IMMINGHAM EASTERN RO-RO TERMINAL

Applicant's Response to ExQ2 with Appendices

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Contents

1 Purpose of this document

1.1. The Examining Authority (ExA) issued its Second Written Questions to the Applicant and other Interested Parties on 15 September 2023 **[PD-013]** ("ExQ2").

1.2. A glossary of terms and a list of acronyms can be found in Section 12 of this document.

1.3. Th ExA's questions are set out using an issued-based framework derived from the Initial Assessment of Principal Issues provided as Annex C to the Rule 6 letter of 20 June 2023 **[PD-006]**.

1.4. Each question has a unique topic prefix identifier (capital letters), a reference number which starts with 1 (indicating that it is from ExQ1) and then a question number.

1.5. Column 4 of the Tables below provides the Applicant's response to each question addressed to the Applicant.

1.6. Where a question has been addressed through the making of a Deadline 4 submission, a cross-reference to the relevant DL4 submission is provided in the appropriate Table.

2 Broad, General and Cross-Topic

ExQ2	Question to:	Question	Applicant's Response
BGC.2.01	Applicant	**Inter-projects cumulative effects assessment:** Respond to the issues relating to ES Chapter 20 assessment of cumulative effects set out by the MMO in its Relevant Representation [RR-014 paras 4.3.2 to 4.3.6 inclusive]. *(If not fully addressed in the Applicant's Deadline 1 response to Relevant Representations.)*	The issues relating to Chapter 20 of the ES **[APP-056]** regarding the assessment of cumulative effects on physical processes set out by the MMO in its Relevant Representation **[RR-014 paras 4.3.2 to 4.3.6 inclusive]** are addressed in the Applicant's response to the Relevant Representations **[REP1-013]** at Table 4.8, references '4.3.2 – coastal processes' to '4.3.6 – coastal processes'. The MMO has since confirmed that all issues relating to physical and coastal processes are considered resolved. This is confirmed at paragraph 5.2.4 of the MMO's Deadline 1 submission **[REP1-020]** in which the MMO states '*given the responses that have been provided, we conclude that there are no remaining major concerns that require further development of the assessments'*. At paragraph 5.2.5, it states that '*the MMO does not have any immediate or definite concerns that the development impacts on coastal processes will, in themselves, result in significant coastal process change'*.
BGC.2.02	Applicant, CLdN, DFDS, IOT Operators, Marine Management Organisation (MMO) and Natural England (NE)	**Government policy concerning need and sustainable port development** With respect to the Government's policy relating to the need for port development and the encouragement for *"sustainable port development"*, including what is stated in the entirety of paragraph 3.3.3 of the National Policy Statement for Ports 2012 (NPSfP), and having regard to the cases you have made to date, explain in policy terms, why you consider the Proposed Development would or would not comply with the Government's encouragement for sustainable port development. In answering this question, the Applicant and other IPs are encouraged to make concise submissions and to address the matters listed in paragraph 3.3.3 of the NPSfP, as relevant.	It is the view of the Applicant that the Proposed Development is "*sustainable port development"* for the purposes of the NPSfP. Sustainable development can be said to involve the achievement of three interdependent objectives, namely – - an economic objective, - a social objective, and - an environmental objective. These objectives are, in the Applicant's view, reflected in those matters listed in paragraph 3.3.3 of the NPSfP which are indicated as being matters which new port infrastructure should achieve *"in order to help meet the requirements of the Government's policies on sustainable development …"* The Applicant's position on the accordance of the IERRT development with the matters set out in NPSfP paragraph 3.3.3 – along with other relevant paragraphs in that same part of the NPSfP – is summarised within Appendix 1 of the Planning Statement **[APP-019]** which in turn draws upon the wider body of evidence provided by the Applicant. The information provided in the Planning Statement is not repeated here for the avoidance of duplication. In advance of ISH3, the Applicant was aware that only one Interested Party (CLdN) had raised a question in respect of sustainable development matters, but that all that had been raised was a general statement – with no detail provided – that the proposed development did not constitute sustainable development. That general statement was not further explained or expanded upon in CLdN's written representation. At ISH3, however, some further assertions were made by CLdN on the matter. It is the Applicant's clear understanding from these comments that CLdN are not raising any inherent issues of sustainability but rather claim that the development is unsustainable in light of CLdN's contentions on other issues. The Applicant has

