biomass plants within the Firth of Forth and Tay region, which if constructed could bring in an increased number of large bulk carriers. It is not known at the time of writing (November 2011) where vessels will be routeing from so further consideration of this is not possible, however plants are been proposed at Leith, Rosyth, Grangemouth and Dundee.

- The Port of Kirkcaldy re-opened for the import of wheat directly to a quayside tenant during March 2011. Additional construction work will include new silos and conveyors to allow the fast delivery of wheat from coastal ships. The port is located on the north side of the Firth of Forth for bulk and timber cargos.

- Rosyth is a commercial port handling general cargo and cruise liners. Additionally there is a Ro-Ro passenger and freight service to Zeebrugge. A new international container terminal is proposed on land that was reclaimed, but never used for the refitting of Trident submarines at Rosyth.

- The port of Leith continues to be re-developed with plans to carry out technical and feasibility studies for the port. The port infrastructure is been evaluated with a view to enabling larger cruise liners to use the port as the entrance lock is not wide enough for bigger vessels.

- Forth and Tay Ports may have facilities to establish support/supply bases within the area for nearby offshore renewable developments.

**Aberdeen Harbour**

Aberdeen is one of the busiest Trust Ports in the UK. An economic impact assessment of Aberdeen (Ref. xviii), identified its principal activities as follows:

- Marine support for the offshore oil and gas industry in North-west Europe: Aberdeen is well placed to take advantage of the North Sea sector due to its strategic location and comprehensive infrastructure.

- The principal commercial port for north east Scotland: The Harbour handles a range and scale of general cargo to and from other ports in Europe and has positioned it as the principal commercial port for North-east Scotland, the major mainland port serving the Northern Isles of Orkney and Shetland and as a centre of international trade. Aberdeen Harbour is the nearest port on the UK mainland to Norway, Sweden, Finland, Russia and the Faroe Islands and is the closest Scottish port to the German and Baltic ports. The Harbour is also an international port, with direct, regular connections to around 30 countries including countries in West Africa and the Far East.

- Ferry and cruise services: Aberdeen Harbour has become a principal mainland terminal for ferry services to Norway and to the Northern Islands of Orkney and Shetland. It is also a port of call for cruise ships.

- A gateway for the agriculture industry: Aberdeen Harbour's proximity to rural hinterland makes it ideal for the import and export of agricultural products. In recent years a transit shed has been dedicated for grain export. The Harbour also handles seasonal imports of livestock including sheep and cattle from the Northern Isles.

- A major centre for the import of forest products and the export of finished paper products.

- Aberdeen Harbour commenced a three phase Torry Quay redevelopment plan in April 2010 (expected to take 18 months). Works are based on replacing upstream berths with 300 metres of realigned, deep water quays. The development will provide stronger quays

for heavy lifts and create more room in the River Dee for vessels to navigate. Future uses of the new facility could include a support base for oil and gas customers and the handling of equipment for offshore renewable energy installations.

- With modern, deep draughted ships and heavy cargoes entering the port more regularly, the new quays at Torry will be more suitable for longer and wider vessels. On completion, the overall project, which is part of Aberdeen Harbour Board's £65 million development strategy, will result in over 500 metres of new deep water berths and more than seven hectares of back up land on the south side of the River Dee.

**Future Traffic Increase**

It has been conservatively assumed that over the life of the Neart na Gaoithe wind farm development, there will be a 10% increase in shipping movements.

### 13.5.2 Fishing

The Commercial Fisheries Assessment (Ref. xix) considered the potential changes to the fishing baseline over the life of the development. It is recognised this is a speculative exercise due to numerous unpredictable, direct and indirect factors which can materially affect fisheries.

At present, no new fisheries are foreseen in the area surrounding Neart na Gaoithe Offshore wind farm and in all probability there is unlikely to be an increase in either fishing effort or vessel numbers. It is also possible that increasing conservation concerns will lead to the implementation of designated protected marine conservation areas which will conceivably have the effect of enforcing further restrictions upon certain commercial fishing activities.

The Hazard Review workshop identified fishing practices within the wind farm area could change during the projects operational life. An example is the appearance of large shoals of squid inshore of the Outer Firth of Forth, providing a valuable fishery which previously did not exist.

Based on the discussion presented, the future level of activity has been assumed to increase by 10% compared to current levels.

### 13.5.3 Recreational

In terms of recreational vessel activity, there are no major developments known of that will increase the activity of these vessels in the area.

It was suggested at the Hazard Review workshop that the turbines could attract sightseers, given their proximity to the shore, however these vessels would like be local craft for nearby harbours with a degree of local sailing experience. It was also noted during the workshop that diving is popular in the outer Firth of Forth and Tay regions and the turbines themselves could be dived.

Based on the discussion presented, the future level of activity has been assumed to increase by 10% compared to the current levels.

### 13.5.4 Collision Probabilities

The potential increase in vessel activity levels would increase the probability of ship-to-structure collisions (both powered and drifting). Whilst in reality the risk would vary by vessel type, size and route, it is roughly estimated this would lead to a linear 10% increase in the base case collision risks.

The increased activity would also increase the probability of vessel-to-vessel encounters and hence collisions. Whilst this is not a direct result of the proposed wind farm, the increased congestion caused by the site and potential displacement of traffic in the area may have an influence. Again a 10% overall increase is assumed.

## *13.6 Risk Results Summary*

The base case and future case annual levels of risk without and with the Neart na Gaoithe offshore wind farm are summarised in Table 13.4 and Table 13.5. The change in risk is also shown, i.e., the estimated collision risk with the wind farm minus the baseline collision risk without the wind farm (which is zero except for vessel-to-vessel collisions).

**Table 13.4 Summary of results – Layout A**

| Collision Scenario | Base Case | | | Future Case | | |
|---|---|---|---|---|---|---|
| | Without | With | Change | Without | With | Change |
| Passing Powered | -- | 1.2E-04 | 1.2E-04 | -- | 1.3E-04 | 1.3E-04 |
| Passing Drifting | -- | 2.9E-05 | 2.9E-05 | -- | 3.2E-05 | 3.2E-05 |
| Vessel-to-Vessel | 9.8E-04 | 1.0E-03 | 4.6E-05 | 1.1E-03 | 1.1E-03 | 5.1E-05 |
| Fishing | -- | 1.7E-02 | 1.7E-02 | -- | 1.9E-02 | 1.9E-02 |
| **Total** | 9.8E-04 | 1.9E-02 | 1.8E-02 | 1.1E-03 | 2.0E-02 | 1.9E-02 |

**Table 13.5 Summary of results – Layout B**

| Collision Scenario | Base Case | | | Future Case | | |
|---|---|---|---|---|---|---|
| | Without | With | Change | Without | With | Change |
| Passing Powered | -- | 8.6E-05 | 8.6E-04 | -- | 9.5E-05 | 9.5E-05 |
| Passing Drifting | -- | 2.1E-05 | 2.1E-05 | -- | 2.3E-05 | 2.3E-05 |
| Vessel-to-Vessel | 9.8E-04 | 1.0E-03 | 4.6E-05 | 1.1E-03 | 1.1E-03 | 5.1E-05 |
| Fishing | -- | 1.5E-02 | 1.5E-02 | -- | 1.6E-02 | 1.6E-02 |
| **Total** | 9.8E-04 | 1.6E-02 | 1.5E-02 | 1.1E-03 | 1.8E-02 | 1.7E-02 |

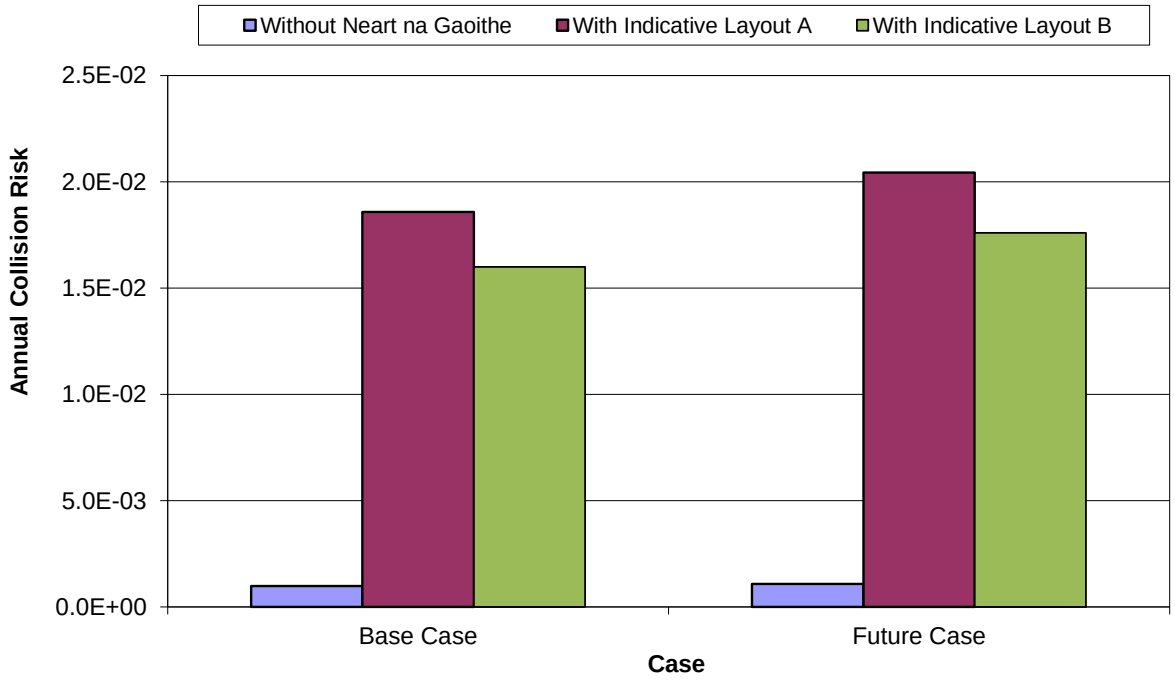


**Figure 13.8 Summary of annual collision risk results**

In the worst case (layout A) the overall annual level of collision risk is estimated to increase due to the proposed development by approximately 1 in 57 years (base case) and 1 in 52 years (future case). The vast majority of this risk is from fishing vessel collisions.

