East Anglia Offshore Wind

VATTENFALL

SCOTTISHPOWER RENEWABLES

East Anglia THREE

Appendix 15.1

Annex 2

Navigational Risk Assessment Consequences

Document Reference – 6.3.15 (1c)

Author – Anatec Limited
East Anglia THREE Limited
Date – November 2015
Revision History – Revision A

This Page is Intentionally Blank

Consequences Assessment

East Anglia THREE Offshore Windfarm

Appendix 15.1

Annex 2

Consequences

Prepared by:	Anatec Limited
Presented to:	EATL
Date:	November 2015
Revision No.:	02
Ref.:	A2953-SP-NRA-1.2

Anatec	**Aberdeen Office**	**Cambridge Office**
Address:	10 Exchange Street, Aberdeen, AB11 6PH, UK	Braemoor, No. 4 The Warren, Witchford, Ely, Cambs, CB6 2HN, UK
Tel:	01224 253700	01353 661200
Fax:	0709 2367306	0709 2367306
Email:	aberdeen@anatec.com	cambs@anatec.com

TABLE OF CONTENTS

1. Introduction

1. This Appendix presents an assessment of the consequences of collision incidents, in terms of people and the environment, due to the impact of the proposed East Anglia THREE.
2. The significance of the impact of the proposed East Anglia THREE is also assessed based on risk evaluation criteria and comparison with historical accident data in the UK waters[1].

[1] In this technical note, UK waters means the UK Exclusive Economic Zone and UK territorial waters means within the 12 nautical miles limit.

2. Risk Evaluation Criteria

2.1 Risk to People

3. With regard to the assessment of risk to people two measures are considered, namely;

- Individual Risk
- Societal Risk

2.1.1 Individual Risk (per Year)

4. This measure considers whether the risk from an accident to a particular individual changes significantly due to the windfarm. Individual risk considers not only the frequency of the accident and the consequence (likelihood of death), but also the individual's fractional exposure to that risk, i.e., the probability of the individual of being in the given location at the time of the accident.
5. The purpose of estimating the Individual Risk is to ensure that individuals, who may be affected by the presence of the windfarm, are not exposed to excessive risks. This is achieved by considering the significance of the change in individual risk resulting from the presence of the windfarm, relative to the background individual risk levels.
6. Annual individual risk levels to crew (i.e., the annual fatality risk of an average crew member) for different ship types are presented in Figure 2.1 (Ref.i). The figure also highlights the risk acceptance criteria as suggested in International Maritime Organisation (IMO) Marine Safety Committee (MSC) 72/16.

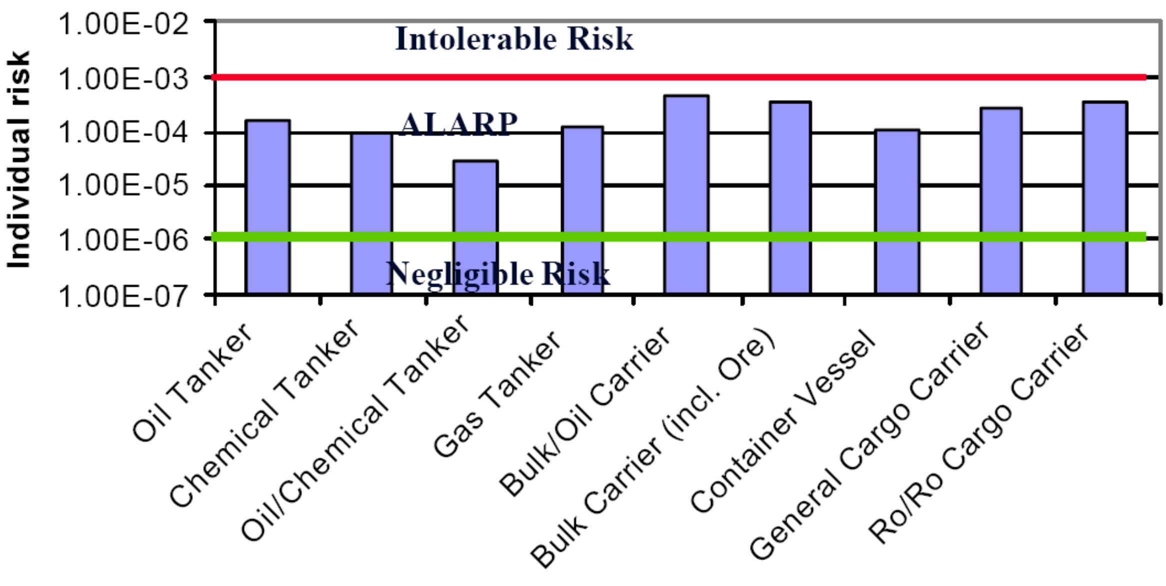

Figure 2.1 Individual Risk Levels and Acceptance Criteria per Ship Type

7. Typical bounds defining the As Low As Reasonably Practicable (ALARP) regions for decision making within shipping are as follows.

Table 2.1 Individual Risk ALARP Criteria

Individual	Lower Bound for ALARP	Upper Bound for ALARP
To crew member	10^{-6}	10^{-3}
To passenger	10^{-6}	10^{-4}
3rd party	10^{-6}	10^{-4}
New ship target	10^{-6}	Above values reduced by one order of magnitude

8. On a UK basis, the Marine Coastguard Agency (MCA) website presents individual risks for various UK industries based on Health and Safety Executive (HSE) data for 1987-91 (Ref. ii). The risks for different industries are compared in Figure 2.2.
9. The individual risk for sea transport of 2.9 x 10^{-4} per year is consistent with the worldwide data presented in Figure 2.1, whilst the individual risk for sea fishing of 1.2 x 10^{-3} per year is the highest across all of the industries listed.

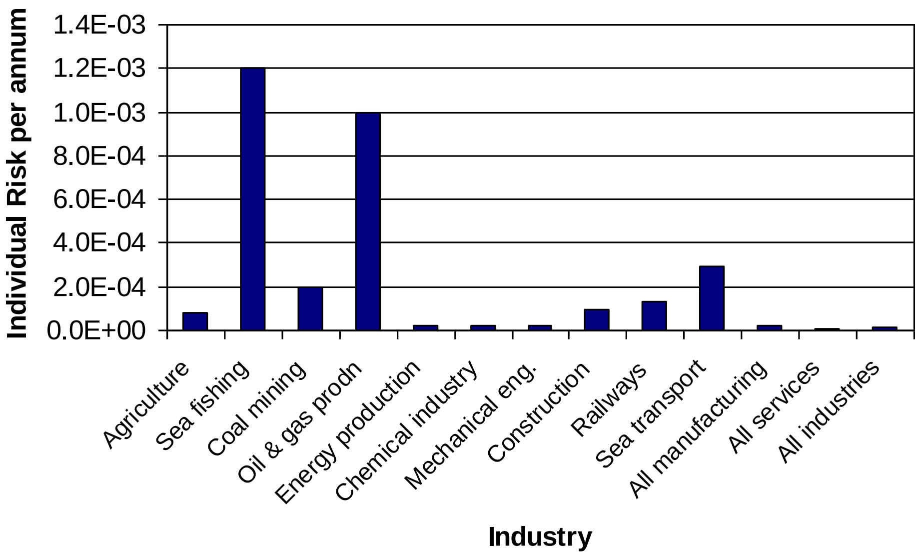

Figure 2.2 Individual Risk per Year for various UK Industries

2.1.2 Societal Risk

10. Societal Risk is used to estimate risks of accidents affecting many persons, e.g., catastrophes, and acknowledging risk averse or neutral attitudes. Societal Risk includes the risk to every person, even if a person is only exposed on one brief occasion to that risk. For assessing the risk to a large number of affected people,

societal risk is desirable because individual risk is insufficient in evaluating risks imposed on large numbers of people.

11. Within this assessment societal risk (navigational based) can be assessed for the proposed East Anglia THREE giving account to the change in risk associated with each accident scenario caused by the introduction of the structures. Societal risk may be expressed as:

- Annual fatality rate: frequency and fatality are combined into a convenient one-dimensional measure of Societal Risk. This is also known as Potential Loss of Life (PLL).

- FN-diagrams showing explicitly the relationship between the cumulative frequency of an accident and the number of fatalities in a multi-dimensional diagram.

12. When assessing societal risk this study focuses on PLL, which takes into account the number of people likely to be involved in an incident (which is higher for passenger ferries, for example), and assesses the significance of the change in risk compared to background risk levels for the UK.

2.2 Risk to Environment

13. For risk to the environment the key criteria considered in terms of the effect of the proposed East Anglia THREE is the potential amount of oil spilled from the vessel involved in an incident.
14. It is recognised there will be other potential pollution, e.g., hazardous containerised cargoes, however, oil is considered the most likely pollutant and the extent of predicted oil spills will provide an indication of the significance of pollution risk due to the proposed East Anglia THREE compared to background pollution risk levels for the UK.

3. MAIB Incident Analysis

3.1 All Incidents

15. All UK commercial vessels are required to report accidents to Marine Accident Investigation Branch (MAIB). Non-UK vessels do not have to report unless they are in a UK port or are in 12 nautical mile territorial waters and carrying passengers to a UK port. There are no requirements for non-commercial recreational craft to report accidents to MAIB, however, a significant proportion of these incidents are reported and investigated by the MAIB.
16. A total of 19,130 accidents, injuries and hazardous incidents were reported to MAIB between 1 January 1994 and 27 September 2005 involving 21,140 vessels (some incidents such as collisions involved more than one vessel). 72% of incidents were in UK waters with 28% reported in foreign waters.
17. The locations[1] of incidents reported in the vicinity of the UK are presented in Figure 3.1, colour-coded by type.