			addressed these other contentions and waits to see the detailed written summary of the position now being taken by CLdN at Deadline 4 before it responds as necessary to the points made at Deadline 5. The Applicant notes that at ISH3 a few points were also made about sustainable development matters by other Interested Parties – DFDS and the IOT Operators, but again solely in respect of those parties' positions on other issues which are separately addressed. The Applicant, therefore, is of the clear understanding that no party is contending that the Proposed Development is not sustainable in its own right. Again, the Applicant – as indicated at the hearing – will wait to see the detailed written summary of those points at Deadline 4 before responding if and when necessary at Deadline 5.
BGC.2.03	Applicant and any other IPs	**Relevant policies other than planning policy** Other than the policies stated in the NPSfP, the Marine Policy Statement 2011 and the East Inshore and East Offshore Marine Plans 2014 do you consider there any other policy considerations to which the Secretary of State for Transport should have regard in deciding this application?	Having submitted detailed policy evidence as part of its application, the Applicant understands that this question is predominantly aimed at Interested Parties. The Applicant will, of course, respond to any 'other policy considerations' points put forward by Interested Parties in due course. That being said, the Applicant highlights that within its application documentation it has drawn attention to various policy and related documents of relevance in addition to those specifically listed in question ExQ2 BGC.2.03. For example, it has drawn attention in its Planning Statement **[APP-019]** to local policy and strategies including that which is contained within the adopted development plan relevant to the site of the proposed development. The policy information provided within the application documentation is not repeated here for the avoidance of duplication.
BGC.2.04	Health and Safety Executive (HSE)	**Implications of the Proposed Development's operation for adjoining Control of Major Accident Hazard (COMAH) sites** Explain what consideration the HSE has given to the Proposed Development's operation having the potential to cause an incident affecting the safe use of any adjoining COMAH sites, for example the Immingham Oil Terminal (IOT), together with the wider Port of Immingham? In this context incidents might involve: a Ro-Ro vessel making contact (alluding) with either a berthed tanker or the IOT pipeline trunkway or an unoccupied berth forming part of the IOT's Finger Pier; a tanker manoeuvring on or off the IOT Finger Pier that alludes with a Ro-Ro vessel berthed at one of the Proposed Development's berth; or a collision between a Ro-Ro vessel manoeuvring to or from one of the Proposed Development's berths and a tanker vessel sailing to or from the IOT Finger Pier.	
BGC.2.05	CLdN	**Issues of storage capacity for Stena** Respond specifically to representations made about trailer storage capacity for unaccompanied freight and dwell times at Port of Killingholme made by Stena Line BV (Stena) in [REP2-065]. Identify any other matters that you consider could impinge on agreeing a new contract/tenancy between your company and Stena to accommodate growth in demand.	

BGC.2.06	CLdN	**Utilisation of facilities at Killingholme** Comment on the Applicant's proposition that there *"… are little to no opportunities for any further attractive berthing windows at preferred timeslots (i.e. during the day) at the current Ro-Ro berths in Killingholme …"* [page 72 in APP-079]?	
BGC.2.07	Stena	**Potential for unaccompanied Ro-Ro expansion at Killingholme** Please expand on the answer given to part (b) of the ExA's question BGC.1.5 in **[REP2-065]** including providing evidence to substantiate the points made about dwell time with direct reference to the 'Volterra Report' appended to the CLdN Written Representation **[REP2-031]**.	
BGC.2.08	Applicant	**Humber Accompanied/Unaccompanied Ro-Ro traffic** The submitted "Humber Shortsea Market Study" [APP-079] at paragraph 77 refers to accompanied Ro-Ro traffic in the Humber being around 12% of the total Ro-Ro volumes in 2020, with that volume being affected by the COVID pandemic. Is data postdating 2020 available and if so for the Humber Ports has the proportion between accompanied and unaccompanied Ro-Ro traffic altered since 2020?	The reference in paragraph 77 of the Market Study **[APP-079]** to '2020' is a typographical error. As the various graphs that are also provided in section 3.5 of the Market Study indicate, this should have been a reference to '2021' and not '2020'. Attached as **Appendix 1** to this document are tables providing Humber Ro-Ro volumes (both in terms of tonnage and units) for the periods 2017 to 2022 inclusive. These tables include the latest data available from 2022. In respect of that aspect of the Market Study that is being referred to in the question – which deals with Ro-Ro traffic in tonnage terms – Table 1 at **Appendix 1** shows that Accompanied Ro-Ro traffic on the Humber accounted for 12.5% of total Humber Ro-Ro traffic and that in 2022 the figure was a similar 12.2%. For completeness, the ExA should be aware that as a result of information contained within the Volterra Report submitted as part of CLdN's Written Representation **[REP2-031]**, it would appear that CLdN report container volumes moved on and off vessels on mobile cassettes to the DfT under a different category than the 'Unaccompanied Ro-Ro' category of cargo. The Applicant is still investigating this matter further and will provide its comments and the implications arising, as necessary, at Deadline 5, although the Applicant does not currently consider that this will affect the figures presented for the amount of Accompanied Ro-Ro cargo handled in terms of tonnage or units.
BGC.2.09	Applicant	**Simultaneous construction and operation** Respond to DFDS's contention that the effects of simultaneous construction have not been fully addressed in the Environmental Statement (ES) and that in-combination effects with the potential Immingham Green Energy Terminal would not be insignificant and those effects are at best as yet unknown [page 5 in REP2-039].	With respect to the effects of simultaneous construction and operation, the Applicant refers the ExA to Section 4 paragraphs 4.1 to 4.8 of *10.2.27 Applicant's Response to DFDS Written Representation* **[REP3-008]**. With respect to in-combination effects with the potential Immingham Green Energy Terminal (IGET), Chapter 20 of the ES **[APP-056]** includes a comprehensive cumulative and in-combination assessment. This assessment was based on the information available at the time of submission of the IERRT DCO application, including in respect of the IGET project. This is consistent with Natural England's advice in its response in the Scoping Opinion **[APP-081]** which notes - "*The following types of projects should be included in such an assessment, (**subject to available information**): […] plans and projects which are reasonably foreseeable, i.e. projects for which an application has not yet been submitted, but which are likely to progress before completion of the*

			development and ***for which sufficient information is available*** *to assess the likelihood of cumulative and in-combination effects".* (Emphasis added). In light of the above, the assessment of cumulative and in-combination effects is considered robust and remains as set out in the IERRT DCO application documentation. Cumulative and in-combination effects are assessed as insignificant and do not require further mitigation. Cumulative and in-combination effects will also be assessed (with mitigation proposed if necessary) in the IGET DCO application documentation for which all information will be available. That said, now that the IGET application has been submitted – albeit not yet accepted – the Applicant will keep the position under review.
BGC.2.10	Environment Agency, MMO, NE and North East Lincolnshire Council (NELC)	**Construction Environmental Management Plan (CEMP)** Advise whether you consider the submitted CEMP [APP-111] is currently sufficiently detailed to enable it to be used during the construction phase for the Proposed Development or whether this document should be treated as an outline CEMP, with a more detailed version needing to be submitted for NELC's approval prior to the commencement of the Proposed Development. Should you be of the view that the currently submitted CEMP is deficient, please identify those deficiencies and explain how they might be rectified.	