The increases are relatively low compared to the existing maritime risks in the area.

## *13.7 Consequences*

The probable outcomes for the majority of hazards are expected to be minor. However, the worst case outcomes could be severe, including events with potentially multiple fatalities.

A collision involving a larger ship is likely to result in collapse of a turbine with limited damage to the ship. Breach of a ship's fuel tank is considered unlikely and in the case of vessels carrying hazardous cargoes, e.g., tanker or gas carrier, the additional safety features associated with these vessels would further mitigate the risk of pollution (for example double hulls). Similarly, in a drifting collision the proposed wind farm structures are likely to absorb the majority of the impact energy, with some energy also being retained by the vessel in terms of rotational movement (glancing blow).

In terms of smaller vessels such as fishing and recreational craft, the worst case scenario would be risk of vessel damage leading to foundering of the vessel and potential loss of life.

A quantitative assessment of the potential consequences of collision due to the proposed Neart na Gaoithe wind farm project is presented in Appendix B. This applies the site-specific collision frequency results presented above with estimated outcomes in terms of fatalities on-

board and oil pollution from the vessel based on research into historical collision incidents (MAIB, International Tanker Owners Pollution Federation Limited [ITOPF], etc.). The results are summarised in Table 13.6. It is noted that these are based on a conservative approach to give account to the uncertainty surrounding the jacket sub-structure foundation type.

**Table 13.6 Annual predicted change in Potential Loss of life (PLL) due to Neart na Gaoithe**

| | **Layout A** | **Layout B** |
|---|---|---|
| Base Case PLL (fatalities per year) | 3.0E-04 | 2.6E-04 |
| Future Case PLL (fatalities per year) | 6.6E-04 | 5.7E-04 |

For the worst case turbine layout (layout 1) the overall increase in PLL estimated due to the development is $3.0 \times 10^{-4}$ fatalities per year (base case), which equates to one additional fatality in 3,321 years. This is a small change compared to the MAIB statistics which indicate an average of 29 fatalities per year in UK territorial waters.

In terms of individual risk to people, the incremental increase for commercial ships (in the region of $10^{-10}$) is very low compared to the background risk level for the UK sea transport industry of $2.9 \times 10^{-4}$ per year.

Similarly, for fishing vessels, whilst the change in individual risk attributed to the development is higher than for commercial vessels (in the region of $10^{-5}$), it is low compared to the background risk level for the UK sea fishing industry of $1.2 \times 10^{-3}$ per year.

Therefore, the incremental increase in risk to both people and the environment caused by the Neart na Gaoithe wind farm development is estimated to be low.

# 14. CONSTRUCTION AND DECOMMISIONING IMPACTS

## *14.1 Introduction*

This study has primarily focused on the operational and maintenance phase of the Neart na Gaoithe offshore wind farm, however, it is recognised that there will be additional potential impacts during the construction, cable laying and decommissioning phases of the project.

In general, whilst the same hazards apply as during operational and maintenance, there are additional hazards which are distinctly associated with these phases of the project and require different risk control measures.

## *14.2 Hazards during Construction/Decommissioning*

During the construction/decommissioning phase there will be an increased level of vessel activity within the Neart na Gaoithe wind farm and along the export cable route.

The presence of construction and cable laying vessels within the area is likely to pose an additional navigational risk, although such vessels can also provide on-site response and mitigation. Vessels passing through the area will be aware of installation and cable laying vessels within the offshore site through Notices to Mariners and fisheries liaison.

The main hazards associated with construction, cable laying/decommissioning which have been identified over and above those associated with all phases (i.e., where the same risk control measures and emergency response will apply during all phases) are listed below.

- Construction/cable laying vessel collision with another vessel on-site
- Construction/cable laying vessel collision with structure
- Construction/cable laying vessel collision with passing vessel en route to or from site
- Construction/cable laying vessel encounters (jack-ups or anchors on) underwater obstruction (e.g., cable, pipeline etc.).
- Construction vessel jacks-up or anchors onto unexploded ordnance
- Man overboard during personnel transfer operations
- Dropped object during major lifting operations

It is noted that to a large extent the hazards will depend on the vessels and procedures which are to be used for these operations. The cable laying works should be temporary in nature and assuming industry standard management and mitigation procedures it is predicted that cable laying works can be carried out safely. However, at this stage, the procedures used will not be known in detail until the structures, construction/cable installation methods and vessels/contractors have been selected.

It is therefore planned that hazard/risk assessment workshops be carried out as part of the project-planning process. The objective of the workshops will be to identify all of the different activities which will be taking place and identify any potential hazards as well as

appropriate mitigation measures and operating procedures relevant to the selected vessels and construction methods.

An example measure might be that, wherever possible, construction vessels would follow prescribed transit corridors. These corridors would be defined in consultation with local maritime stakeholders, such as Forth Ports.

The suggested compositions for the workshops are as follows:

- Project Team
- Contractor Representatives (e.g., barges, cable-laying)
- Harbour Representatives
- HM Coastguard (MCA)
- Fishing Representative
- Recreational Vessel Representative
- RNLI Representative

This process will build mutual understanding of the activities and operating constraints of the different parties involved and allow effective procedures to be developed. Separate workshops should be held for each phase of the project as well as for distinct activities.

It is noted that the construction company appointed will have their own internal health and safety procedures that they will adhere to during the work, providing additional security. Experience and lessons learned from the construction of other offshore wind farm projects will be considered prior to the Neart na Gaoithe wind farm being constructed. The same process will apply during the decommissioning phase of the project

## *14.3 Risk Control/Mitigation during Construction/Decommissioning*

Details of risk control/mitigation measures which will apply during these phases of the work are summarised in Section 20.

# 15. IMPACT ON MARINE RADAR SYSTEMS

## *15.1 Introduction*

In 2004 the MCA conducted trials at the North Hoyle wind farm off North Wales to determine any impact of wind turbines on marine communications and navigations systems (Ref. iv).

The trials indicated that there is minimal impact on VHF radio, Global Positioning Systems (GPS) receivers, cellular telephones and AIS. Ultra High Frequency (UHF) and other microwave systems suffered from the normal masking effect when turbines were in the line of the transmissions.

This trial identified areas of concern with regard to the potential impact on ship borne and shore based radar systems. This is due to the large vertical extent of the wind turbine generators returning radar responses strong enough to produce interfering side lobe, multiple and reflected echoes (ghosts). This has also been raised as a major concern by the maritime industry with further evidence of the problems being identified by the Port of London Authority around the Kentish Flats offshore wind farm in the Thames Estuary. Based on the results of the North Hoyle trial, the MCA produced a wind farm/shipping route template (see Section 2.2) to give guidance on the distances which should be established between shipping routes and offshore wind farms.

A second trial was conducted at Kentish Flats on behalf of British Wind Energy Association (BWEA) (Ref. v). The project steering group had members from BERR, the MCA and the Port of London Authority (PLA). The trial took place between 30 April and 27 June 2006. This trial was conducted in Pilotage waters and in an area covered by the PLA VTS. It therefore had the benefit of Pilot advice and experience but was also able to assess the impact of the generated effects on VTS radars.

The trial concluded that:

- The phenomena referred to above detected on marine radar displays in the vicinity of wind farms can be produced by other strong echoes close to the observing ship although not necessarily to the same extent.
- Reflections and distortions by ships structures and fittings created many of the effects and that the effects vary from ship to ship and radar to radar.
- VTS scanners static radars can be subject to similar phenomena as above if passing vessels provide a suitable reflecting surface but the effect did not seem to present a significant problem for the PLA VTS.
- Small vessels operating in or near the wind farm were detectable by radar on ships operating near the array but were less detectable when the ship was operating within the array.

## *15.2 Impact on Collision Risk*

The potential radar interference is mainly a problem during periods of bad visibility when mariners may not be able to visually confirm the presence of other vessels in the vicinity.

The onset range from the turbines of false returns is about 1.5NM, with progressive deterioration in the radar display as the range closes.

Figure 15.1 presents 29 days of survey data from *Ocean Discovery* relative to the worst case (largest number of turbines) Layout A with buffers of 500m, 1.5NM and 2NM.