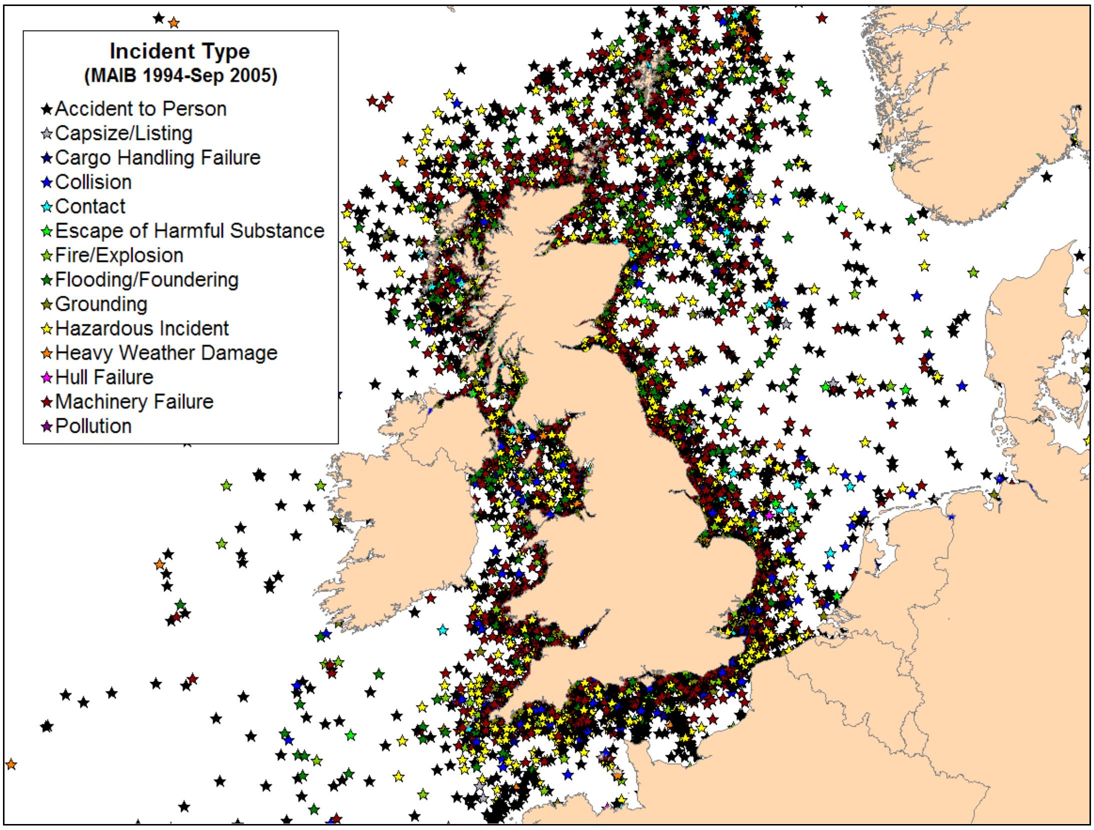

Figure 3.1 Incident Locations by Type (MAIB 1994-Sep 2005)

18. The distribution of incidents by year is presented in Figure 3.2.

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

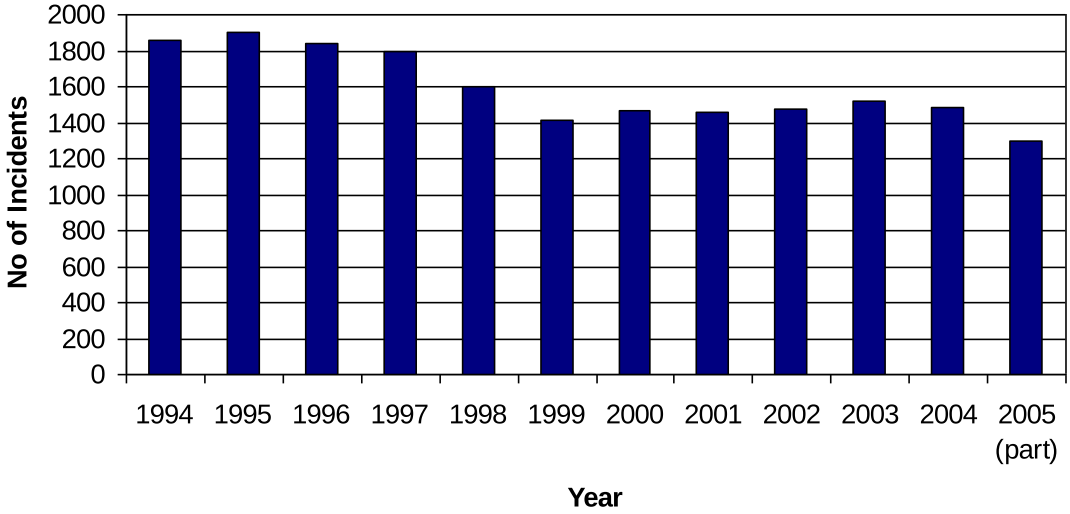

Figure 3.2 Incidents per Year (MAIB 1994-Sep 2005)

19. The average number of incidents per year, excluding 2005 which is a part-year, was 1,621. There is a declining trend in incidents.
20. The distribution by incident type is presented in Figure 3.3.

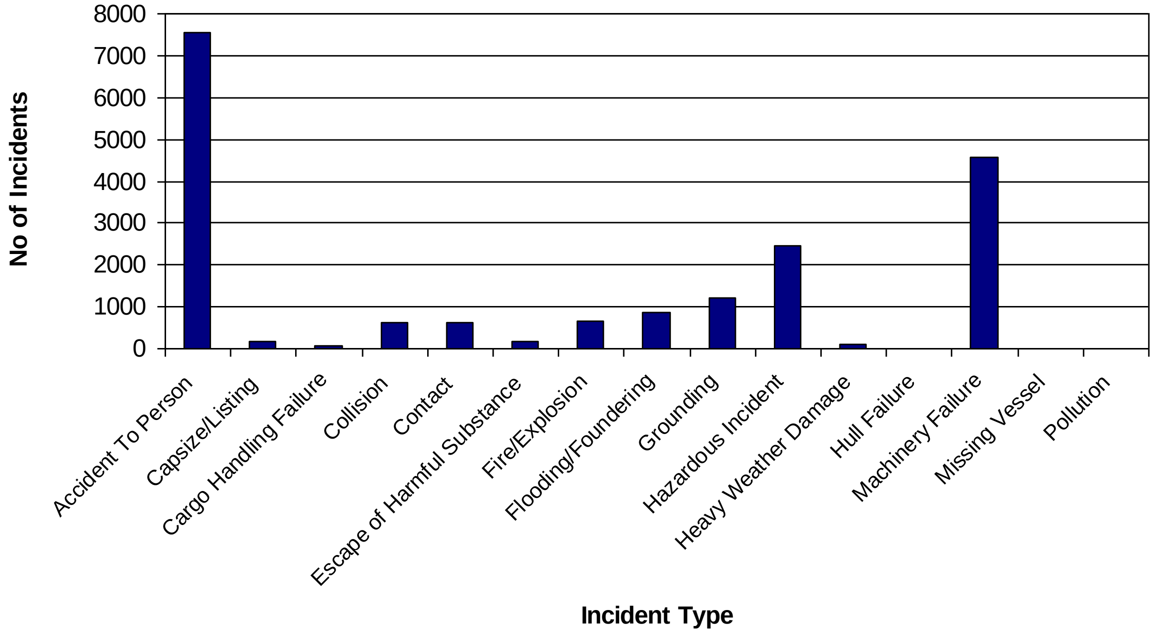

Figure 3.3 Incidents by Incident Type (MAIB 1994-Sep 2005)

21. Therefore, the most common incident types were Accident to Person[1] (40%), Machinery Failure (24%) and Hazardous Incident (13%). Collisions and Contacts each represented 3% of total incidents.
22. The distribution of vessel type categories involved in incidents is presented in Figure 3.4.

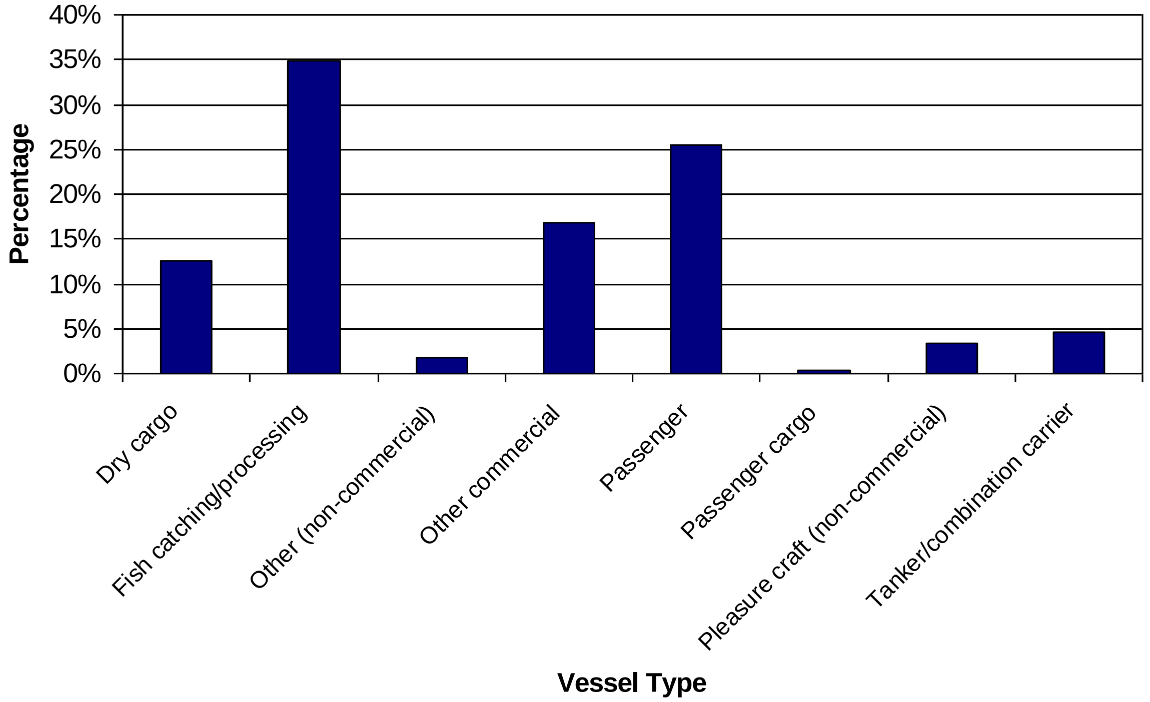

Figure 3.4 Incidents by Vessel Type (MAIB 1994-Sep 2005)

23. The most common vessel types involved in incidents were fishing vessels (35%), passenger vessels (25%) and other commercial vessels (17%), which includes offshore industry vessels, tugs, workboats and pilot vessels.
24. The total number of fatalities per year (divided into crew, passenger and other) reported in the MAIB incidents is presented in Figure 3.5.