3 Compulsory Acquisition, Temporary Possession and Other Land Rights Considerations

ExQ2	Question to:	Question	Applicant's Response
CA.2.01	Applicant	**Acquisition of other land or rights** Would any land or rights acquisitions be required in addition to those identified in the Book of Reference **[APP-016]** to facilitate the construction and/or the maintenance of any impact protection measures subject to proposed Work No. 3, including any amendments to the design of that proposed work, should it be determined that the implementation of Work No. 3 would be necessary pursuant to the provisions of Requirement 18 of the dDCO **[REP3-002]**? In answering this question, the Applicant should have regard to the submissions made by the IOT Operators in its NRA **[REP2-064]** about the proximity of the impact protection measures subject to Work No. 3 to the Immingham Oil Terminal (IOT) trunkway and the practicalities of maintaining the latter.	In terms of the IEERT DCO application as submitted, no additional land or rights are required in addition to those identified in the Book of Reference. As the ExA is aware, however, the Applicant is currently discussing with the IOT Operators (as outlined in the Applicant's letter of 28 September 2023) the practicalities for the provision of a revised scheme of impact protection measures. If those discussions prove both positive and constructive, an amended scheme will be included in the pending Changes Application referenced at ISH1 and ISH3 and at that stage, information will be provided as to any amendments required in the context of both the Order Limits and any consequential amendments to the Book of Reference.

4 Climate Change

ExQ2	Question to:	Question	Applicant's Response
		No questions at this time	

5 Draft Development Consent Order (dDCO) [REP3-002/003]

ExQ2	Question to:	Question	Applicant's Response
DCO.2.01	Applicant	**Company versus Undertaker in the dDCO** The ExA notes that the Applicant considers the use of "Company" rather than "Undertaker" in any made DCO would avoid confusion in terminology in respect of any references to "statutory undertaker(s)" in other parts of a made DCO, not least because the Applicant is a statutory undertaker **[REP1-006/007 and REP1-008]**. The ExA is, however, mindful that National Highways (and its predecessor), as a company, has promoted numerous nationally significant infrastructure projects for which DCOs have been made by the Secretary of State for Transport, with National Highways being referred to as an Undertaker rather than a Company. Given that precedent the ExA is of the view that the Applicant should adopt that precedent. The Applicant should therefore replace references to Company with Undertaker when it next submits an amended version of the dDCO.	As previously noted, the Applicant's position remains that the choice of description itself has no legal consequences and it was intended to provide clarity, in line with other harbour facility DCOs previously accepted by the Secretary of State. In accordance with the ExA's request, however, the Applicant will replace references to "Company" with "Undertaker" when it next submits an amended version of the dDCO at Deadline 5 in accordance with the Examination Timetable set out in Annex A of the ExA's Rule 8 Letter **[PD-009]**.
DCO.2.02	Applicant	**Article 2 (interpretation)** ""the Order Land" means the land on the land plans and described in the Book of Reference". Do the dredging disposal sites come within that definition given that neither of them have been shown on the land plans or been referred to in the Book of Reference? If not then how might that discrepancy be addressed, given that Article 25(3) would permit the disposal of dredged materials as part of a made DCO?	The Applicant does not consider there to be a discrepancy between the land identified on the land plans and described in the Book of Refence and Article 25(3) of the dDCO. The disposal of dredged materials is governed by the Deemed Marine Licence ("DML") in Schedule 3 of the dDCO. Paragraph 4 'Licence to dredge and deposit' of the DML identifies two existing and already licenced deposit grounds where the deposit of dredged materials is permitted. These two deposit grounds are identified by their licence references in paragraph 4(4) of the DML and by their co-ordinates under paragraph 1 'Interpretation' of the DML. As a consequence, the disposal sites do not need to be included on the land plans or in the Book of Reference, following the approach taken for other port made Development Consent Orders, such as Able Marine Energy Park DCO 2014 and the Port of Tilbury (Expansion) Order 2019.
DCO.2.03	Applicant	**Article 4 (Incorporation of the 1847 Act)** a) What would be the consequences for the construction and/or operation of the Proposed Development if each of the sections of the 1847 Act listed in Article 4 of the dDCO were not to be incorporated into a made DCO? b) Notwithstanding the above, should section 89 be incorporated as it appears to be a section that has been repealed [page 61 in AS-004]? c) Notwithstanding the above, should section 101 be incorporated as it appears to only relate to the City of London [page 67 in AS-004]?	The Applicant notes the ExA's comments and, following ISH4 and the action points arising from that hearing, intends to review Article 4 and submit a revised dDCO at Deadline 5. That draft will capture those amendments from ExQ2 DCO.2.03 following the review by the Applicant.
DCO.2.04	Applicant	**Requirement 10 (Noise insulation)** During the course of Issue Specific Hearing 1 (ISH1) the ExA asked how proposed Requirement 10 would be enforced, because as drafted its provisions would be 'wholly self-policed' by the Applicant. The Applicant undertook to review the wording for this requirement. There has, however, been no substantive redrafting of Requirement 10 since ISH1. The Applicant should therefore review the wording	The Applicant notes the ExA's comments and, following ISH4 and the action points arising from that hearing, intends to respond with the details of the offer of noise insulation subject to Requirement 10 at Deadline 5.

