East Anglia Offshore Wind

VATTENFALL

SCOTTISHPOWER RENEWABLES

East Anglia THREE

Appendix 15.1

Annex 4

Navigational Risk Assessment
Risk Model Overview
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Overview of Risk Models

East Anglia THREE Offshore Windfarm

Appendix 15.1

Annex 4

Risk Model Overviews

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TABLE OF CONTENTS

1 Introduction

1. This appendix presents more details on Anatec's COLLRISK models used for the quantification of shipping risk.
2. The following models are described:

- Powered Allision Risk;
- Drifting Allision Risk;
- Ship-to-Ship Collision Risk; and
- Fishing Vessel Allision Risk.

3. Prior to this, background information is supplied on the shipping data used within COLLRISK.

2 Shipping Data

2.1 Overview of ShipRoutes

4. ShipRoutes is a shipping route database developed by Anatec to assist in identifying shipping passing in proximity to proposed offshore developments such as oil and gas sites, windfarms and dredging areas. The database was developed in two main phases:

- Movements Analysis:
  The number of movements per year on routes passing through UK waters was estimated by analysing a number of data sources including port callings data and voyage information obtained directly from ship operators. It is noted that ShipRoutes excludes the movements of 'non-routine traffic' such as fishing vessels, naval vessels, tugs, dredgers, yachts and offshore service vessels to mobile rigs.

- Routeing Analysis:
  The routes taken by ships between ports were obtained from several data sources, including:

  - Offshore installation, standby vessel and shore-based survey data.
  - Passage plans obtained from ship operators.
  - Consultation with ports and pilots.
  - Admiralty charts and publications.

5. This information was combined to create the ShipRoutes database containing all the shipping routes passing through UK waters, with each route having a detailed distribution of shipping characteristics.

2.2 Ship Exposure

6. One of the major assumptions of the COLLRISK models is that the collision risk is related to the exposure time, i.e., the longer a vessel is exposed to a hazard, such as bad weather or other shipping traffic, the more likely it is that an incident can occur.
7. On this basis, the first stage of the overall analysis is to assess the level of exposure time within each of a grid cells used in the analysis. This is achieved using Anatec's ShipRoutes shipping data and assessing the following for each route:

   - Number of vessels using route;
   - Proportion of route passing through cell; and
   - Average distance of route through cell.