[1] Where the incident is an accident to a vessel, e.g., collision or machinery failure, it would be reported under this vessel accident category.

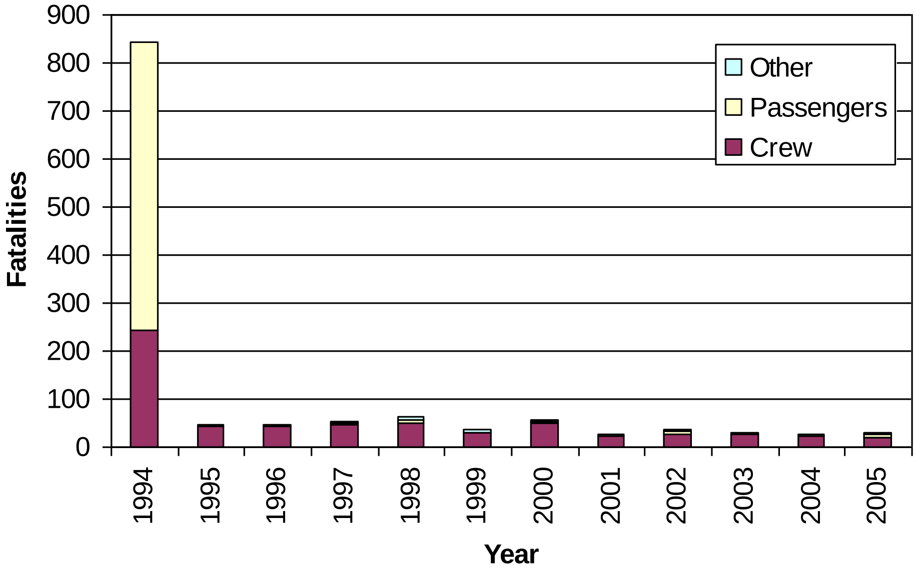

Figure 3.5 Number of Fatalities (MAIB 1994-Sep 2005)

25. The average number of fatalities per year, excluding 2005 which is a part-year, was 115. The sinking of the 'Estonia' passenger ferry in the Baltic Sea in 1994, which resulted in a reported 852 fatalities, dominates the figures. If 1994 were excluded, the average number of fatalities per year would drop to 42.
26. Considering only the incidents reported to have occurred in UK territorial waters, the number of fatalities per year is presented in Figure 3.6.

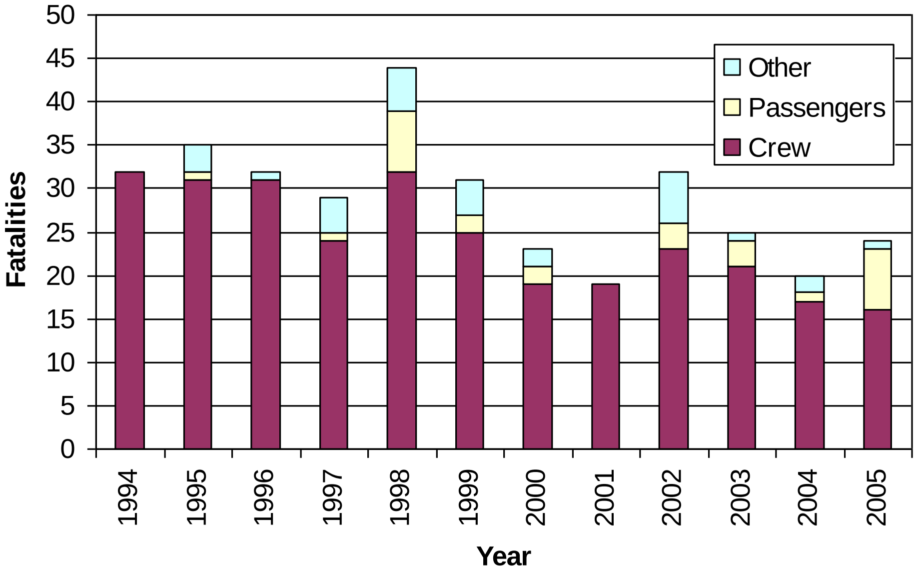

Figure 3.6 Number of Fatalities for Incidents in UK Waters (MAIB 1994-Sep 2005)

27. Therefore, the average number of fatalities per year in UK territorial waters between 1994 and 2004 was 29.
28. The distribution of fatalities in UK waters by vessel type and person category is presented in Figure 3.7.

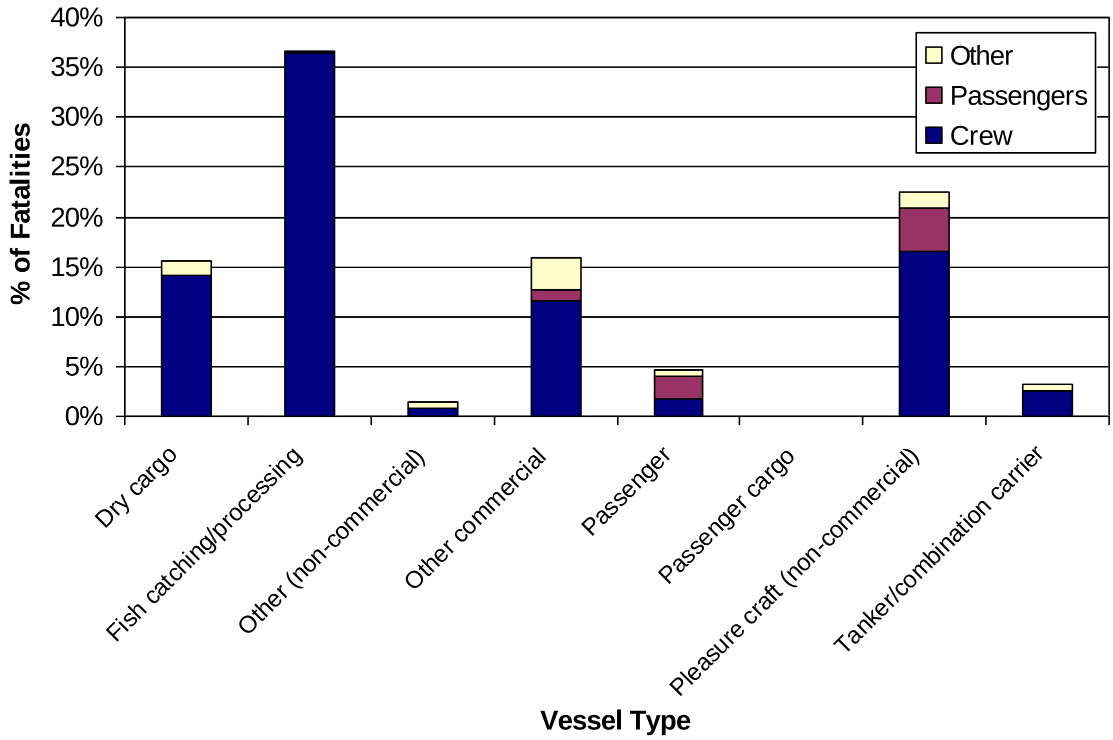

Figure 3.7 Fatalities by Vessel Type for Incidents in UK (MAIB 1994-Sep 2005)

29. It can be seen that the majority of fatalities in the UK occurred to fishing vessels and pleasure craft, with crew members the main people involved.

3.2 Collision Incidents

30. MAIB define a collision incident as "vessel hits another vessel that is floating freely or is anchored (as opposed to being tied up alongside)."
31. A total of 623 collisions were reported to MAIB between 1 January 1994 and 27 September 2005 involving 1,241 vessels (in a handful of cases the other vessel involved was not logged).
32. The locations of collisions reported in the vicinity of the UK are presented in Figure 3.8.