		for Requirement 10, paying particular regard to how it would be enforced and how any disputes between a party being offered noise insulation and the Applicant would be adjudicated upon.	The Applicant is reviewing Requirement 10 and will address as necessary any amendments arising from ExQ2 DCO.2.04 in the updated dDCO to be submitted at Deadline 5.
DCO.2.05	Applicant	**Requirement 18 (Impact Protection Measures)** a) In the redrafted version of Requirement 18 why has the Statutory Conservancy and Navigation Authority (Harbour Master for the Humber) rather than the Statutory Harbour Authority for the Port of Immingham (the Dock Master) been identified as the body that would be responsible for making a recommendation to the Undertaker ("Company") as to whether or not the impact protection measures should be installed? b) In sub-paragraph (1) should *"The Company must give due consideration to any recommendation received …"* be replaced with 'must implement any [direction or instruction] [received or issued] by …'? c) Is the sequencing for sub-paragraphs (2) and (3) correct? Following any decision to install the impact protection measures it would appear more logical that the IOT Operators and the MMO be advised of that decision and then prior to the installation of those measures they be consulted about the detailed design for the measures. d) In terms of enforceability the wording for Requirement 18 needs further review, because the final design for the measures would need to be approved by a regulatory authority with that authority then having responsibility for enforcing the installation of an agreed/approved set of measures. As currently drafted the Applicant/developer would be required to consult on the design of the impact protection measures but having undertaken a consultation there would be no compulsion on it to implement the measures that had been consulted upon.	As the ExA is aware, the provision of impact protection measures (IPM) is currently subject to ongoing discussions with the IOT Operators in the light of information provided to the ExA during ISH3. The revised version of the dDCO to be submitted at Deadline 5 will include such revisions to Requirements 18 and related provisions as may be considered necessary.
DCO.2.06	Applicant	**Part 2 of Schedule 2 (Procedure for the discharge of Requirements)** a) **Paragraph 19(b)** (Interpretation), should the definition for "discharging authority" refer to section 60 of the Control of Pollution Act 1974 (CoPA1974), given the issuing of a notice under section 60 would be an enforcement activity rather than a procedure for discharging a Requirement? b) **Paragraph 20(3)** (deemed approval of applications to discharge requirements). The ExA at ISH1, raised a concern about deemed approvals being available in respect of any works to be undertaken within the Humber Special Area of Conservation, Special Protection Area and the Ramsar site. The wording for paragraph 20(3) therefore requires reviewing. c) **Paragraph 22(1)(b)** (Appeals), while Article 37 (Appeals under section 74 of Control of CoPA1974) has been removed from the originally drafted dDCO [APP-013] in the redrafted dDCO, Paragraph 22(1)(b) remains. There therefore appears to be an anomaly if the Applicant has accepted that any appeal arising from the issuing of notice under section 60 of CoPA1974 should be considered in a Magistrates Court and not by the Secretary of State for Transport. In any event the issuing of a notice under section 60 of CoCPA1974 would not be an act of discharging a Requirement. Consideration should be given to deleting paragraph 22(1)(b).	The Applicant notes the ExA's comments and, following ISH4, the Applicant is reviewing the identified paragraphs and will address as necessary amendments from ExQ2 DCO.2.06 in the updated dDCO to be submitted at Deadline 5.

DCO.2.07	Applicant and MMO	**Schedule 3 – Deemed Marine Licence (DML)** a) **Paragraph 1** (Interpretation) of **Part 1** of Schedule 3 of the DML – with respect to "Notice to Mariners", who is/are "*the King's harbour masters*"? That term has not previously been defined in the dDCO. b) **Condition 8** in **Part 2** of the DML - what triggers the need for a cold weather construction restriction strategy to be prepared or is its availability an absolute conditional requirement? Is there a need for a strategy to be prepared or submitted or should this condition simply set out a protocol for addressing cold weather conditions, with sub-paragraphs (a) to (c) already stating what can/cannot be done. c) **Condition 9** (Marine Noise Registry), is there any need to refer to detonation of explosives as there appears to be no reference to the use of explosives in connection with the construction of the Proposed Development in the application documentation? d) **Condition 12** (marine piling), suggested possible alternate wording: "(1) All marine piling in connection with the authorised development shall be subject to the following conditions – a) … b) The form of soft start shall be submitted to and agreed in writing by the MM), in consultation … (2) … 30 minutes prior to the commencement of percussive piling a search ~~should~~ **must** be undertaken … zone, percussive piling ~~should~~ **must** not be commenced … (3) … percussive piling ~~will~~ **must** cease until … (7) Subject to sub-paragraph (7) **(8)** … (8) (a) … 200 metres from **the** exposed mudflat … (8) (c) … on all construction barges ~~on the side of the barges closest to the foreshore~~ ~~and~~ **the** construction activity … (11)(a) and (b) should the maximum permissible number of piling rigs be specified? ie "196 hours where between two and four piling rings are in operation" (12) "… each work-block described in paragraph ~~(10)~~ (**11)** … (13) if the wording of condition 8 (cold weather piling restriction strategy/protocol) is amended along the lines suggested and goes onto incorporate wording requiring compliance with that protocol then there would be no need for sub-paragraph 13. e) **Condition 13** - licensed activities to comply with the marine scheme of archaeological investigation, combine with Condition 10? f) **Condition 20** (disposal at sea) – would there be any disposal at sea? If not then is this condition necessary? g) **Condition 22** (notice to mariners):	The Applicant notes the ExA's comments and intends to review the draft DML in discussion with the MMO. A meeting with the MMO is being arranged and the revised dDCO to be submitted at Deadline 5 will carry such amendments as are required – particularly in light of the ExA's comments.