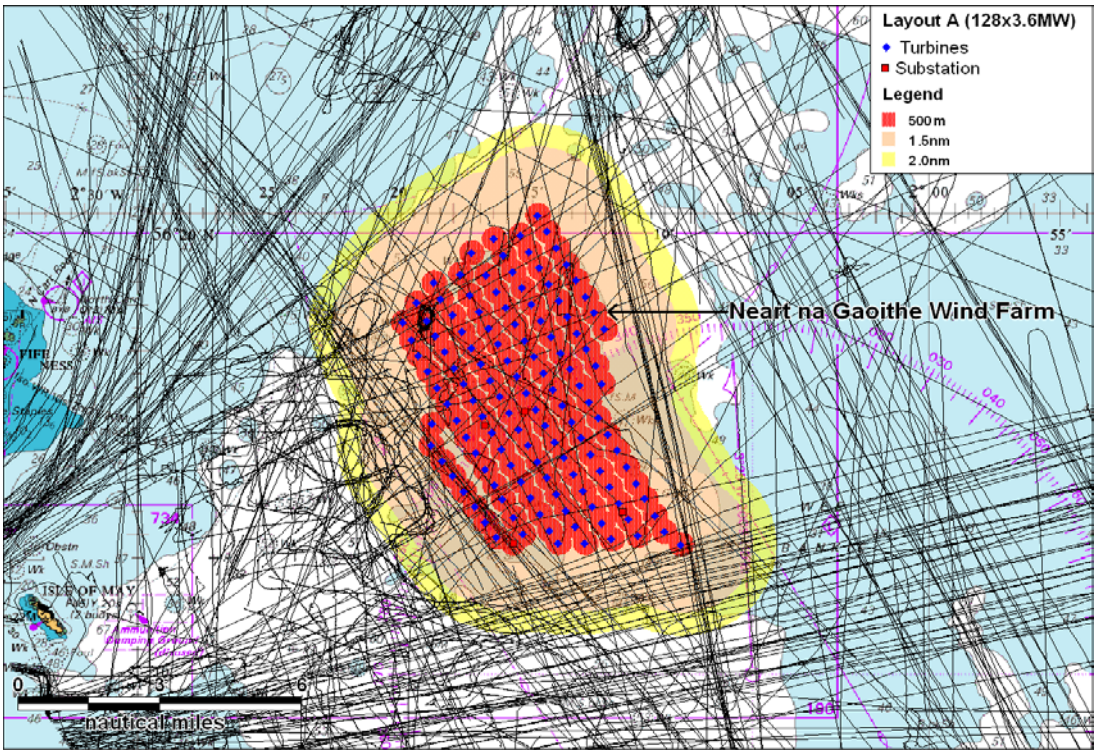


**Figure 15.1 Layout A buffer zones versus ship tracks (29 days tracks)**

Vessels headed into Firth of Tay, coastal tankers (east of Neart na Gaoithe) and a number of vessels headed into the Firth of Forth (south of the site) pass inside the 1.5NM range from the turbines in worst case Layout A.

On these routes a small level of radar interference could be experienced, however, based on the revised routeing around the wind farm (Section 9.1), the radar interference is predicted to decrease.

Experienced mariners should be able to suppress the observed problems to an extent and for short periods (a few sweeps) by careful adjustment of the receiver amplification (gain), sea clutter and range settings of the radar. However, there is a consequent risk of losing targets with a small radar cross section, which may include buoys or small craft, particularly yachts or Glass Reinforced Plastic (GRP) constructed craft, therefore due care is needed in making

such adjustments. The Kentish Flats study observed that the use of an easily identifiable reference target (a small buoy) can help the operator select the optimum radar settings.

The performance of a vessel's automatic radar plotting aid (ARPA) could also be affected when tracking targets in or near the wind farm. However, although greater vigilance is required, it appears that during the Kentish Flats trials, false targets were quickly identified as such by the mariners and then the equipment itself.

Although the evidence from mariners operating in the vicinity of existing wind farms is that they quickly learn to work with and around the effects, it is possible that the radar impacts may result in an increase in the risk of collision. The MCA have produced guidance to mariners operating in the vicinity of UK OREIs which highlights this issue amongst others to be taken into account when planning and undertaking voyages in the vicinity of OREIs off the UK coast (Ref. xx).

AIS information can be used to verify the targets of larger vessels, generally ships above 300 tonnes and, fishing vessels over 45m in length, (by 2014 all fishing vessels 15m in length or greater, will be required to install AIS).

Finally, vessel monitoring may be able to assist a vessel if in doubt as to whether a target is genuine during periods of reduced visibility.

# 16. CUMULATIVE AND IN-COMBINATION IMPACTS

## *16.1 Introduction*

Cumulative impacts associated with shipping and navigation in the vicinity of Neart na Gaoithe (shipping, fishing, recreation and associated facilities) are assessed as part of the main NRA.

This section presents details of other potential cumulative and in-combination impacts (see Section 1.3 for the methodology) associated with the development of Neart na Gaoithe project based on the following factors:

- Wind farm developments within the UK Renewable Energy Zone (REZ).
- Assessment of FTOWDG regional developments indicative (red line) boundaries for each project.

## *16.2 Renewable Developments within the UK Renewable Energy Zone (REZ)*

This review is required to assess the potential impacts associated with the cumulative impact on shipping and navigation throughout the UK REZ, an area defined by the Energy Act (2004).

Figure 16.1 presents a review of all Round 1 and 2 offshore wind farms, Round 3 Zones and Scottish Territorial Water sites currently leased within the UK REZ.

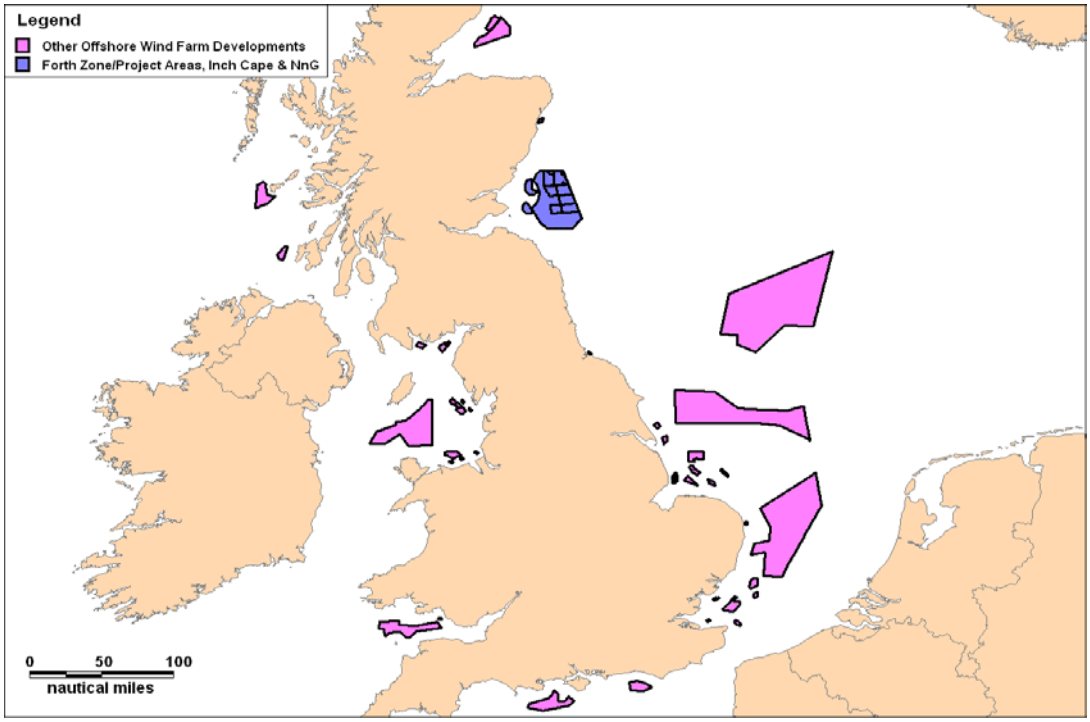


**Figure 16.1 Overview of wind farm sites in UK**

It can be observed that Neart na Gaoithe is not in close proximity to other developments outside the outer Firth of Forth and Tay area. The nearest wind farm development is the Aberdeen European Offshore Wind Farm Deployment Centre (EOWDC) located approximately 52NM to the north. In terms of the EOWDC no cumulative issues are expected along the north east coastline of Scotland.

Due to the nature of shipping and navigational activities, cumulative issues can by UK wide. Vessels bound to/from the Forth area could be cumulatively impacted by a number of offshore developments including other Round 3 development Zones including, Dogger, Hornsea and East Anglia.

At this stage the exact impact of these developments is uncertain as no specific information is available on individual Zone development plans, therefore this NRA and the FTOWDG regional study has addressed local cumulative impacts only.

## *16.3 Assessment of Indicative Project Boundaries*

Figure 16.2 shows the indicative red line boundaries that are currently being used as part of on-going assessments. This includes, where applicable for each projects timeline, assessments on cumulative impacts within hazard workshops and NRA's. These boundaries are current as of January 2012 and include full site capacity for Neart na Gaoithe and Inch Cape and a 3.5GW capacity layout for the Forth of Forth Zone 2.

The indicative project boundaries were used in the Hazard Review workshop carried out in November 2011 to gain feedback from marine stakeholders on the potential cumulative impacts of the regional developments. The results of the workshop are presented in Section 12.2.