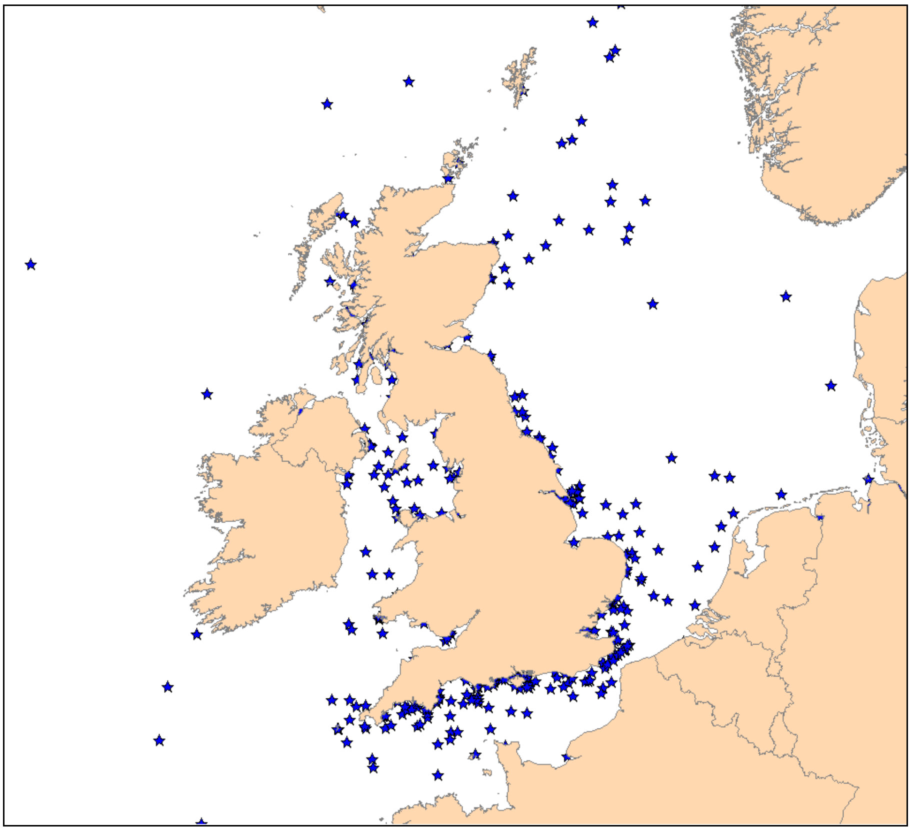

Figure 3.8 Collision Incident Locations (MAIB 1994-Sep 2005)

33. The distribution of all collision incidents by year is presented in Figure 3.9.

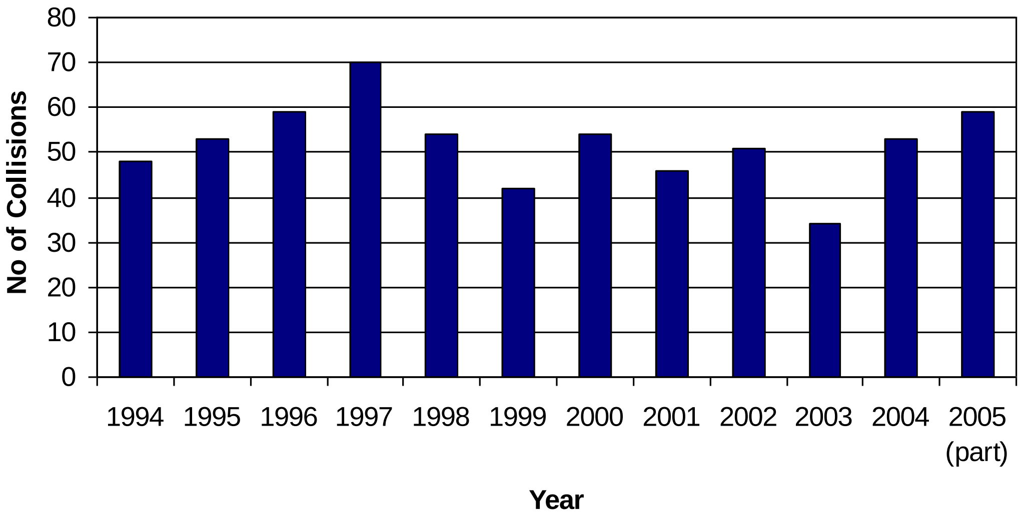

Figure 3.9 Collisions per Year (MAIB 1994-Sep 2005)

34. The average number of collisions per year, excluding 2005 which is a part-year, was 51.
35. The distribution of vessel types involved in collisions is presented in Figure 3.10.

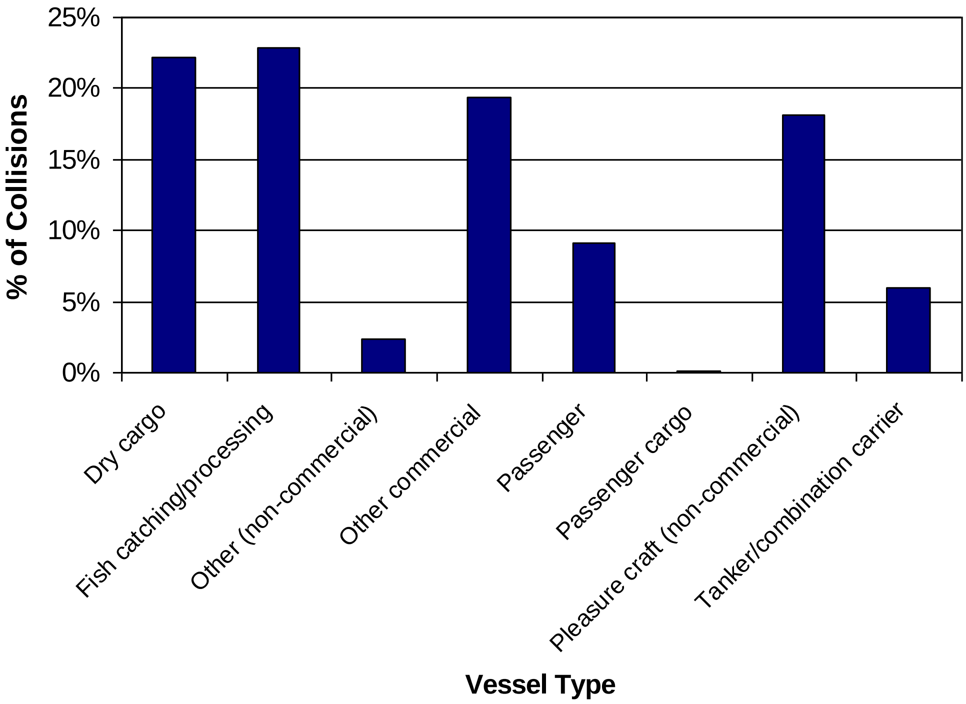

Figure 3.10 Collisions by vessel Type (MAIB 1994-Sep 2005)

36. Therefore, the most common vessel type involved in collisions were fishing vessels (25%), dry cargo vessels (22%), other commercial vessels (19%) and non-commercial pleasure craft (18%).
37. Finally, the total number of fatalities per year (divided into crew and passenger) reported in all MAIB collisions is presented in Figure 3.11.

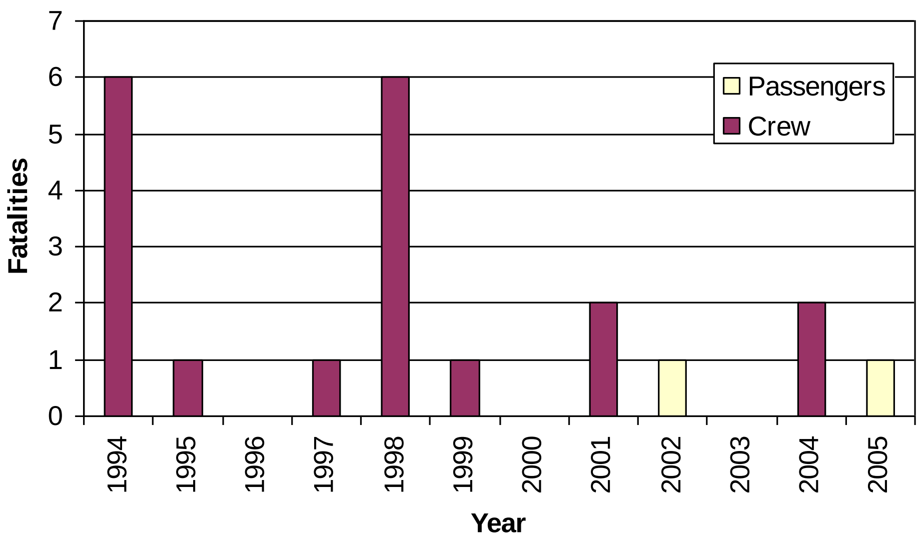

Figure 3.11 Fatalities from Collisions (MAIB 1994-Sep 2005)

38. The average number of fatalities per year, excluding 2005 which is a part-year, was 1.8.
39. Details on the 12 incidents reported by MAIB that involved fatalities are presented in Table 3.1. In each case the first vessel listed suffered the losses. It can be seen that most incidents involved fishing vessels and recreational craft.

Table 3.1 Fatal Collision Incidents (MAIB 1994-Sep 2005)

Date	Description	Fatalities
Nov 1994	Beam trawler collision with bulk carrier Foreign waters, high seas, moderate visibility and sea state	6
Jun 1998	Seine netter collision with container ship Foreign waters, high seas, good visibility, moderate seas	5
Feb 1995	Stern trawler collision with supply ship Foreign waters, river/canal, good visibility, moderate seas	1
Mar 1997	Stern trawler collision with other fishing vessel Foreign waters, good visibility, calm seas	1
Jun 1998	RIB collision with other RIB UK territorial waters, river/canal	1
Mar 1999	Fishing vessel collision with container ship Foreign waters, coastal waters, good visibility	1
Aug 2001	Pleasure craft collision with small commercial motor vessel UK territorial waters	1
Oct 2001	General cargo vessel collision with chemical tanker UK territorial waters, coastal waters, good visibility	1
Aug 2002	Speed craft collision with another speed boat UK waters, unspecified location, good visibility, calm seas	1
May 2004	Port service tug collision with passenger ferry (during towing) Foreign waters, coastal waters	1
Jun 2004	Pleasure craft collision with other pleasure craft Foreign waters, river/canal	1
Jul 2005	Pleasure craft collision with (1 passenger fatality) UK territorial waters, coastal waters, good visibility, calm seas	1

40. A more detailed description of the two incidents which resulted in multiple fatalities is provided below:

- Collision between bulk carrier and beam trawler in eastward lane of Terschelling - German Bight Traffic Separation Scheme (TSS). Both vessels were on passage. Visibility was about 5 miles. Collision caused extensive damage to beam trawler and vessel rapidly flooded and sank with loss of her 6 crew, all of whom were Dutch nationals. Collision was primarily caused by Master of bulk carrier failing to take early and substantial action when complying with his obligation to keep out of the way.
- The fishing vessel was on an easterly course while on passage from Firth of Forth to Esbjerg, and the container ship was on a north-westerly course from Hamburg to Gothenburg. The fishing vessel was the give-way vessel but did not alter course and speed, the cause of which could not be established. The chief officer of the container ship did not alter course until it was too late and the two vessels collided. The fishing vessel foundered so quickly that all hands were trapped inside the accommodation and the container ship was so badly damaged that she had to use Esbjerg as a port of refuge.