		(1) Is there a need to include a reference to who will be responsible for providing notice, ie the licence holder? • (3)(c) - Is there a need to quote WGS84 in full and make provision for any successor document? • (3)(c) - Re notifying the MMO is there any duplication with Condition 25? h) Paragraph 27 (notice of determination) – in paragraph (1) what happens if the MMO does not issue a decision within 6 weeks of receiving an application? Is a deemed approval implied?	
DCO.2.08	Applicant	**Schedule 4 (Protective Provisions)** • General consistency point, in some parts of Schedule 4 reference is made to “authorised works” (e.g., Statutory Harbour Authority and Northern Powergrid), while in others reference is made to “authorised development” (e.g., Environment Agency, Exolum). Consistent phraseology should be used. • **Part 1 Statutory Conservancy and Navigation Authority for the Humber** ➢ In paragraph 1 (interpretation), for the Statutory Conservancy and Navigation Authority is there any need to refer to Associated British Ports, as the authority is a statutory authority operating independently of the Associated British Ports? ➢ Paragraph 3 (approval of details) – is text required stating that the tidal works cannot be commenced until they have been approved or been deemed to have been approved and if approved shall be carried in accordance with the approved details? Is text required clarifying that following a request for approval of details being made and the authority in response to that request seeking additional information/details that the 28-day determination period is recast to take account of when the additional details are received by the authority? ➢ Paragraph 10(4) (protective action) – who would determine that an environmental impact was greater than that anticipated in an Environmental Document? Could this situation arise because it would be likely to come to light through the discharge of Schedule 2 Requirements and/or DML conditions? • **Part 2 Environment Agency** ➢ Paragraph 19(1) “authorised development” is undefined, presumed reliance is placed on the definition in Article 2. Inconsistency point, why in some schedules is there a definition and why in parts of the dDCO reference is	The Protective Provisions as they appear in the dDCO are under negotiation with the relevant IPs, having been substantially based on precedents received from those parties. Inconsistencies in approach such as in the phraseology of defined terms are, therefore, (for the most part) because of the preferences of the recipients of these Protective Provisions, many of whom are unlikely to countenance revisions. This is especially the case where the revisions will have very limited or no impact on the meaning of the Protective Provision as a whole. It is also the Applicant’s experience that, even where precedent provisions are not applicable and have no relevance to the Proposed Development, some IPs are still insisting that these provisions be retained rather than deleted ‘just in case’. This is most notable in the retention of protections against compulsory acquisition for statutory undertaker land interests, despite the Applicant not seeking the compulsorily acquisition of any such land; but would also apply to points such as protections against the use of explosives. That said, the Applicant notes the ExA's comments and, following ISH4 and the action points arising from that hearing, intends to submit a revised dDCO at Deadline 5. That draft will capture those amendments from ExQ2 DCO.2.08 with which the Applicant agrees, and which the Applicant can agree with the relevant Interested Parties.

		made to authorised development while in other parts authorised works are referred to. If there was a single definition for the development/works that could be only stated in Article 2 and then reliance placed on that throughout the rest of the dDCO, with Schedule 1 providing a full explanation of the works. • **Part 3 Exolum** ➢ Paragraph 25 - no definition for “authorised development” ➢ Paragraph 26 – why is there a definition for “specified work”, which seems to overlap with the definition for “relevant works” used in paragraph 28? ➢ Paragraph 28(1) – why is there a reference to explosives? Does the Applicant have any intention to use explosives in connection with the construction of the Proposed Development? ➢ Paragraph 28(2) – why is there a reference to ABP rather than the Undertaker [“Company”]? • **Part 4 Humber Oil Terminal Trustees Ltd** ➢ Paragraph 37 – final word “Schedule”, should this be “protective provision”? ➢ Paragraph 38(1)(b), (c) and (d) - “relevant works”, undefined, issue of consistency. ➢ Paragraph 38(2)(a) – “Schedule”, should this be “protective provision”? • **Part 5 Northern Powergrid** ➢ Paragraph 43 “authorised works”? ➢ Paragraph 45(4) and (5) – references to “Schedule” rather than protective provision? ➢ Paragraph 46(1) – reference to Schedule rather than protective provision? Paragraph 53 - reference to Schedule rather than protective provision?	