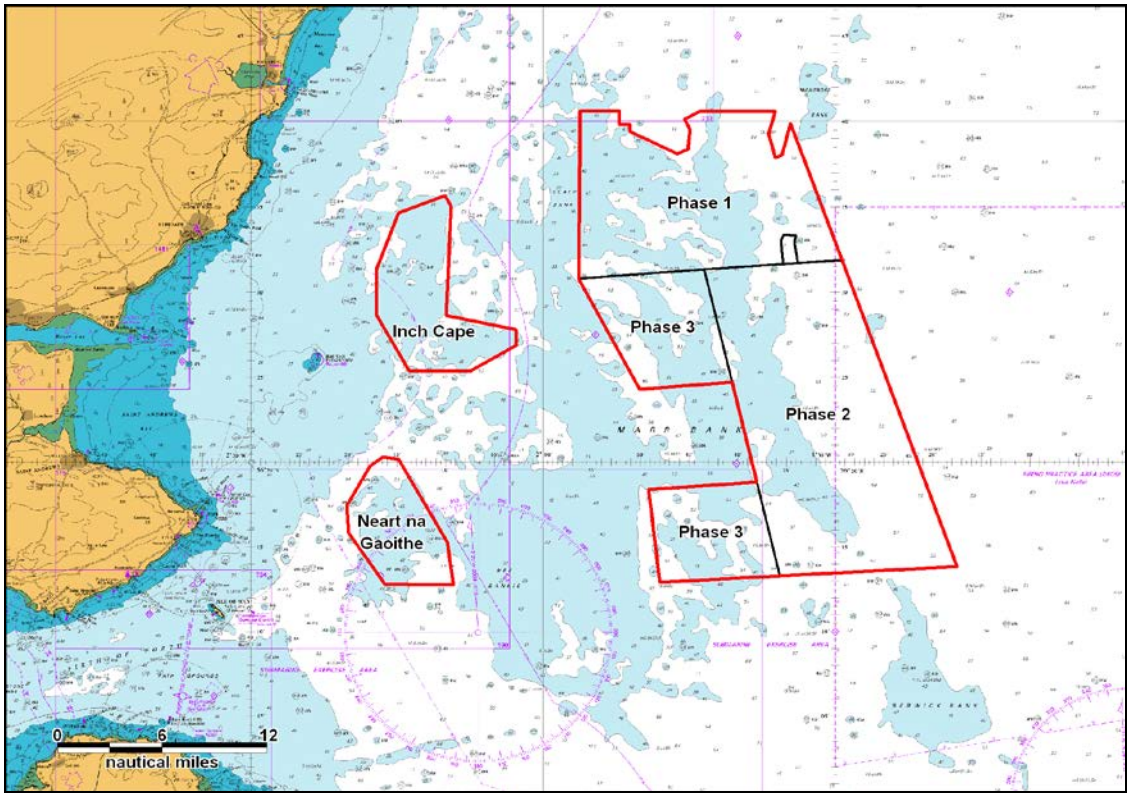


**Figure 16.2 Indicative red line boundary for project level cumulative assessments**

It should be noted that the identification of these boundaries at this stage, and there use within the assessments, does not exclude the potential for any site modifications or future developments within the Forth of Forth Zone 2.

It is expected that Neart na Gaoithe will be constructed first (commencing construction in 2014), with the construction of Inch Cape and Phase 1 sites are planned in 2015.

The following sections assess the potential cumulative and in-combination impact of the Neart na Gaoithe development with Inch Cape and Firth of Forth Zone 2 project areas on shipping and navigation. The assessment assumes industry standard mitigation measures (as per MGN 371 and IALA O-139); see Section 20, Table 20.1.

## *16.4 Cumulative impacts associated with Neart na Gaoithe*

As noted above (see Figure 16.2) the following sections assess the potential cumulative impacts associated with Neart na Gaoithe using the regional indicative red line boundaries.

In addition, there may also be higher risk areas during overlapping construction and decommissioning phases of different projects within the region, associated with partially constructed turbines and cables; however these activities are generally of short duration and limited extent.

### 16.4.1 Commercial Ship Routeing and Collision Risk

The marine traffic survey (Section 9) identified two routes will be required to deviate from Neart na Gaoithe site. Shipping headed to Dundee and the Firth of Tay will pass to the west of the Neart na Gaoithe and coastal traffic transiting between northern Scottish ports (Aberdeen, Peterhead and the Northern Isle) and the Humber will deviate to the east of the site. An average track estimated on each of the impacted routes prior to the construction of Neart na Gaoithe and the regional developments is presented in Figure 9.2.

Vessels deviating to the north east of Neart na Gaoithe could be cumulatively impacted by Inch Cape and the Phase 1 developments within the Firth of Forth Zone 2 due to vessels being 'squeezed' into narrower sea areas and denser routes. There is a channel of approximately 3 to 4NM between Inch Cape and the western edge of Phase 1. Feedback from the Hazard Review workshop indicated that smaller merchant vessels and coastal tankers are likely to be operating to tight time and fuel margins and need to take the shortest routes.

As described by The MCA's Wind Farm Shipping Route Template (Annex 3 of Ref. ii), the impact on vessels (collision risk, deviations from current tracks and impacts on marine radar) using a route deviated through this channel are likely to be tolerable (ALARP). Assuming ships will be able to pre-plan their revised passage in advance of encountering the regional wind farm developments, Masters should be able to navigate through this channel.

However an alternative coastal route could be taken west of Neart na Gaoithe and Inch Cape dependant on the sea state and weather conditions. It was noted during the regional FTOWDG marine stakeholder feedback that the prevailing wind is south westerly; and it is not perceived to pose any problems with vessels navigating in proximity to the wind farms. It was also stated by Marine Scotland Compliance Masters that with a north easterly to south easterly (onshore wind) the vessel officers are likely to make an assessment on if it considered safe to take the inshore route via Bell Rock, or to transit further east prior to turning and passing east of the wind farms.

When these effects were considered against the low number of vessels on the deviated coastal route transiting between northern Scottish ports and Humber (approximately one every three days), and assuming standard mitigation measures (Table 20.1), the impact on vessel routeing, collision risk and radar impacts was considered to be moderate. Overall, the cumulative effects on commercial shipping from Neart na Gaoithe are considered to moderate.

### 16.4.2 Recreation Vessels

The marine traffic survey (Section 8) and stakeholder consultation (Section 5) have all identified a low level of recreational activity compared to other UK sea areas.

Potential impacts are likely to relate to the navigation of recreational vessels in close proximity to structures and recreational vessels being displaced into commercial shipping routes (and vice versa) to 'squeeze'. As a result of both these impacts it is expected that the

main area of risk will be associated with recreational craft exiting the Neart na Gaoithe in proximity to commercial shipping routes.

Given the low level of recreational activity recorded within and in proximity to Neart na Gaoithe and the assumption that standard mitigation measures are in place (lighting, minimum blade clearance and marking on charts), vessels will be able to navigate between the wind farm turbines in a safe manner. Therefore cumulative effects on recreational activities are considered to minor.

### 16.4.3 Fishing Vessels (transits)

From the baseline assessment it is noted that the majority of commercial fishing traffic in the vicinity of Neart na Gaoithe is located to the south west. A small number of vessels were recorded on passage through Neart na Gaoithe (north/south) and could be cumulatively impacted in terms of routeing around Inch Cape and the Phase 1 sites of the Forth Development Zone 2 (increased transit distance and time).

As with recreational vessels, the main hazard identified relates to exiting the wind farms into shipping routes. However, it is noted that over time the risks associated with this hazard will reduce as AIS carriage on fishing vessels becomes mandatory for smaller vessels, (by 2014 all fishing vessels 15m in length or greater, will be required to install AIS).

Taking into account the low number of fishing vessels recorded transiting through Neart na Gaoithe and assuming standard mitigation measures are in place, the cumulative impact is considered to be of minor.

## *16.5 In-combination Impacts associated with Neart na Gaoithe*

The following sections assess the potential in-combination impacts associated with Neart na Gaoithe on other developments in the area.

### 16.5.1 Ports

There are a number of major ports located within the Firth of Forth and Tay area; therefore in-combinations effects on shipping are likely to be linked to associated traffic movements rather than port functions (pilots generally board within the inner Firth of Forth, off Leith and the Forth Ports limit is 8NM west of Neart na Gaoithe). Following a review of the future case traffic (Section 13.5) potential increases in traffic associated with new or improved port developments is likely to have a minor impact on Neart na Gaoithe.

During cable laying activities there will be an increase in vessel activity within the export cable corridor which will increase risk to vessels transiting in and out of the Firth of Forth ports by increasing vessel-to-vessel encounters and ‘squeeze’ especially in emergency situations.

When these effects are considered against the limited duration of the activities and industry standard mitigation measures (including promulgation of information), the risk was

considered to be low. Therefore in-combination impact on ports activities with Neart na Gaoithe and offshore cable route are considered to be minor**.**

Consultation with Forth Ports (Section 5.4.2) also identified that there are possible proposals for 3-4 biomass plants within the Firth of Forth and Tay region, which if constructed could bring in an increased number of large bulk carriers.

The Environmental Statements (ES) for the four proposed biomass plants (Leith, Rosyth, Grangemouth and Dundee) note that they expect up to 90% of fuel deliveries could arrive by ship. However, it is not known at the time of writing this NRA (January 2012) where vessels will be routeing to and from so further consideration of the potential in-combination impact with Neart na Gaoithe is not possible

### 16.5.2 Offshore Operations

Due to the distance of the nearest offshore installation (Norpipe platform is 97nm south east) there are not considered to be any in-combination impacts on offshore operations from Neart na Gaoithe. It is noted that the impact on transiting vessels has been considered within the main shipping and navigation NRA.

Jack-up drilling rigs can be towed through the area to Dundee when under-going maintenance. Given restrictions in manoeuvrability, rigs under tow are likely to keep well clear of the Neart na Gaoithe and any effects on additional routeing distance and collision risk are not expected to be significant.

# 17. Safety Zones

## *17.1 Guidance on Applications for Safety Zones*

Guidance for safety zone applications can be found in the DECC guidance notes (authored whilst under the name of BERR [Department for Business, Enterprise and Regulatory Reform]) (Ref. xxi). The safety zone scheme, as set out in the Energy Act (2004) applies to territorial waters in or adjacent to England, Scotland and Wales. A safety zone can be established either by the successful application by an applicant or, if no such application is made and the view of the Secretary of State for DECC, following consultation with the MCA Navigation Safety Branch, is that a safety zone is necessary, by the Secretary of State.