8. This calculation is illustrated in Figure 2.1.

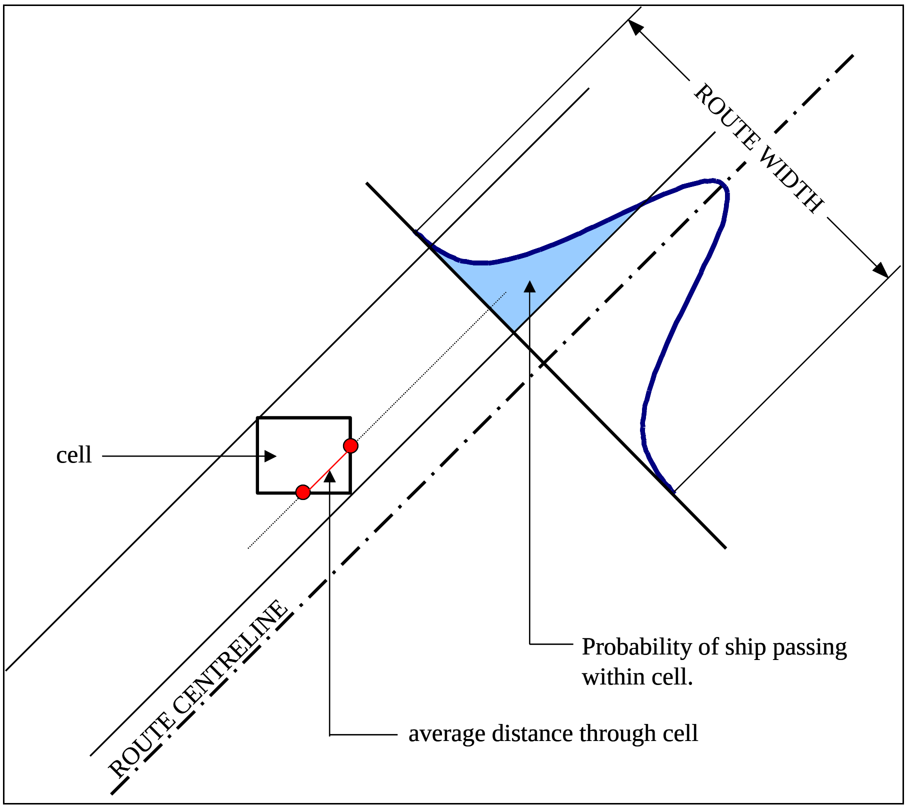

Figure 2.1 Calculation of Distance Travelled by Ships within a Cell

9. Having assessed the average distance for each route the speed distribution for that route can be used to estimate the overall time for shipping to pass through the cell on a daily and yearly basis. This is the exposure time.

3 Risk Model Descriptions

3.1 Ship/Installation Powered Allision Model

3.1.1 Probability of Collision

10. Anatec used COLLRISK to assess the risk of ship allision with the structures within the East Anglia THREE. The model is based on the premise that the allision frequency is proportional to the volume of traffic interacting with the structures. This is based on a review of historical data which indicated that ship watchkeeping failure tends to be the cause of passing vessel allisions with offshore installations (Ref. i) and hence that the size of the structure is indicative of the probability of the installation being hit by errant traffic on any particular route.
11. The shipping route data are taken from ShipRoutes. Within the model, the annual traffic levels, mean position and standard deviation of each route is used as a basis for determining the level of shipping that interacts with the structures.
12. The number of vessels on an allision course is calculated using the distribution algorithm for shipping around a route mean. Using this equation the model calculates the geometrical target area for each of the routes, giving account to the installation size, route standard deviation and mean CPA, and also the size distribution of the ships passing on each of the routes. The calculation is illustrated in Figure 3.1.
13. This assessment is performed for each of the routes passing the installations and the number of ships interacting with the installations is determined. These are summed to provide the total number of interactions that can be expected, which forms the basis of the calculating the collision frequency.