6 Historic Environment including Marine Archaeology

ExQ2	Question to:	Question	Applicant's Response
		No questions at this time	

7 Biodiversity, Ecology and Natural Environment

ExQ2	Question to:	Question	Applicant's Response
BNE.2.01	Applicant	**Addressing concerns raised by Natural England** Provide an update on latest discussions and current position on each of the six areas of disagreement set out by Natural England's Principal Areas of Disagreement Summary Statement document dated 15 August 2023 **[REP1-022]** submitted at Deadline 1. • Impact of loss of functional habitat for SPA waterbirds • Noise and visual disturbance • Use of 300 metres rather than 200 metres as a disturbance distance for SPA waterbirds • Noise and vibration impacts on Special Area of Conservation's lamprey population • Construction noise impacts on marine mammals (grey seal) • Loss of intertidal/subtidal/seabed habitats Could you also provide an update on progress towards the other remaining issues set out in Table 1 of **[REP2-019]** where further information has been requested by Natural England.	The Applicant, along with its technical expert consultants, has consulted and been in discussion with Natural England in relation to their assessment of potential adverse effects on the Humber Estuary European Marine Site (EMS). This has taken place through the pre-application stage of the Project – and those discussions have continued following submission of the DCO application and through the Examination period. More specifically, following receipt of Natural England's Relevant Representation **[RR-015]**, Principal Areas of Disagreement Summary Statement document (PAD) **[REP1-022]**, and its subsequent Written Representation **[REP2-019]**, a number of meetings have taken place to discuss issues raised in those representations (including the arrangement of a Natural England site visit to the Port). As many of the questions raised relate to information which is available within the assessment material, a series of 'signposting documents' have been produced with the aim of identifying where the relevant information or assessment work can be found and to clarify and address the sorts of issues that were raised. That has already been a very productive process (as illustrated, for example, by the shortening list of outstanding comments in Natural England's most recent Examination submissions **[REP2-019 and REP2-020]**). To address the outstanding comments (both in Table 1 of **[REP2-019]** and those listed in the PAD **[REP1-022]**), a meeting was held with Natural England on 18 September 2023. Further clarifications were also provided to Natural England in writing following the meeting on 6 October 2023. Discussions on these matters continue to be constructive and the Applicant is optimistic all issues can be resolved, at least provisionally, by Deadline 5 and captured in the Statement of Common Ground. This sentiment was shared with Natural England in their initial feedback following the meeting. An update on each of the six areas of disagreement set out by Natural England is provided below: • **Impact of loss of functional habitat for SPA waterbirds** – Detailed analysis of bird distribution mapping data for the Immingham frontage has been provided to Natural England to clarify this point. It shows that birds use areas of mudflat enclosed by port infrastructure in similar densities to open areas of mudflat. It is, therefore, considered that any loss of functional habitat for SPA waterbirds during operation will be negligible and not of a magnitude that will cause an adverse effect on integrity (AEOI). • **Noise and visual disturbance** – Disturbance responses of coastal waterbirds are expected to be very limited during construction, both in terms of frequency and the spatial extent of effects. This is based on a robust and detailed assessment of the evidence on bird disturbance, as presented in Chapter 9 of the ES **[APP-045]** and the Habitats Regulations Assessment report (HRAr) **[APP-115]**. A detailed explanation of the evidence that supports the conclusions of the assessment was given to Natural England

			during the meeting. The assessment is based on evidence on disturbance distances from scientific literature (particularly using evidence from industrial environments with anthropogenic activity), bird surveys during ground investigation works for the IERRT Project, and the application of the proposed mitigation measures (winter marine construction restriction from 1 October to 31 March, use of noise suppression system during percussive piling, acoustic barriers/screening on barges, cold weather construction restriction, soft starts during percussive piling). • **Use of 300 metres rather than 200 metres as a disturbance distance for SPA waterbirds** – Stage 1 (Screening) of the HRA screened in birds (for potential Likely Significant Effects) using numbers for the entire Sector B count area (which overlaps with a wider area than a 300 metre zone) on the basis that the majority of birds recorded in Sector B occur in the eastern section of the foreshore fronting Immingham Docks (from the lock gate towards the IOT Jetty). It was considered possible that large flocks could be recorded in a 200-300 metre zone of influence of potential disturbance and therefore peak counts for the entire area should be used in Stage 1 (screening) and Stage 2 (Appropriate Assessment) of the HRA on a precautionary basis. As evidence has demonstrated, however, the responses of waterbirds to disturbance stimuli is in fact limited at any distances over 200 metres, it was considered appropriate to further refine this zone to 200 metres at the Appropriate Assessment stage, specifically for the Port of Immingham area, bearing in mind also the proposed provision of suitable mitigation. This precautionary approach is in line with the advice given by Natural England in its PAD **[REP1-022]** and Written Representation **[REP2-019 and REP2-020]**. • **Noise and vibration impacts on Special Area of Conservation's lamprey population** – Natural England are awaiting further input from a fish migratory specialist on each of the points relating to underwater noise and lamprey (as noted in **[REP2-020]**). The Applicant will continue to engage with Natural England in respect of this and looks forward to receiving an update from Natural England in due course. Based on the detailed assessment undertaken and the mitigation measures proposed for this project (including a night-time restriction on percussive piling during sensitive periods for migratory fish), however, it is considered that there is no potential for an AEOI on qualifying interest features of the Humber Estuary SAC including river and sea lamprey. • **Construction noise impacts on marine mammals (grey seal)** – The Applicant has committed in writing **[REP3-014]** to providing an updated HRAr **[APP-115]** to address the points raised by Natural England at Deadline 5. As part of this update, the above impact pathway will be assessed separately for injury and disturbance to marine mammals. A detailed assessment of disturbance and barrier effects to grey seal features has been provided in Chapter 9 of the ES **[APP-045]** and within the HRAr **[APP-115]**, and the conclusion remains that there is no potential for AEOI on qualifying interest features of the Humber Estuary SAC including grey seal.