Where a consent for an OREI is required from the Secretary of State under Section 36 of the Electricity Act 1989 (for generating stations above 1MW in internal and territorial waters and above 50MW in the UK Renewable Energy Zone [REZ]) the Secretary of State must consider whether a safety zone will be needed at the same time that consideration is given to the consent for the OREI development. The safety zone application process is summarised below:

- The applicant makes an application to the Secretary of State and serves notice of application on the MCA and, as appropriate, the Scottish Government or National Assembly for Wales, providing information as necessary to support the case for the safety zone;
- In parallel the applicant publicises the fact that an application is being made to give an opportunity to anyone who wishes to comment on the application to make their views known to the Secretary of State; and
- The Secretary of State then takes a decision on the application, taking into account any comments they have received and all other material considerations.

## *17.2 Construction/Decommissioning & Major Maintenance Phases*

The NRA assessment was primarily focused on the operational phase of the project. However, it is identified that during the construction/decommissioning phases of the development there will be large construction vessels, working personnel and support craft in operation within and around the wind farm and export cable. Further, heavy lifting, piling and cable laying operations will be carried out which have inherent dangers.

In addition the cost of operating construction vessels, and the cost of delay can be significant. A means of controlling 3rd party navigation during these periods of high activity is required. Without this it will not be possible to exclude vessels and carry out their offshore operations in a controlled manner.

Therefore, to ensure the personnel carrying out these activities and those navigating in this sea area are not exposed to unnecessary risk, 500m safety zones may be applied for around each turbine or their foundations whilst work is being performed, as indicated by the presence of construction vessels.

A safety zone will provide a means of regulating the rights of navigation so as to preserve the safety of those working in the wind farm and those on-board other vessels that may be navigating in this area. These safety zones will apply to all vessel types not involved in the wind farm operations.

During the construction and decommissioning phases, operational procedures will be implemented for radar and AIS monitoring of vessel activities within the working area, to detect safety zone infringements. Procedures will also be established to ensure that any infringements are formally reported in line with the regulatory requirements.

Occasionally larger support vessels may be required for planned and unplanned maintenance activities. It is likely that several pre-determined areas would be identified and marked as temporary anchorage areas. In these cases semi-permanent structure markings would also comply with the NLB requirements and IALA O-0138 and 500m safety zones would apply. Safety zones will be based on the length of time and type of maintenance activities at the wind farm.

## *17.3 Operational Phase*

During normal operations the working activities will be limited to general and emergency maintenance work and as such the benefits and requirements for safety zones will require to be assessed giving account to the working vessels likely to be present within and around the wind farm.

An application in line with DECC guidance may be made for safety zones around the offshore substations during the normal operational phase of the project. However, experience during the construction phase may present evidence that such zones may not be required.

In terms of third-party vessels, it is considered highly unlikely that merchant ships would elect to pass between turbines due to the limited sea room and the fact that the closest routes tend to naturally avoid the location. Therefore, it is expected that fishing and recreational vessels are the main vessel types navigating within the site.

It will be up to individual Masters, taking into account the prevailing weather and sea conditions, to decide whether it is safe to navigate, or fish, within the turbine array.

## *17.4 Summary*

The safety zones planned for the project are as follows:

- Construction/Decommissioning:
    - 500m rolling safety zone to prevent vessels not associated with the development work from interfering with the active construction site.

The existence of safety zone will be published electronically and via Notices to Mariners.

# 18. Search and Rescue (SAR)

## *18.1 Introduction*

This section summarises the existing Search & Rescue resources in the region and the issues being considered in relation to the design of the wind farm.

(A detailed review of the historical incidents in the area, including RNLI launches, has been presented in Section 7.)

## *18.2 SAR Resources*

### 18.2.1 SAR Helicopters

A review of the assets in the area of the wind farm site indicated that the closest SAR helicopter base is located at Boulmer, operated by the RAF, approximately 52NM to the northwest of Neart na Gaoithe. This base has Sea King helicopters with a maximum endurance of 6 hours giving a radius of action of approximately 250NM which is well within the range of the wind farm. One helicopter is available at 15 minutes readiness between 0800 and 2200 hours, with another available at 60 minutes readiness between 0800 hours and evening civil twilight (ECT). Between 2200 and 0800 hours, one helicopter is held at 45 minutes readiness.

All RAF SAR helicopters are equipped for full day/night all weather operations over land and sea (some limitations exist with regard to freezing conditions, but in general terms the helicopters are all weather capable) and have a full night vision goggle (NVG) capability. Crews are well practised in NVG operations which is a major enhancement to search capability. In addition, all RAF SAR helicopter rear crew are medically trained, with the winchman trained up to paramedic standard.

Up to 18 persons can be carried, however this is dependent on weather conditions and the distance of the incident from the helicopter's operating base. All RAF SAR helicopters are equipped with VHF (Marine and Air Band), UHF and High Frequency (HF) radios. They are also capable of homing to all international distress frequencies.

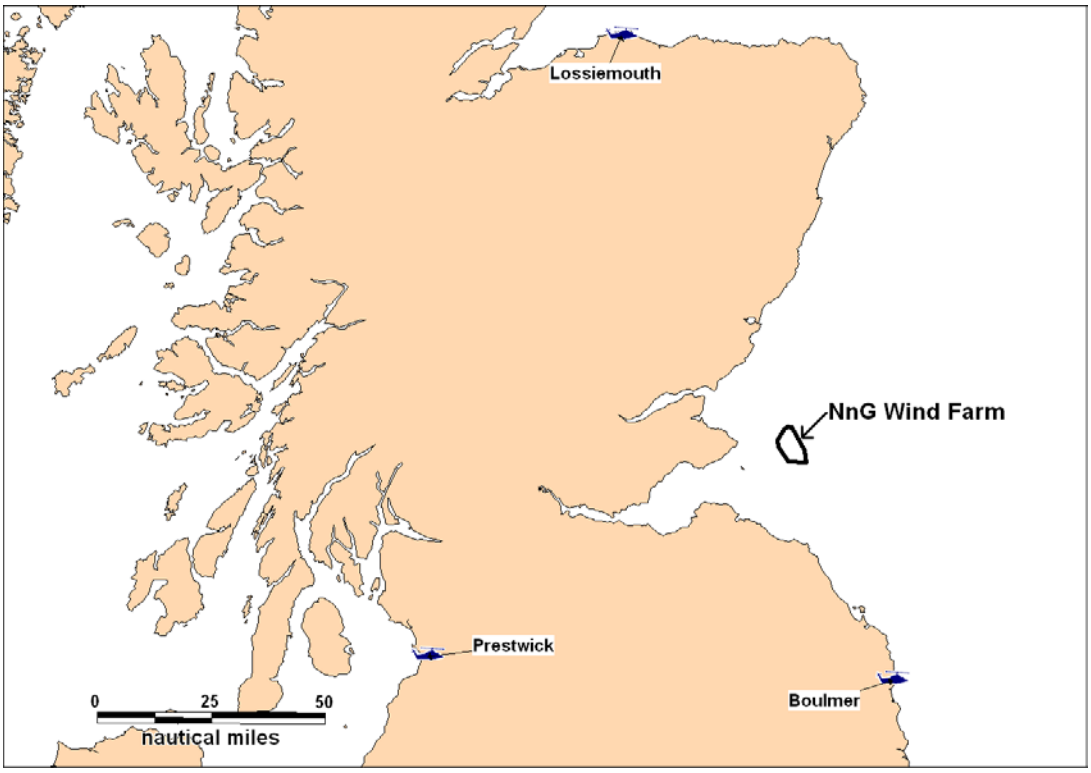


**Figure 18.1 SAR Helicopter Bases relative to Neart na Gaoithe**

Based on the above information, the day-time response to the wind farm will be in the order of 30 minutes. At night time this will increase by 30 minutes to approximately 1 hour due to the additional response time at the base. It is noted that these calculation are based on still air and will vary depending on the prevailing conditions.

### 18.2.2 RNLI Lifeboats

The Royal National Lifeboat Institution maintains a fleet of over 400 lifeboats of various types at 235 stations round the coast of the UK and Ireland. The RNLI stations in the vicinity of the proposed Neart na Gaoithe wind farm are presented in Figure 18.2.

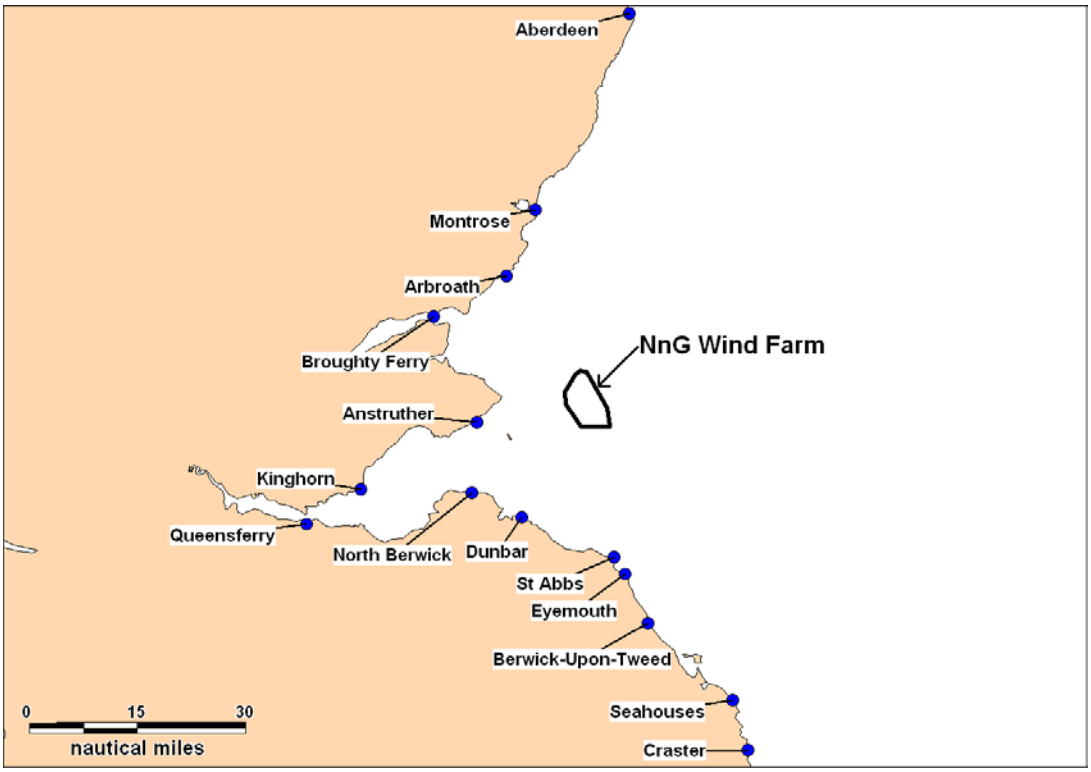


**Figure 18.2 RNLI Bases near the Neart na Gaoithe wind farm**

At each of these stations crew and lifeboats are available on a 24-hour basis throughout the year. Table 18.1 provides a summary of the facilities at the stations closest to the Neart na Gaoithe site.