3.3 Contact Incidents

41. MAIB define a contact incident as “vessel hits an object that is immobile and is not subject to the collision regulations e.g. buoy, post, dock (too hard), etc. Also, another ship if it is tied up alongside. Also floating logs, containers etc.”
42. A total of 609 contacts were reported to MAIB between 1 January 1994 and 27 September 2005 involving 663 vessels.
43. The locations of contacts reported in the vicinity of the UK are presented in Figure 3.12.

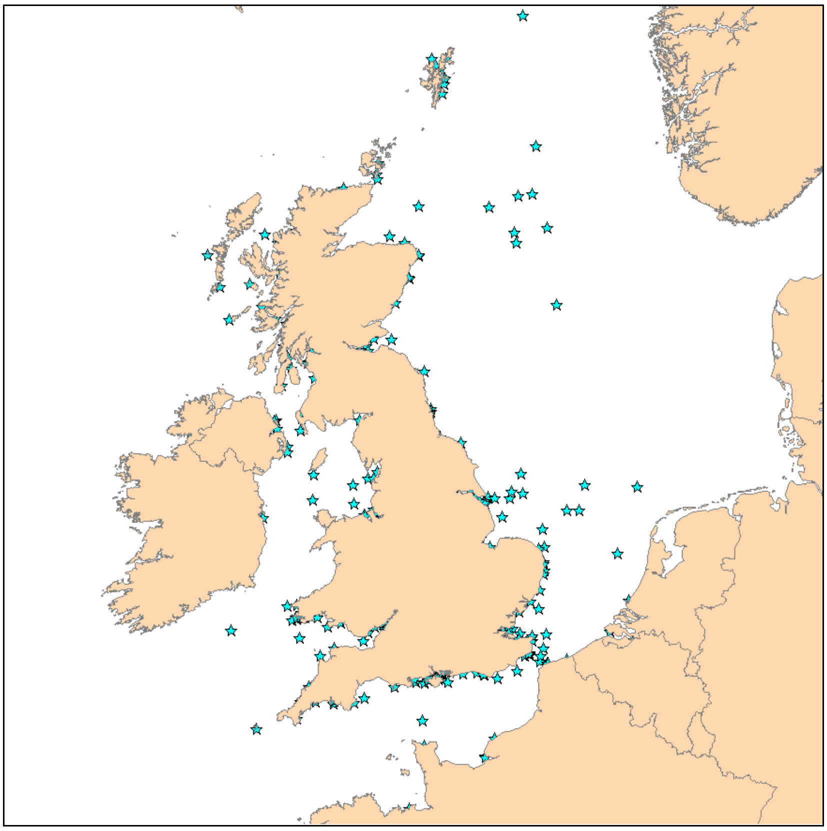

Figure 3.12 Contact Incident Locations (MAIB 1994-Sep 2005)

44. The distribution of contact incidents by year is presented in Figure 3.13.

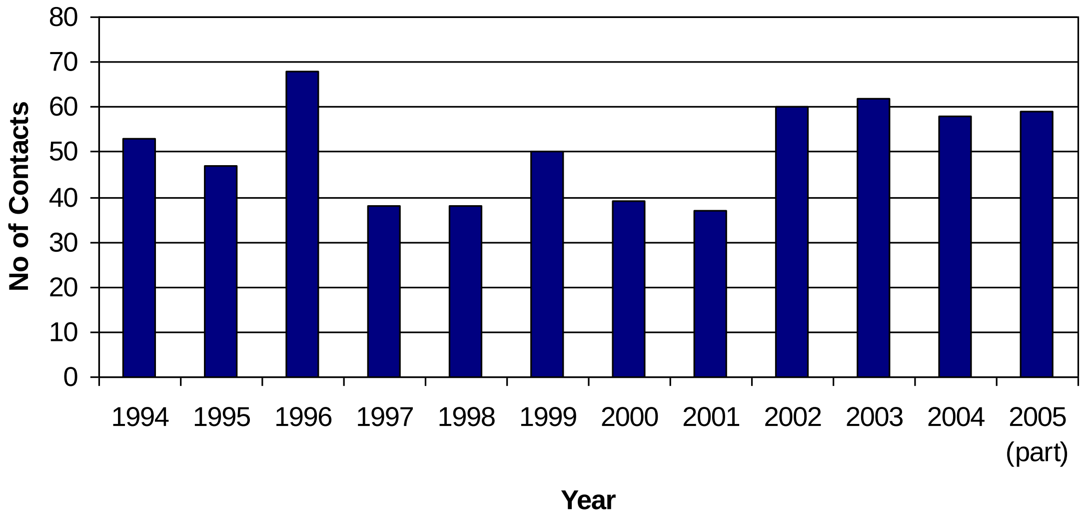

Figure 3.13 Contact Incidents per Year (MAIB 1994-Sep 2005)

45. The average number of contacts per year, excluding 2005 which is a part-year, was 50.
46. The distribution of vessel types involved in contacts is presented in Figure 3.14.

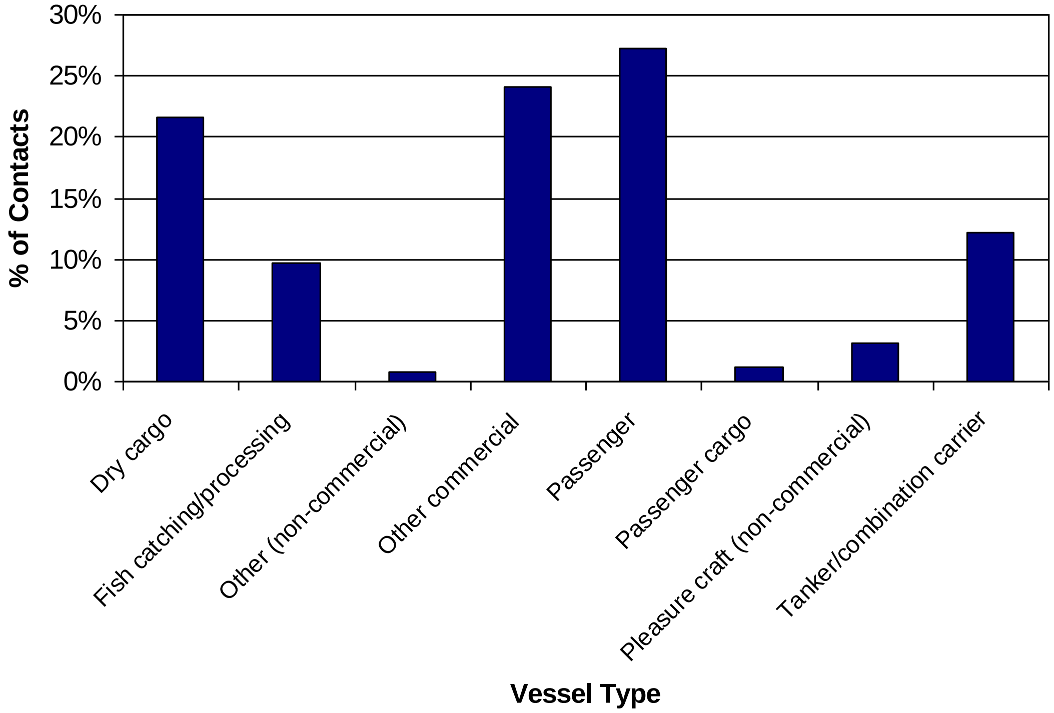

Figure 3.14 Contacts by Vessel Type (MAIB 1994-Sep 2005)

47. Therefore, the most common vessel type involved in contacts were passenger ferries (27%), other commercial vessels (24%) and dry cargo vessels (22%).
48. There were no fatalities in any of the contact incidents recorded by MAIB.

4. Fatality Risk

4.1 Introduction

49. This section uses the MAIB incident data along with information on average manning levels per vessel type to estimate the probability of fatality in a marine incident associated with the proposed East Anglia THREE.
50.
51. The proposed East Anglia THREE is assessed to have the potential to affect the following incidents:

- Passing Powered Allision with Windfarm Structure;
- Passing Drifting Allision with Windfarm Structure;
- Vessel-to-Vessel Collision; and
- Fishing Vessel Allision with Windfarm Structure.

52. Of these incidents, only vessel-to-vessel collisions match the MAIB definition of collisions and hence the fatality analysis presented in Section 3.2 is considered to be directly applicable to these types of incidents.
53. The other scenarios of passing powered, passing drifting and fishing vessel allisions with the windfarm structures are technically contacts, i.e., vessel hits an immobile object in the form of a turbine or substation. From Section 3.3 it can be seen that none of the 609 contact incidents reported by MAIB between 1994 and 2005 resulted in fatalities.
54. However, as the mechanics involved in a vessel contacting a wind turbine may differ in severity from hitting, for example, a buoy, quayside or moored vessel, the MAIB collision fatality risk rate has also been conservatively applied for these incidents.