			• **Loss of intertidal/subtidal/seabed habitats –** The Applicant maintains that Chapter 20 of the ES **[APP-056]** and the HRAr **[APP-115]** includes a comprehensive cumulative and in-combination assessment. As stated in Table 4.7 of the Applicant's responses to Relevant Representations submitted at Deadline 1 **[REP1-013]**, this assessment was based on the information available at the time of submission of the IERRT DCO application, including in respect of the IGET project. In light of the above, the assessment of cumulative and in-combination effects is considered robust and remains as set out in the IERRT DCO application documentation, in that cumulative and in-combination effects are assessed as insignificant and do not require further mitigation. Cumulative and in-combination effects will also be assessed (with mitigation proposed if necessary) in the IGET DCO application documentation for which all information will be available. Aside from the above, all other comments made by Natural England to date are considered resolved (or are awaiting further specialist advice from Natural England). As noted above, the Applicant has also committed in writing **[REP3-014]** to providing an updated HRAr **[APP-115]** by Deadline 5 to address the points raised by Natural England.
BNE.2.02	Applicant	**Updating the Habitats Regulation Assessment report** Provide confirmation that the updated HRA report, to replace **[APP-115]** will be submitted by Deadline 5 (23 October 2023), as stated most recently in **[REP3-014].**	The Applicant confirms that an updated HRA report will be submitted at Deadline 5.
BNE.2.03	Applicant	**Underwater noise modelling** Does the Applicant have any comments to make about the MMO's Deadline 1 representations relating to underwater noise modelling at paragraphs 5.1.2 to 5.1.17 of **[REP1-020]**?	The Applicant had a positive and constructive meeting with the MMO and its advisors, Cefas, on 21 September 2023 to discuss the MMO's Deadline 1 **[REP1-020]** and Deadline 2 **[REP2-016]** representations. The majority of the comments in their representations have been resolved and the meeting gave the Applicant an opportunity to present further clarification on the approach that was undertaken in the underwater noise modelling and confidence in the assessment outputs. The MMO's representations raised points about the model parameters that have been used in the underwater noise model. As was set out in the Applicant's underwater noise assessment **[APP-088]**, underwater noise monitoring has previously been undertaken in the Humber Estuary for the Green Port Hull (GPH) Project. This monitoring has enabled the Applicant to confirm that the key input parameters used in the model (namely the attenuation and absorption coefficient terms) are good estimates of the measured values for these parameters in the Humber Estuary. In other words, the input parameters have been validated by real-world data and this gives the Applicant confidence that the model predictions are robust and provide a reasonable representation of the actual propagation of underwater noise in the Humber Estuary and the potential range of effects. The Sound Exposure Level Single Strike (SELss) behavioural threshold that the MMO has suggested (135 dB SELss) as an alternative to what was applied in the ES (157 dB Sound Pressure Level Peak (SPLpeak)) is considered to be overly conservative and precautionary for Atlantic salmon as it is based on sound levels to

			which schools of sprat, which are a much more sensitive fish species to noise than salmon, responded on 50% of observations. The use of an intermediate behavioural threshold (139 dB SELss) commensurate with the lower hearing ability of salmon is considered more appropriate and results in very similar range of effects as the peak behavioural threshold that was used in the ES **[APP-088 and APP-045]**. There are two key outstanding comments from the MMO that have yet to be resolved: 1) the justification for the proposed migratory fish restrictions in June and between August and October; and 2) whether the restrictions should apply to vibro piling as well as percussive piling. The Applicant's position on each of these points was presented at the meeting with the MMO and its advisors, Cefas, on 21 September 2023 and the MMO is going to consider these remaining issues further before providing a formal response. Further detail in relation to point 1 is provided below against ExQ2 BNE.2.04. In terms of point 2, vibro piling will only result in a potential noise barrier across a small part of the estuary (*circa* 1 km range and less than 50% of width affected at all states of the tide). This partial barrier will be temporary and intermittent, only taking place up to 20 minutes each day (across four 5 minute vibro-piling windows) which equates to a maximum 1 % of the time during the period of the piling works. Given the validity and good level of confidence in the model outputs, as noted above in relation to the model parameters and thresholds applied, the potential effects of a partial barrier for 1 % of each day on the behaviour of migratory fish are considered inconsequential and not significant. It is clearly not considered proportionate or appropriate, therefore, for the restrictions to be applied to vibro piling. Furthermore, it should be noted that vibro piling is quoted in guidance[1] as a technique that may reduce noise levels, and has been applied as a mitigation measure for a number of marine projects, such as piling at New Holland Dock upstream of IERRT on the southern Humber Bank, which has recently been consented by the MMO (Marine Licence number: L/2023/00224/1). It is also not included in the piling restrictions that have been accepted for the Able Marine Energy Park's (AMEP) development. Overall, therefore, it is not considered reasonable or equitable for the proposed restrictions to apply to vibro piling for IERRT.
BNE.2.04	Applicant	**Duration of marine piling** Comment further on the MMO's concern in **[REP1-020]** that adequate justification has not yet been provided in respect of the proposed 140 hour and 196 hour piling timeframes over a four-week period during June and between August and October.	During the pre-application stage of the project, the MMO advised the Applicant to consider the Able Marine Energy Park's (AMEP) multiple seasonal piling restrictions as the potential basis for the development of targeted mitigation measures for the IERRT Project. By way of background, in simple terms, the AMEP measures limit the number of hours of piling per 4 week period during June and between August and October. It should also be noted that the AMEP development has been consented but has not yet been constructed and, therefore, the AMEP restrictions could take place