**Table 18.1 Lifeboats held at nearby RNLI Stations**

| Station | Lifeboats | ALB Spec | ILB Spec | Distance to Site Boundary |
|---|---|---|---|---|
| Anstruther | ALB & ILB | Mersey | D Class | 12NM |
| Dunbar | ALB & ILB | Trent | D Class | 15NM |
| Arbroath | ALB & ILB | Mersey | D Class | 16NM |
| North Berwick | ILB | - | D Class | 17NM |
| St Abbs | ILB | - | B Class | 18NM |

| Station | Lifeboats | ALB Spec | ILB Spec | Distance to Site Boundary |
|---|---|---|---|---|
| Eyemouth | ALB | Trent | - | 20NM |
| Broughty Ferry | ALB & ILB | Trent | D Class | 21NM |
| Montrose | ALB & ILB | Tyne | D Class | 23NM |

Based on the offshore position of the development it is likely that ALBs would respond to an incident at the wind farm from Anstruther, Dunbar or Arbroath. This is confirmed when reviewing the historical incident data (see Section 7.3).

The Mersey class lifeboat has a speed of 17 knots and a 140NM range all-weather lifeboats are fitted with the latest in navigation, location and communication equipment, including electronic chart plotter, VHF radio with direction finder, radar and global positioning systems (GPS).

The D class lifeboat is small and highly manoeuvrable, making it ideal for rescues close to shore in fair to moderate conditions. It has a speed of 25 knots, range of 3 hours at maximum speed and is equipped with VHF radio and GPS. The B class (Atlantic) lifeboat is similar to the D class but has a speed of 35 Knots and a range of 3 hours at maximum speed with equipment similar to the D class boat.

The Tyne class lifeboat includes a low-profile wheelhouse and a separate cabin behind the upper steering position. It has a speed of 17 knots and a range of 240 nautical miles.

Response times vary but an average declared by RNLI is 14 minutes for all-weather lifeboats and 7 minutes for inshore lifeboats. This is the time from callout, i.e., first communication from the Coastguard to the lifeboat station to launch.

The time for an all-weather lifeboat to reach the Neart na Gaoithe wind farm (taking into account a 14 minute call out time) from the nearest station at Anstruther would be approximately 1 hour (from initial call out).

### 18.2.3 Changes to Coastguard Stations

MCA published a consultation document in December 2010 (Ref. xxii) in order to modernise HM Coastguard. The main part of the document proposes the reduction in the number of Maritime Rescue Co-ordination (MRCC) stations around the UK coastline.

Revised plans were released by the UK Government mid-way through 2011 (Ref. xxiii) with a second consultation period from 14th July 2011 to 6th October 2011. Under the revised proposals the MCA intends to:

- Establish a single 24 hour Maritime Operations Centre (MOC) based in the Southampton/Portsmouth area with 96 operational coastguards. The MOC will act as a national strategic centre to manage Coastguard operations across the entire UK network as well as co-ordinating incidents on a day to day basis. The MOC will also generate a maritime picture using information from a variety of sources;

- Dover will be configured to act as a stand-by MOC for contingency purposes. Dover would have 28 staff and would retain its responsibilities for the Channel Navigation Information Service (CNIS);

- In addition to the MOC and Dover, there will be eight further put in centres, Maritime Rescue Sub-Centres (MRCS), all of which would be connected to the national network and the MOC. All would be open 24 hours a day with a total staffing of 23 in each. These would be based at the following stations:

    - MRSC Aberdeen
    - MRSC Shetland
    - MRSC Stornoway
    - MRSC Belfast
    - MRSC Holyhead
    - MRSC Milford Haven
    - MRSC Falmouth
    - MRSC Humber

*The station at London will be retained unchanged.

### 18.2.4 Effect of Changes to Coastguard Stations on the Neart na Gaoithe

The proposed wind farm development currently lies in the former Scotland and Northern Ireland region with the nearest Maritime Rescue Sub-Centres being (MRCS) Aberdeen. MRCS Aberdeen's area of responsibility provides search and rescue coverage from Cape Wrath (most northerly tip of mainland UK) to the East coast of Scotland at Doonie Point (just south of Aberdeen).

The proposed changes to the UK MRCS structure will result in the Aberdeen MRCS covering a much wider area of northern UK; and it will respond to any incidents within the outer Firth of Forth and Tay including the Neart na Gaoithe.

### 18.2.5 Salvage

At the time of writing (October 2011) two Emergency Towing Vessels (ETVs) carry out MCA[1] duties in the north of Scotland providing emergency towing cover for the Western

[1] It is noted that as part of the UK Government's spending review in 2010 it was announced that ETV fleet would no longer be funded by the MCA after September 2011. An additional three months of funding was provided by the UK Government covering the two Scottish ETVs in September 2011. It is noted that over the next three months (from late September 2011) options will be explored to ensure longer term funding for the vessels.

Isle/north west Scotland and Shetland. The UK Government has provided an additional three month extended contract for the tugs and during this time longer-term arrangements will be made to fund the ETVs.

In addition each Marine Rescue Co-ordination Centre (MRCC) also holds comprehensive databases of harbour tugs available locally. Procedures are also in place with Brokers and Lloyd's Casualty Reporting Service to quickly obtain information on towing vessels that may be able to respond to an incident.

Emergency tug provision will generally be a contracted agreement between the vessel owners and tug operators. Coastguard Agreement on Salvage and Towage (CAST) will be invoked when owners are either unable or unwilling to engage in a commercial tow contract. MCA will pursue costs through arbitrators on a cost recovery basis.

Briggs Marine and Environmental Services operate four tugs and two anchor handlers that work out of Burntisland, Fife (approximately 34NM south west of Neart na Gaoithe).

In addition, there were offshore support vessels recorded during the maritime shipping surveys which may have towing capabilities. Most vessels were recorded passing through the area (bound for Aberdeen, Dundee and Leith), however it is noted that these vessels can tow jack-up drilling rigs into Dundee for maintenance work.

Lastly, tugs are available within Firth Ports harbour limits at the Breafoot Bay and Hound Point marine terminals. Details of these tugs are provided below:

- Tugs are on 24 hour stand-by (5-10 minute call out time with a 120 tonne bollard pull) at Hound Point and Braefoot Bay.
- Tugs in the Firth of Forth can steam at approximately 13 knots with the possibility of responding to a drifting or ship collision incident at Neart na Gaoithe offshore wind farm within approximately two hours of mobilisation.

### *18.3 Wind Farm SAR Matters*

The wind farm will meet the MCA's requirements in terms of standards and procedures for generator shutdown and other operational requirements in the event of a search and rescue, counter pollution or salvage incident in or around the site. These are laid out in Annex 5 of MGN 371 (Ref. ii).

This includes the development of an Emergency Response Co-operation Plan (ERCoP) for the wind farm, which will in place pre-construction. Examples of features to be incorporated are as follows :

**Design:**

- All wind turbine generators (WTGs) and other OREI individual structures will each be marked with clearly visible unique identification characters which can be seen by both vessels at sea level and aircraft (helicopters and fixed wing) from above.

- The identification characters shall each be illuminated by a low-intensity light visible from a vessel thus enabling the structure to be detected at a suitable distance to avoid a collision with it. The size of the identification characters in combination with the lighting will be such that, under normal conditions of visibility and all known tidal conditions, they are clearly readable by an observer, stationed 3m above sea level, and at a distance of at least 150m from the turbine.

**Operation:**

- The Marine Control Centre, or mutually agreed single contact point, will be manned 24 hours a day.

- All MRCCs (MOC and/or MRCS) will be advised of the contact telephone number of the Central Control Room, or single contact point (and vice versa)

- The control room operator, or single contact point, will immediately initiate the shut-down procedure for WTGs as requested by the MRCC (MOC and/or MRCS), and maintain the WTG in the appropriate shut-down position, as requested by the relevant rescue centre, until receiving notification from the MRCC (MOC and/or MRCS) that it is safe to restart the WTG.

# 19. ADDITIONAL NAVIGATION ISSUES

## *19.1 Introduction*

There are a number of additional navigational issues identified within MGN 371 (Ref. ii) which require to be addressed by the developer. The following subsections cover additional navigation related issues which have not been covered elsewhere within this report.