4.2 Fatality Probability

55. Twelve of the 623 collision incidents reported by MAIB resulted in one or more fatalities. This represents a 2% probability that a collision will lead to a fatal accident. A total of 21 fatalities resulted from the collision incidents.
56. To assess the fatality risk for personnel on-board a vessel, either crew, passenger or other, the number of persons involved in the incidents needs to be estimated. From an ILO survey of seafarers during 1998-99 (Ref. iii), the average commercial vessel had a crew of 17. For other (non-commercial vessels) such as naval craft and Royal National Lifeboat Institute (RNLI) lifeboats the average crew has been estimated to be 20. On-board fishing vessels and pleasure craft the average crew has been estimated to be 5. Finally, for passenger vessels it is estimated that the average number of passengers carried, in addition to crew, is 300 (based on UK sea passenger movements on principal ferry routes, Ref. iv).

57. It is recognised these numbers can be substantially higher or lower on an individual vessel basis depending on size, subtype, etc., but applying reasonable averages is considered sufficient for this analysis.
58. Using the average number of persons carried along with the vessel type information involved in collisions reported by MAIB (see Figure 3.10), gives an estimated 50,000 personnel on-board the ships involved in the collisions.
59. Based on 21 fatalities, the overall fatality probability in a collision for any individual on-board is approximately 4.3×10^{-4} per collision (0.04%).
60. It is considered inappropriate to apply this rate uniformly as the statistics clearly shown that the majority of fatalities tend be associated with smaller craft, such as fishing vessels and recreational vessels. Therefore, the fatality probability has been subdivided into two categories of vessel as presented in Table 4.1.

Table 4.1 Fatality Probability per Incident per Vessel Category

Vessel Category	Sub Categories	Fatalities	People Involved	Fatality Probability
Commercial	Dry cargo, passenger, tanker, etc.	3	46,200	6.5E-05
Non-Commercial	Fishing, pleasure, etc.	18	3,120	5.8E-03

61. From the above table it can be seen the risk is approximately two orders of magnitude higher for people on-board non-commercial vessels.

4.3 *Fatality Risk due to the Proposed East Anglia THREE*

62. The base case and future case annual collision and allision frequency levels without the East Anglia THREE and with both of the proposed turbine layouts are summarised below.

Table 4.2 Summary of Annual Collision and Allision Frequency Results – Partial Fill Build Scenario

Scenario	Base Case			Future Case		
	Without	With	Change	Without	With	Change
Passing Powered	--	2.97E-02	2.97E-02	--	3.27E-02	3.27E-02
Passing Drifting	--	2.07E-03	2.07E-03	--	2.28E-03	2.28E-03
Vessel-to-Vessel	2.47	2.49	1.56E-02	2.72	2.73E-03	1.72E-02
Fishing	--	6.76E-02	6.76E-02	--	7.43E-02	7.43E-02
Total	2.47	2.59	1.15E-01	2.72	2.84	1.26E-01

Table 4.3 Summary of Annual Collision and Allision Frequency Results – 100% Fill Build Scenario

Scenario	Base Case			Future Case		
	Without	With	Change	Without	With	Change
Passing Powered	--	1.67E-02	1.67E-02	--	1.83E-02	1.83E-02
Passing Drifting	--	1.14E-03	1.14E-03	--	1.25E-03	1.25E-03
Vessel-to-Vessel	2.47	2.48	5.30E-03	2.72	2.72	5.82E-03
Fishing	--	6.76E-02	6.76E-02	--	7.43E-02	7.43E-02
Total	2.47	2.56	9.07E-02	2.72	2.82	9.97E-02

63. For the local vessels operating in the area of the site, the average manning/persons on-board (POB) has been estimated as follows.

Table 4.4 Vessel types, incidents and average persons exposed

Vessel Type	Collision/Allision Incidents	Average Manning/ POB

Cargo/Offshore	Passing powered, passing drifting, vessel-to-vessel.	25
Tanker	Passing powered, passing drifting, vessel-to-vessel.	20
Passenger Ferry	Passing powered, passing drifting, vessel-to-vessel.	1,300
Fishing Vessel	Vessel-to-vessel and fishing.	6
Recreational Vessel	Vessel-to-vessel.	4

64. From the detailed results of the collision frequency modelling, the distribution of the predicted change in collision and allision frequency by vessel type due to the proposed East Anglia THREE site layouts are presented in the following figures.

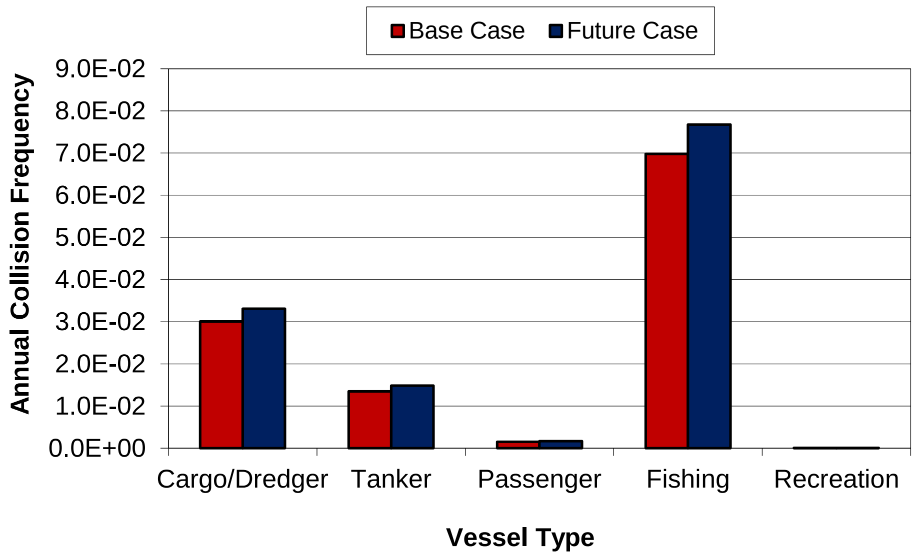

Figure 4.1 Change in Collision and Allision Frequency by Vessel Type Estimated for the Proposed East Anglia THREE Site (Partial Fill Build Scenario)

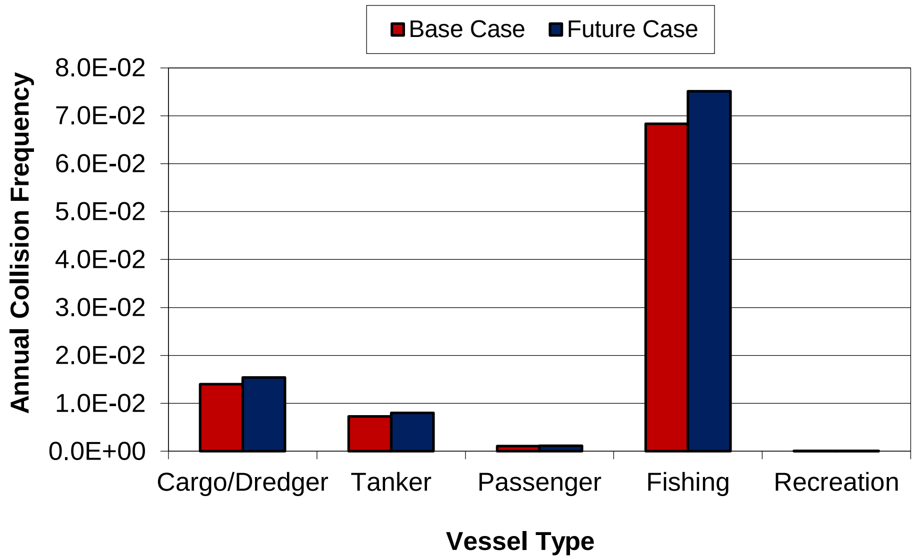

Figure 4.2 Change in Collision and Allision Frequency by Vessel Type Estimated for the Proposed East Anglia THREE Site (100% Fill Build Scenario)

65. It can be seen that for both of the proposed turbine layouts the change in collision/allision frequency is dominated by fishing vessels. The change in frequency is lowest for commercial vessels (tankers and ferries) and recreational vessels.
66. Combining the collision/allision frequency, the estimated number of persons onboard each vessel type (Table 4.4) and the estimated fatality probability for that vessel category (Table 4.1), the annual increase in Potential Loss of Life (PLL) due to the impact of the proposed East Anglia THREE site is estimated to be as follows:

Table 4.5 Potential Loss of Life due to East Anglia THREE

	Partial Fill	100% Fill
Base Case PLL (fatalities per year)	2.7E-03	2.5E-03
Future Case PLL (fatalities per year)	3.0E-03	2.8E-03

67. For the worst case turbine layout (partial fill) the estimated base case PLL increase equates to an average of one additional fatality in 366 years, whilst the future case PLL increase corresponds to an average of one additional fatality in 333 years.
68. For both of the proposed turbine layouts, the predicted incremental increases in PLL due to the windfarm, distributed by vessel type for the base and future cases, are presented in Figure 4.3 and Figure 4.4.