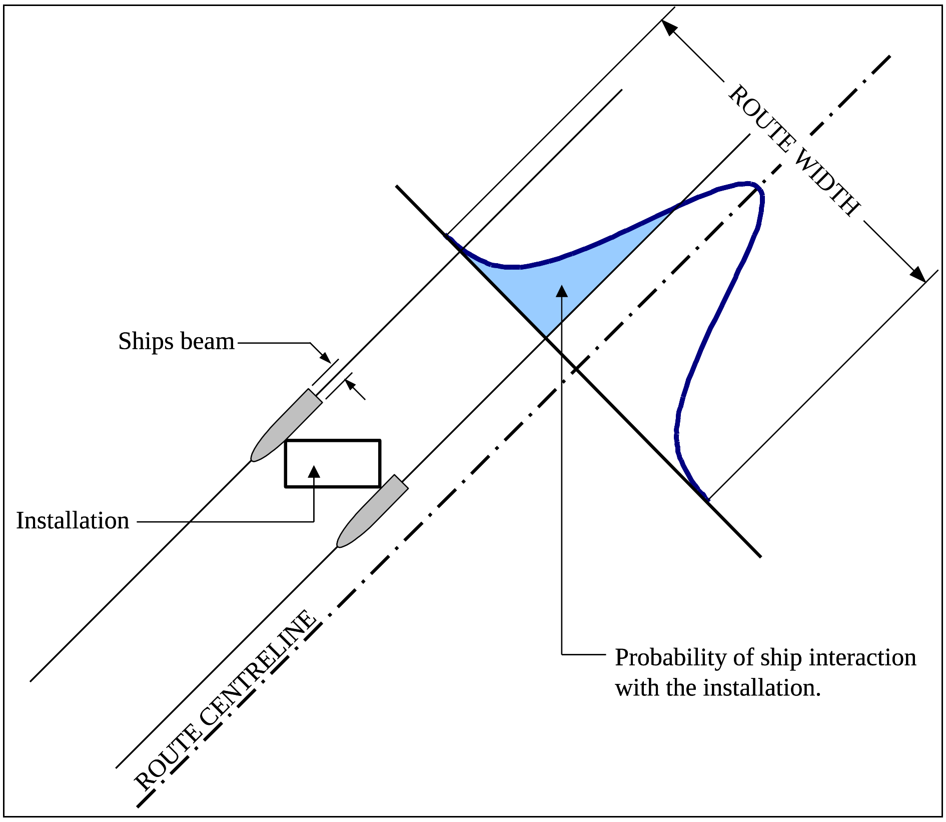

Figure 3.1 Geometrical Probability of a Collision Course

3.1.2 Calibration of Model and Influencing Factors

14. The Anatec collision frequency model has recently been calibrated based on a review of historical collision data on the UKCS (Ref. i), taking into account:

- Number of collisions;
- UK installation details (operational years, status and dimensions); and
- Vessel type (Note: Infield and fishing vessels were excluded).

15. The model uses location-specific data to take into account the effect of the following influencing factors on collision frequency based on HSE research (Ref. ii):

- ERRV specification (not applicable in this case);
- Visibility;
- Wave height;
- Vessel speed distribution;
- Shipping data (traffic density, type and size); and
- Installation dimensions and orientation.

3.2 Vessel/Installation Drifting Allision Model

16. The COLLRISK drifting risk model is based on the assumption that the engine(s) on a vessel must fail before it will drift. A generic failure rate of 2 x 10^{-5} per hour for shipping has been applied based on general maritime research, in the absence of detailed data for different vessel types and sizes. However, to provide further sensitivity within the model, the fact that certain vessels are likely to have more than one engine has been accounted for based on a survey of a cross-section of vessels of each type/size category operating in the area of interest. For example, passenger ferries generally have multiple engines providing redundancy.
17. Using this information it is possible to derive the overall rate of breakdown within each grid cell.
18. The probability of a vessel drifting towards the hazard, i.e., coastline, and the drift speed are estimated using the metocean data for the area. Similarly, the drift speeds are estimated based on this information.
19. Finally, the probability of vessel recovery from drift is estimated based on the time available to repair engines before allision. Many failures are identified and corrected before they can result in an impact, as vessel's engineers are generally well trained and equipped to perform repairs at sea, and spare parts for many major components are normally kept on-board. There is also the potential for external recovery via a tug. This varies depending on vessel size, drift speed and tug availability.
20. Vessels that do not regain power or obtain a tow to safety within the time to reach the hazard are assumed to allide.
21. As discussed above, the following influencing factors, identified from analysis of accident data, are considered when modelling the vessel drifting allision risk:

- Exposure time;
- Vessel Type;
- Vessel Size;
- Metocean Data; and
- Sea State.

22. The model requires information on the installations presenting the allision risk, i.e., the turbine layout and the structure dimensions.

3.3 Vessel to Vessel Collision Model

23. The risk of vessels colliding with other vessels is calculated in COLLRISK using the exposure times stored within the grid of cells for the area as well as the following influencing factors identified from analysis of historical data:

- Vessel types;
- Vessel sizes;
- Vessel speeds;
- Encounter situation (e.g., head-on, overtaking or crossing);

- Visibility; and
- Vessel Traffic Service (VTS).

24. Bad visibility has been demonstrated to increase the risk of vessel collision, whilst the presence of a VTS has been shown to reduce the risk of collision. Both of these factors are taken into account within the model using local data for the area of interest.

3.4 Fishing Vessel/Installation Allision Model

25. The fishing vessel allision frequencies for East Anglia THREE structures were estimated using Anatec's COLLRISK model for fishing vessels. This is a density-based model, calibrated directly with historical data, taking into account the following factors;

- Allision data between fishing vessels and UKCS offshore installations;
- Fishing vessel activity data for the UKCS;
- Fishing vessel activity within the windfarm site; and
- Installation dimensions.

4 References

i Ship/Platform Collision Incident Database, HSE, 2003.

ii Effective Collision Risk Management, HSE 1999.

Appendix 15.1 (e) ends here