## *19.2 Visual Navigation and Collision Avoidance*

### 19.2.1 Introduction

MGN 371 identifies the potential for visual navigation to be impaired by the location of offshore wind farm structures, based on vessels not being visible to each other (hidden behind structures) and navigational aids and/or landmarks not being visible to shipping.

### 19.2.2 Visual Impact (Other Vessels)

Based on the position, orientation, number of turbines and spacing between turbines it is not considered there will be any significant issue or visual impact between vessels on the main commercial shipping routes in the area, which should pass to the east or west of Neart na Gaoithe. There is a busy shipping route just over 8NM to the south of the wind farm, but vessels using should also remain visible and generally will be vigilant, managing their vessel speed when approaching the Firth Ports Harbour limit.

There is limited small craft activity in the area (i.e. recreational vessels tend to follow the North Berwick/East Lothian and Fife Ness coastlines) which limits the likelihood of a small vessel emerging from the wind farm towards shipping traffic. Even if that were the case, the vessel should be visible for the vast majority of the time due to the small size of the turbines relative to the large spacing between them.

### 19.2.3 Visual Impact (Navigational Aids and/or Landmarks)

Depending on the approach direction of vessels (those headed to the Firth of Tay), the wind farm could hamper the view of existing navigational aids and landmarks, such as Bell Rock, Fife Ness and North Carr.

However, North Carr and Fife Ness have AIS installed which is not likely to be significantly impacted by the wind farm structures. It addition, vessels routeing to Dundee are likely to pass west of the wind farm reducing the visual impact on navigational aids in the area as Fife Ness and North Carr will be visible for a vessel routeing west of Neart na Gaoithe.

The wind farm site itself will form a significant aid to navigation, which will be very visible to shipping with lights on significant peripheral structures as well as selected intermediate structures in accordance with NLB requirements (see Section 4). It is therefore not considered that the Neart na Gaoithe site will degrade the ability of ships to navigate in the area through visual impairment of navigation aids or landmarks.

## 19.3 Potential Effects on Waves and Tidal Currents

Based on a specialist study, it was concluded that there will be no significant or measurable far field impact from the development on local tidal currents. Any impact on the waves will be very localised (in close proximity to the turbines).

## 19.4 Impacts of Structures on Wind Masking/Turbulence or Sheer

The offshore turbines have the potential to affect vessels under sail when passing through the site from effects such as wind shear, masking and turbulence. From previous studies of offshore wind farms it was concluded that turbines do reduce wind velocity by in the order of 10% downwind of a turbine. The temporary effect is not considered as being significant and similar to that experienced passing a large ship or close to other large structures (e.g., bridges) or the coastline. In addition, practical experience to date from RYA members taking vessels into other sites indicates that this is not likely to be an issue. Finally, it is noted that there sailing activity is more confined to coastal areas off Fife Ness and west of Isle of May

## 19.5 Sedimentation/Scouring Impacting Navigable Water Depths in Area

There exists the potential for structures in the tidal stream to produce siltation, deposition of sediment or scouring which could affect the navigable water depths in the wind farm area or adjacent to the area. The specialist work carried out as part of the ES has shown that no significant impact on navigation will result from the potential effects of the Neart na Gaoithe development on the physical environment.

## 19.6 Structures and Generators affecting Sonar Systems in Area

No evidence has been found to date with regard to existing wind farms to suggest that they produce any kind of sonar interference which is detrimental to the fishing industry, or to military systems. No impact is anticipated for the Neart na Gaoithe project.

## 19.7 Electromagnetic Interference on Navigation Equipment

Based on the findings of the trials at the North Hoyle Offshore Wind Farm (Ref. iv), the wind farm generators and their cabling, inter-turbine and onshore, did not cause any compass deviation during the trials. However, it is stated that as with any ferrous metal structure, caution should be exercised when using magnetic compasses close to turbine towers.

It is noted that all equipment and cables will be rated and in compliance with design codes. In addition the cables associated with the wind farm will be buried and any generated fields will be very weak and will have no impact on navigation or electronic equipment. No impact is anticipated for the Neart na Gaoithe project.

## 19.8 Impacts on Communications and Position Fixing

The following summarises the potential impacts of the different communications and position fixing devices used in and around offshore wind farms. The basis for the assessment is the trials carried out by the MCA at North Hoyle and experience of personnel/vessels operating in and around other offshore wind farm sites.

### 19.8.1 VHF Communications (including Digital Selective Calling)

Vessels operating in and around offshore wind farms have not noted any noticeable effects on VHF (including voice and DSC communications). No significant impact is anticipated at the site.

### 19.8.2 Navtex

The Navtex system is used for the automatic broadcast of localised Maritime Safety Information (MSI). The system mainly operates in the Medium Frequency radio band just above and below the old 500 kHz Morse Distress frequency. No significant impact has been noted at other sites and none are expected at Neart na Gaoithe.

### 19.8.3 VHF Direction Finding

During the North Hoyle trials, the VHF direction equipment carried in the lifeboats did not function correctly when very close to turbines (within about 50 metres). This is deemed to be a relatively small scale impact and provided the effect is recognised, it should not be a problem in practical search and rescue.

### 19.8.4 Automatic Identification System (AIS)

In theory there could be interference when there is a structure located between the transmitting and receiving antennas (i.e., blocking line of sight). This was not evident in the trials carried out at the North Hoyle site and no significant impact is anticipated for AIS signals being transmitted and received at the Neart na Gaoithe site.

### 19.8.5 Global Positioning System (GPS)

No problems with basic GPS reception or positional accuracy were reported during the trials at North Hoyle and this has been confirmed from other vessels which have been inside offshore wind farms. Consideration will require to be given to any potential degradation of DGPS signals being used to position construction equipment when close to a tower.

### 19.8.6 LORAN-C

LORAN-C is a low frequency electronic position-fixing system using pulsed transmissions at 100 kHz. The absolute accuracy of Loran-C varies from 0.1 to 0.25 nautical miles. Its use is in steep decline, with GPS being the primary replacement. It is mostly used in ships on and near the US coast, although some GPS receivers have built-in Loran C software.

Attempts were made to test a system during the North Hoyle trial, but there were difficulties which were probably attributable to operational errors or lack of a nearby transmitter.

Although a position could not be obtained using LORAN-C in the wind farm area, the available signals were received without apparent degradation. The Neart na Gaoithe development is not expected to have a significant impact on LORAN-C. It is noted that the Department for Transport are funding an enhanced LORAN (eLORAN) service in the UK.

## *19.9 Noise Impact*

### 19.9.1 Acoustic Noise Masking Sound Signals

The concern which must be addressed under MGN 371 is whether acoustic noise from the wind farm could mask prescribed sound signals. The sound level from a wind farm at a distance of 350m has been estimated to be 35-45 Decibel (dB) and it should therefore be well below a background sound level which is typically 63-68 dB.

The 1972 International Regulations for Preventing Collisions at Sea (1972 COLREGS), ANNEX III, entered into force by the IMO, specifies the technical requirements for sound signal appliances on marine vessels. Frequency range and minimum decibel level output is specified for each class of ship (based on length).

A ship's whistle for a vessel of 75m should generate in the order of 138 dB and be audible at a range of 1.5NM, so this should be heard above the background noise of Neart na Gaoithe. Foghorns will also be audible over the background noise of the wind farm.

Therefore, there is no indication that the sound level of the Neart na Gaoithe offshore wind farm will have any significant influence on marine safety.

### 19.9.2 Noise Impacting Sonar

Once in operation it is not believed that the subsea acoustic noise generated by the wind farm will have any significant impact on sonar systems.

# 20. RISK MITIGATION MEASURES & MONITORING

## *20.1 Mitigation*

This section summarises the main risk mitigation measures that could be adopted at the Neart na Gaoithe offshore wind farm to reduce the navigational impact of the development.

**Table 20.1 Mitigation Measures**

| Type of Mitigation | Mitigation | Description |
|---|---|---|
| Industry Standard | Marked on Admiralty Charts | Wind farm will be charted by the UK Hydrographic Office using the magenta turbine tower chart symbol found in publication 'NP 5011 - Symbols and Abbreviations used in Admiralty Charts'. Export and inter-array and cables associated with wind farm will also be charted on the appropriate scale charts. |
| Industry Standard | Information circulation | Appropriate liaison to ensure information on the wind farm sites and special activities is circulated in Notices to Mariners, Navigation Information Broadcasts and other appropriate media. |
| Industry Standard | Marking and lighting | Structures to be marked and lit in-line with NLB and IALA O-139 guidance. (See Section 4.) |
| Industry Standard | Turbine air draught | Lowest point of rotor sweep at least 22m above Mean High Water Springs as per MCA recommendation. |
| Industry Standard | Cable burial and protection | Export cable(s) will be protected appropriately taking into account fishing and anchoring practices, eg rock dumping, concrete mattresses and trenching to a suitable depth. |
| Industry Standard | Compliance with MCA's Marine Guidance Notice (MGN) 371 including Annex 5 | Annex 5 specifies 'Standards and procedures for generator shutdown and other operational requirements in the event of a search and rescue, counter pollution or salvage incident in or around an OREI.' |
| Industry Standard | Formulation of an Emergency Response Cooperation Plan (ERCoP) as per MCA template | Mainstream will use the draft template created by the MCA to formulate an emergency response plan and site Safety Management Systems, in consultation with the MCA. |
| Industry Standard | Fishing Industry Liaison | Positions of the cable routes notified to Kingfisher Information Services-Cable Awareness (KIS-CA) for inclusion in cable awareness charts and plotters for the fishing industry. |

| Type of Mitigation | Mitigation | Description |
|---|---|---|
| Best Practice | Marine Control Centre | A Marine Control Centre will monitor AIS and non-AIS vessels by CCTV and record the movements of ships around the wind farm sites as well as company vessels working at the site. Vessels identified in construction areas or safety zones will be identified and contacted. |
| Best Practice | Surveys of the cable routes and burial depths | Periodic and planned surveys of cable routes to monitor burial depths and sea bed mobility. |
| Best Practice | Vessels anchoring in the area can set up anchoring alarm zones | Vessels anchoring in the area can set up alarm zones to warn if an anchor has moved (dragged). |

Discussions on other measures will continue both pre- and post-construction and during the life of the project with the MCA and other relevant stakeholders.