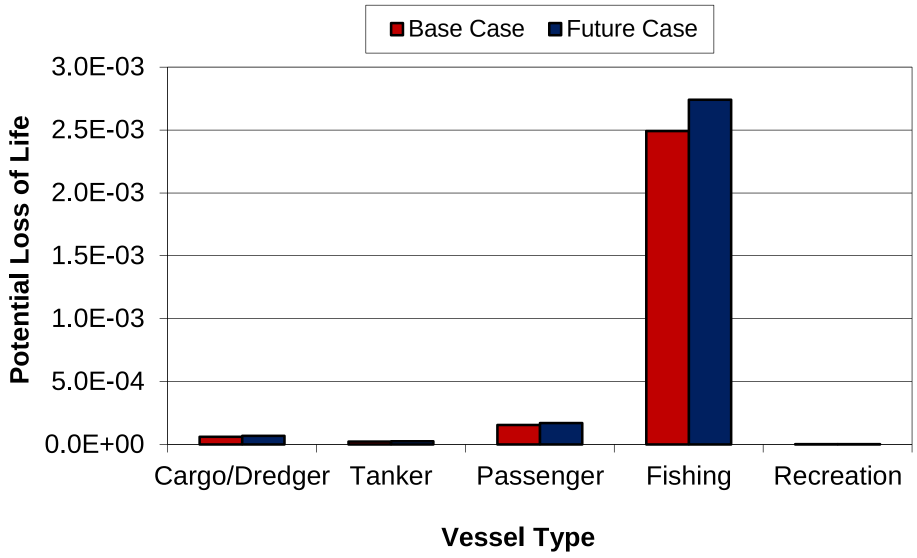

Figure 4.3 Estimated Change in Annual PLL by Vessel Type due to the Proposed East Anglia THREE Site (Partial Fill Build Scenario)

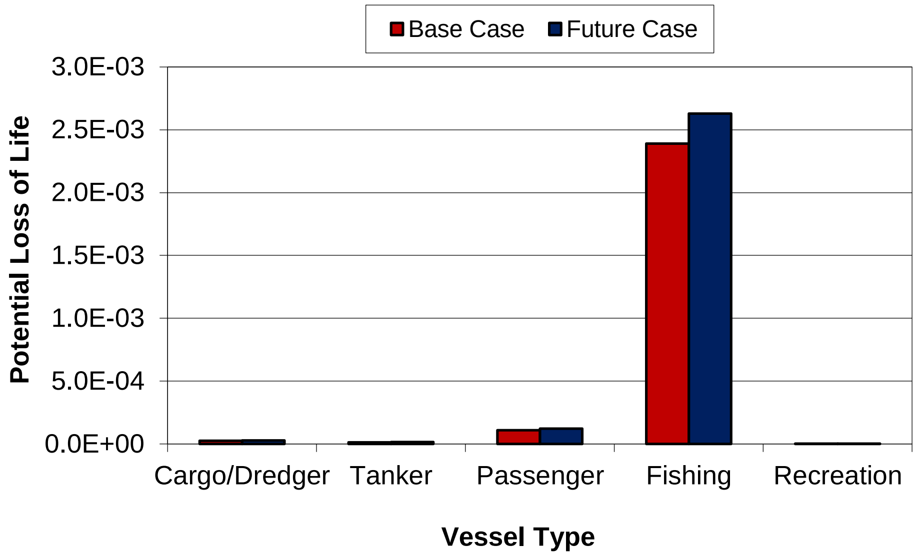

Figure 4.4 Estimated Change in Annual PLL by Vessel Type due to the proposed East Anglia THREE Site (100% Fill Build Scenario)

69. Therefore, it can be seen that the fatality risk is dominated by fishing vessels, which historically have a higher fatality probability per incident than merchant vessels.
70. Converting the PLL to individual risk based on the average number of people exposed by vessel type, the results are presented in Figure 4.5 and Figure 4.6.
71. This calculation assumes that for cargo/offshore vessels, tankers, fishing and recreational vessels, the risk is shared between 10 vessels of each type, which is considered to be conservative based on the number of different vessels operating in the vicinity of the site.

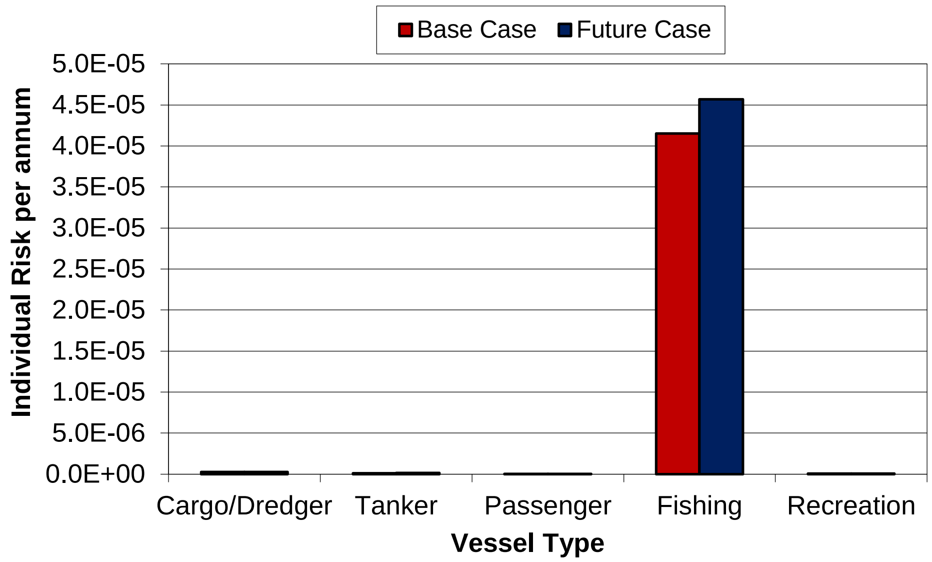

Figure 4.5 Estimated Change in Individual Risk by Vessel Type due to the Proposed East Anglia THREE Site (Partial Fill Build Scenario)

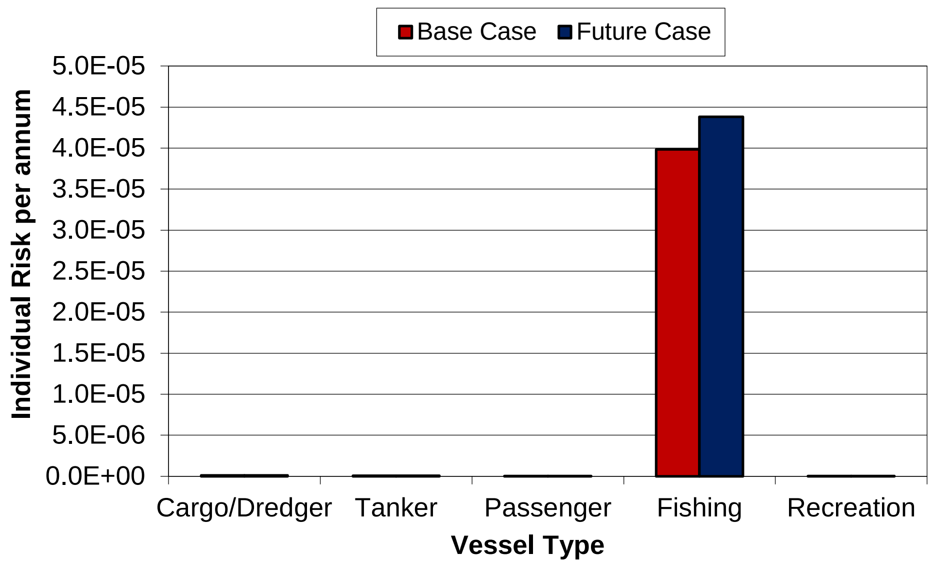

Figure 4.6 Estimated Change in Individual Risk by Vessel Type due to the Proposed East Anglia THREE Site (100% Fill Build Scenario)

72. Therefore, individual risk is highest for people on fishing vessels, which is related to the higher probability of fatalities occurring in the event of an incident as the greater change in collision frequency for fishing vessels.

4.4 Significance of Increase in Fatality Risk – East Anglia THREE

73. The worst case overall increase in PLL estimated due to the development is 2.7 x 10^{-3} fatalities per year for turbine the partial fill build scenario (base case),

which equates to one additional fatality in 366 years. This is a small change compared to the MAIB statistics which indicate an average of 29 fatalities per year in UK territorial waters.

74. In terms of individual risk to people, the incremental increase for commercial ships (in the region of 10^{-6}) is low compared to the background risk level for the UK sea transport industry of 2.9×10^{-4} per year.
75. 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^{-4}), it is relatively low compared to the background risk level for the UK sea fishing industry of 1.2×10^{-3} per year.

5. Pollution Risk

5.1 Historical Analysis

76. The pollution consequences of a collision in terms of oil spill depend on the following:

- Spill probability (i.e., likelihood of outflow following an accident)
- Spill size (amount of oil)

77. Two types of oil spill are considered:

- Fuel oil spills from bunkers (all vessel types)
- Cargo oil spills (laden tankers)

78. The research undertaken as part of the DfT's Marine Environmental High Risk Areas (MEHRAs) project (Ref. v) has been used as it was comprehensive and based on worldwide marine spill data analysis.
79. From this research, the overall probability of a spill per accident was calculated based on historical accident data for each accident type as presented in Figure 5.1.

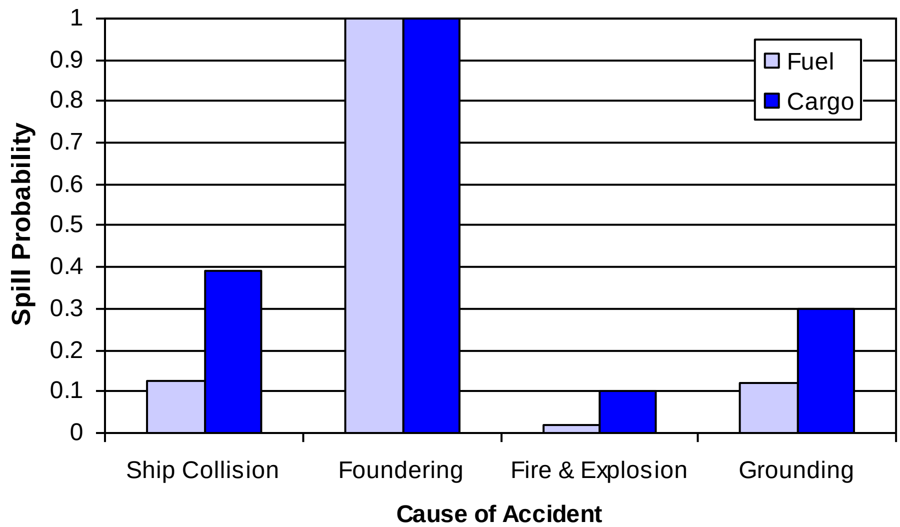

Figure 5.1 Probability of an Oil Spill Resulting from an Accident

80. Therefore, it was estimated that 13% of ship collisions result in a fuel oil spill and 39% of collisions involving a laden tanker result in a cargo oil spill.
81. In the event of a bunker spill, the potential outflow of oil depends on the bunker capacity of the vessel. Historical bunker spills from ships have generally been limited to a size below 50% of the bunker capacity, and in most incidents much

lower. For the types and sizes of ships exposed to the site, an average spill size of 100 tonnes of fuel oil is considered to be a conservative assumption.