## *20.2 Future Monitoring*

The operator has a commitment to manage the risks associated with the activities undertaken at the wind farm.

A Safety Management System (SMS) will include an incident/accident reporting system which will allow incidents and near misses to be recorded and reviewed to monitor the effectiveness of the risk control measures in place at the site. In addition to this any information learned from near misses/accidents at other offshore wind farm site will be considered with respect to the control measures applied at the Neart na Gaoithe offshore wind farm.

The subsea cable routes will be subject to periodic inspection to ensure they remain buried.

Met masts and Met Ocean buoys will be deployed prior to the construction phase; however these devices will also be used to support operations throughout the life of the project.

## *20.3 Future Monitoring of Marine Traffic*

Whilst no radar monitoring of vessel movements has been proposed for the site, AIS monitoring should be explored to record the movements of vessels around Neart na Gaoithe, associated export cables to shore and works vessels on site. It was noted during the shipping and navigation Hazard Workshop that Forth Ports have VTS coverage in the area of Neart na Gaoithe.

There will also be vessels regularly operating in the site, including during maintenance, which can monitor any third party vessel activity both visually and on radar, although this will not be their primary function.

## *20.4 Decommissioning Plan*

A decommissioning plan in line with standard requirements will be developed. With regards to impacts on shipping and navigation this will also include consideration of the scenario where on decommissioning and on completion of removal operations, an obstruction is left on site (attributable to the wind farm) which is considered to be a danger to navigation and which it has not proved possible to remove. Such an obstruction may require to be marked until such time as it is either removed or no longer considered a danger to navigation, the continuing cost of which would need to be met by the developer/operator.

# 21. CONCLUSIONS

Following a review of the baseline shipping and navigation a Navigational Risk Assessment for the proposed Neart na Gaoithe offshore wind farm has been undertaken.

The assessment has included collision risk modelling and a formal safety assessment for all phases of the project as well as an assessment of cumulative and in combination impacts.

## *21.1 Consultation*

Consultation has been undertaken with regulators and operators, key points include:

- The availability of tugs in the Firth of Forth which can steam at approximately 13 knots with the possibility of responding to a drifting or ship collision incident at Neart na Gaoithe within approximately two hours of mobilisation.
- Fishing stakeholders stated the preference for rock dumping to protect subsea cabling, as mattresses can be a hazard to smaller vessels with less power.
- In terms of recreational vessels collision risk, the main risk is likely to be from foreign sailing vessels, which do not carry up-to-date charts, as local users are likely to become aware of the wind farm site.
- A general point was made during the shipping and navigation Hazard Review workshop that the Neart na Gaoithe wind farm site in isolation is not a problem in terms of ship-to-ship collision risk due to the available sea room (east and west of the site).
- In terms of offshore safety zones, no significant impact was predicted during the shipping and navigation Hazard Review on sailing and fishing vessels (i.e. vessels could pass through the site). However it was not expected that merchant vessels would pass through the wind farm.

## *21.2 Marine Traffic*

In terms of nearby shipping, the majority of traffic passes clear of Neart na Gaoithe (shipping routes east/west from the Forth and coastal traffic off Fife Ness). The two routes that will be partly affected are the north west-south east shipping lane to/from Firth of Tay and coastal traffic between the Humber and northern Scottish Ports including Aberdeen, Peterhead and Lerwick.

One vessel per day on average uses the Firth of Tay route, with one vessel every three days on the coastal route from Humber to northern Scotland. The majority of vessels are coastal tankers and cargo vessels, and are likely to pass east and west of the wind farm when constructed.

Levels of recreational craft within Neart na Gaoithe were low, with one recreation vessel recorded passing through the Neart na Gaoithe wind farm boundary during the survey. The majority of vessels pass closer to the Fife coast and west of Isle of May.

The predominant fishing activity in the vicinity of Neart na Gaoithe is demersal trawling and scallop dredging; with the highest density of fishing activity recorded to the south west of wind farm. During the surveys it was noted that the majority of tracks appeared to be fishing as apposed to transiting through the area. The level of fishing vessel activity along the export cable route is generally higher towards the coast.

From a regional perspective shipping and navigational cumulative issues are an on-going consideration in the outer Firth of Forth and Tay through FTOWDG work.

In terms of Neart na Gaoithe a small number of vessels on the deviated coastal route passing east of the wind farm (transiting between northern Scottish ports and Humber), could be cumulatively impacted by the Inch Cape and Forth Round 3 Zone 2 Phase 1 developments. However, assuming standard mitigation measures the impact on vessel routeing, collision risk and radar impacts was considered to be moderate.

The cumulative impacts on fishing and recreational vessels, relate to exiting the wind farms into shipping routes. Taking into account the low number of recorded transiting through Neart na Gaoithe and assuming standard mitigation measures are in place, the cumulative impact is considered to be of minor.

## *21.3 Collision Risk Modelling and Impact Assessment*

An assessment of current vessel to vessel encounters was carried out by replaying (at high-speed) 29 days of AIS and this showed that the density of encounters in the vicinity of the proposed wind farms is generally low (one per day).

The baseline vessel-to-vessel collision risk level pre-wind farm development is in the order of 1 major collision in 1,020 years and modelling of the revised traffic pattern, the collision risk was estimated to increase to 1 major collision in approximately 970 years. The change in collision frequency due to the wind farm was estimated to be $4.6 \times 10^{-5}$ per year (approximate 5% increase).

In terms of an errant vessel under power deviating from its route to the extent that it comes into proximity with the Neart na Gaoithe wind farm, it is not considered to be a probable occurrence (worst case collision return period of 1 every 8,200 years).

It was also noted that the individual collision frequencies ranged from $2.6 \times 10^{-5}$ for the turbine on the south eastern tip of the wind farm, to negligible for turbines within the centre and north east of the wind farm.

The worst case drifting collision risk has been identified as 1 every 34,000 years. Not under command collisions are assessed to be less frequent than powered collisions, which is reflective of historical data.

In order to mitigate blade, mast and keel collision for recreational craft the development of Neart na Gaoithe will adhere to the RYA's guidance on the construction of WTGs including;

- a minimum rotor height clearance above MHWS of 22m
- a minimum underwater clearance of 3.5m below MHWS.

These guideline measurements mean that whilst the collision risk cannot be completely eliminated it will be reduced to a level as low as reasonably practicable.

With regarding to cable interaction for anchoring and trawling all the subsea cables will be buried or trenched where sea bed conditions allow, providing protection from all forms of hostile seabed interaction, such as fishing activity, dragging of anchors and dropped objects. There will be periodic inspections and surveys to ensure they do not become exposed. They will also be marked on Admiralty Charts, although whether all submarine cables are charted depends upon the scale of the chart; in some cases only the export cable may be shown.

## *21.4 Visual Navigation and Collision Avoidance*

A review of visual navigation and collision avoidance was also undertaken in line with MGN 371 and identifies the potential for visual navigation to be impaired by the location of offshore wind farm structures, based on vessels not being visible to each other and navigational aids and/or landmarks not being visible to shipping. The following identifies the key issues for Neart na Gaoithe.

**Site Design**

Aids to Navigation for vessels navigating around the site especially in reduced visibility. Further consultation will be carried out with the regulatory stakeholders once a final layout and lighting/buoyage is defined.

**Visual Impacts**

Visual impacts associated with development of Neart na Gaoithe are broadly acceptable because of the low number recreational vessels further east of Fife Ness (and more coastal areas) in the area which limits the likelihood of a small craft emerging from Neart na Gaoithe towards shipping traffic. Even if that were the case, the vessel should be visible for the vast majority of the time due to the size of the turbines relative to the large spacing between them.

**Impacts of Marine Radar**

The MCA shipping template indicates that at 500m the effects on marine radar become intolerable however due to the open sea room and navigable water depths around Neart na Gaoithe, vessels will be able to safely distance themselves from the turbines to mitigate the impacts including interference and multiple echoes. It was therefore concluded that the effects of wind turbines on marine radars for Neart na Gaoithe were tolerable when mitigated by measures as indicated in Section 20.

## *21.5 Formal Safety Assessment*

In ordered to provide expert opinion and local knowledge, a hazard workshop was undertaken to create a hazard log that was project and site specific. The hazard log identified the hazards

caused or changed by the introduction of the wind farm, the risk associated with the hazard, the controls put in place and the tolerability of the residual risk.

The log also includes both industry standard and additional mitigation measures required to show that the hazards associated with the wind farm are Broadly Acceptable or Tolerable on the basis of ALARP declarations. For the most likely outcome, two of the risks were in the tolerable region. When the worst case consequences were assessed, as well as the two risk above, four additional hazards were ranked as tolerable based on the worst case outcome. No risks were assessed to be in the unacceptable region.

## *21.6 Mitigations*

Mitigation and safety measures will be applied to Neart na Gaoithe development appropriate to the level and type of risk determined during the Environmental Impact Assessment (EIA). The specific measures to be employed will be selected in consultation with the MCA Navigation Safety Branch and other relevant statutory stakeholders where required.

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