82. For cargo spills from laden tankers, the spill size can vary significantly. International Tanker Owners Pollution Federation limited (ITOPF) report the following spill size distribution for tanker collisions between 1974 and 2004.

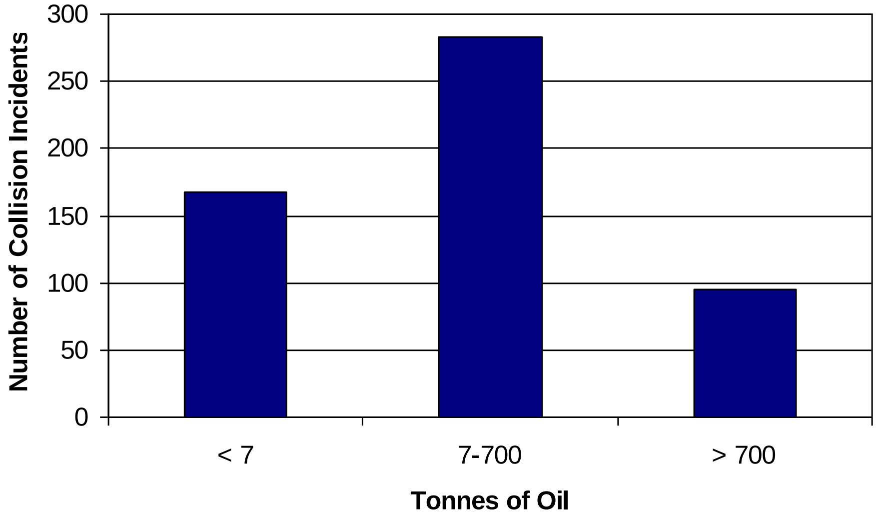

Figure 5.2 Spill Size Distribution in Tanker Collision Incidents (ITOPF 1974-2004)

83. 31% of spills are below 7 tonnes, 52% are between 7 and 700 tonnes and 17% are greater than 700 tonnes. Based on this data and the tankers transiting the area in proximity to the proposed East Anglia THREE site, an average spill size of 400 tonnes is considered conservative.

84. For fishing and recreational vessel collisions/allisions, comprehensive statistical data is not available so it is conservatively assumed that 50% of all collisions involving these vessels will lead to oil spill with the quantity spilled being an average of 5 tonnes for fishing vessels and 1 tonne for recreational vessels.

5.2 Pollution Risk – East Anglia THREE

85. Applying the above probabilities to the combined collision and allision frequency by vessel type presented in Figure 4.1 to Figure 4.2, and the average spill size per vessel, the amount of oil spilled per year due to the impact of the development is estimated to be as follows:

Table 5.1 Annual Oil Spilled due to East Anglia THREE

	Partial Fill	100% Fill
Base Case (tonnes of oil per year)	2.69	1.5
Future Case (tonnes of oil per year)	2.96	1.65

86. The predicted increases in tonnes of oil spilled distributed by vessel type for the two proposed turbine layouts are presented in Figure 5.3 to Figure 5.4.

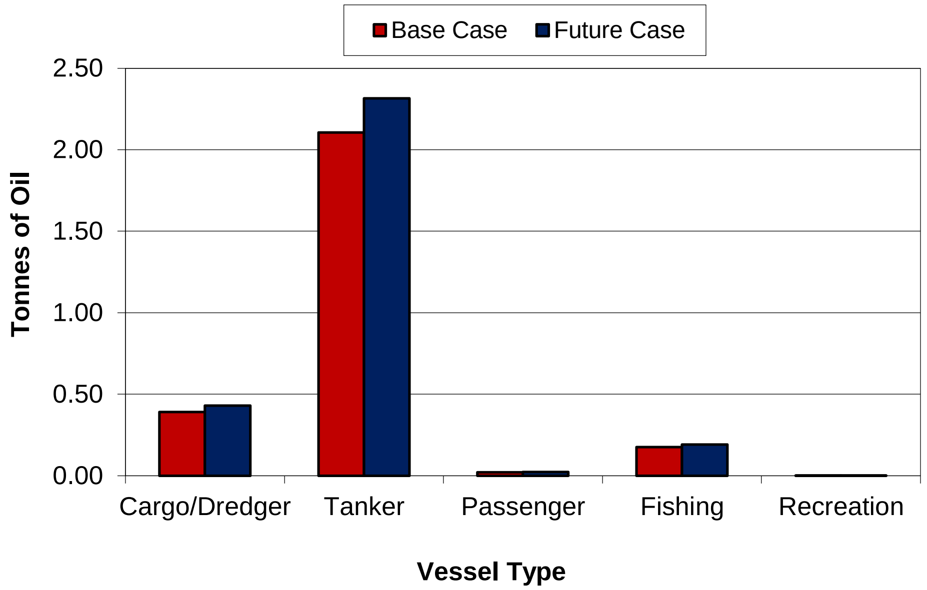

Figure 5.3 Estimated Change in Pollution by Vessel Type due to the proposed East Anglia THREE (Partial Fill Build Scenario)

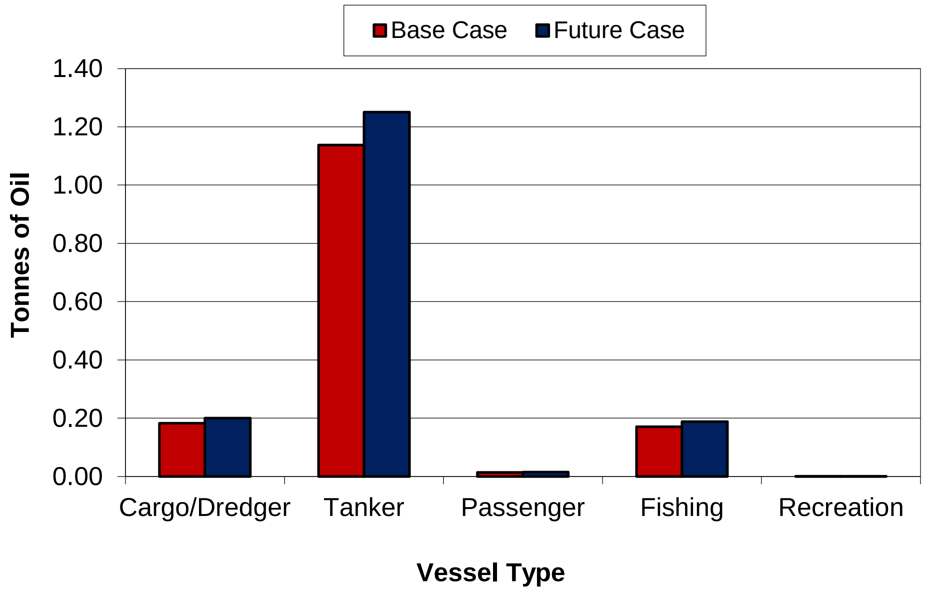

Figure 5.4 Estimated Change in Pollution by Vessel Type due to the proposed East Anglia THREE (100% Fill Build Scenario)

87. It can be seen that tankers, which can spill both fuel and cargo oils, contribute the majority of the overall risk of oil spill, although fishing and cargo/dredger vessels are also a significant contributor given the high annual collision frequency for the proposed development.

5.3 Significance of Increase in Pollution Risk

88. To assess the significance of the increased pollution risk from marine vessels caused by the proposed East Anglia THREE, historical oil spill data for the UK has been used as a benchmark.
89. From the MEHRAs research (Ref. v); the average annual tonnes of oil spilled in the waters around the British Isles due to marine accidents in the 10-year period from 1989 - 1998 was 16,111. This is based on a total of 146 reported oil pollution incidents of greater than 1 tonne (smaller spills are excluded as are incidents which occurred within port and harbour areas or as a result of operational errors or equipment failure). Merchant vessel spills accounted for approximately 99% of the total while fishing vessel incidents accounted for less than 1%.
90. The overall increase in pollution estimated due to the development is very low compared to the historical average pollution quantities from marine accidents in UK waters (approximately 0.017% for the partial fill build scenario, the worst case).

6. Conclusions

91. The quantitative risk assessment indicates that the impact of the proposed East Anglia THREE on people and the environment is relatively low compared to background risk levels in UK waters.
92. However, it is recognised that there is a degree of uncertainty associated with numerical modelling. For example, the model does not consider the potential radar interference from turbines which may have an influence on the risk of vessel-to-vessel collisions, especially in reduced visibility where one or both of the vessels involved is not carrying Automatic Identification System (AIS). Therefore, conservative assumptions have been applied in this analysis and the overall project is being carried out based on the principle of ALARP to ensure the risks to people and the environment are managed to a level that is as low as reasonably practicable.
93. It should also be noted that this is the localised impact of a single project and there will be additional maritime risks associated with other offshore windfarm projects in southern North Sea and the UK as a whole.

7. References

i IMO Maritime Safety Committee, 74th Edition, Agenda Item 5 (MSC 74/5/X), Bulk Carrier Safety – Formal Safety Assessment, 2001.

ii MCA "Safety Information – FSA, Statistical Data" web page.

iii International Labour Organisation, The Impact on Seafarers' Living and Working Conditions of Changes in the Structure of the Shipping Industry, Geneva 2001, JMC/29/2001/3.

iv Department for Transport Maritime Statistics 2004.

v Department for Transport, Identification of Marine Environmental High Risk Areas (MEHRA's) in the UK, 2001.

Appendix 15.1 (c) ends here