1 JNCC (2010). Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise.

			now and are considered an entirely acceptable real-life present day form of mitigation for the Humber Estuary. In order to develop measures specific to IERRT, the AMEP restrictions were rationalised by considering the differences between both projects in terms of: 1) the specific nature and scale of works; 2) the size and number of piles; and 3) the outcomes of the underwater noise modelling. In terms of the nature and scale of the works, IERRT will involve less than half the overall duration of piling that is required for the AMEP development (24-37 weeks for IERRT versus a minimum 2 year construction programme or 104 weeks for AMEP). In terms of the second point, IERRT will involve smaller sized piles that involve a lower hammer energy and therefore level of noise to install than AMEP (1.422 m diameter piles for IERRT versus 2.54 m diameter piles for AMEP). It will also involve far fewer piles (214 steel tubular piles for IERRT versus approximately 370 steel tubular piles plus additional sheet piles and anchor piles for AMEP). In terms of the third point, the percussive piling for AMEP was predicted to result in a potential noise barrier effect for migratory fish across the entire width of the estuary whereas the percussive piling that is required for IERRT is only predicted to result in a partial barrier across *circa* 70% width of the estuary at low water and *circa* 50% of the estuary at high water (as noted above in response to ExQ2 BNE.2.03, the vibro piling activity for IERRT is predicted to result in partial barrier across less than 50 % width of the estuary at all states of the tide). IERRT is also situated in a slightly wider, outer part of the estuary compared to AMEP and is surrounded by existing marine infrastructure on the southern bank of the Humber (e.g. the Immingham Outer Terminal (IOT)) that could potentially interfere and limit the propagation of noise into the central part of the estuary. It is important to stress that the partial barrier to movements and disturbance effects as a result of the piling for IERRT would be temporary and intermittent. It will not take place continuously as there will be periods of downtime, pile positioning and set up. The actual piling activity is only estimated to take place up to 14% of the time (involving up to 180 minutes of impact piling and up to 20 minutes of vibro piling each working day). The movements of migratory fish will therefore be unconstrained for the vast majority of time during construction. It is also worth noting that the underwater noise assessment is based on the worst case assumption that the percussive piling would be undertaken at full power for up to 45 minutes each pile (and up to 180 minutes for four piles per day). In actual fact, each pile will involve at least 20 minutes of initial soft start when the piling power will be gradually increased, incrementally, until full operational power is achieved (the use of soft start also forms part of the mitigation measures that will

			be implemented for the project in line with the JNCC piling protocol[2]). The assessment outputs are therefore considered to be precautionary. In summary, it is not considered reasonable to apply the more restrictive AMEP measures in their entirety and these have therefore been rationalised for IERRT to ensure they are proportionate whilst still being robust. Overall, the proposed restrictions are therefore considered proportionate to the level of risk for migratory fish.
BNE.2.05	Applicant	**Mitigating noise effects on fish** The MMO has concerns in respect of percussive piling and has proposed alternative mitigation measures (paragraphs 5.1.30, 5.1.31 and 5.1.33 in **[REP1-020]**). The Environment Agency (EA) in its Principal Area of Disagreement Summary Statement **[PDA-010]** has requested an additional condition be incorporated into the Deemed Marine Licence in the dDCO **[REP3-002]** relating to the protection of migratory fish from noise arising from percussive piling. Comment on the representations the MMO and EA have made about mitigating the effects of noise on fish.	**MMO alternative mitigation measures** The alternative mitigation measures that have been suggested by the MMO for June, and August to October involve restricting percussive piling during ebb and flood tides as salmon are considered to use tidal streams to move up and down the estuary. These suggestions have been given thorough consideration by the Applicant. A detailed tidal analysis has been undertaken to determine when the suggested periods of the ebb and flood tide would fall during the months of June, and August to October, when potential effects on migratory salmon might be less. These have also been compared against daylight hours to identify potential periods when piling activity could take place. The available working windows vary considerably each day and are very complex. For example, working windows may be available after sunrise and before the first tidal restriction, but on other days the restriction may be in place at the time of sunrise (which would mean there would no window of opportunity at first light to commence work). A working window may then become available once the tidal restriction has passed, and either until the next tidal restriction or until sunset (whichever comes first). This complex set of working windows has to be planned alongside an already very complex construction programme and works plans (which involves consideration of construction worker shift patterns and change overs, time spent ensuring health and safety procedures and safe systems of work are carried out, construction equipment and plant preparation, and implementing other mitigation measures such as soft start procedures during piling). The fact that the suggested alternative tidal restrictions create constantly moving working windows would mean construction planning would become prohibitively difficult. As such, the alternative measures are considered entirely impractical and would disproportionately prolong the construction programme with minimal ecological benefit (based on the assessment of effects, described in response to ExQ2 BNE.2.04 above). It is also important to highlight that piling activities are on the critical path for the construction programme (i.e., piling is the first activity that needs to be completed in order to construct the rest of the marine infrastructure, meaning it is not possible to complete other construction activities that do not involve piling). Any delay in completing the piling works will have a knock-on effect for the rest of construction programme. It is important to consider the restrictions that we have proposed for migratory fish in the context of other mitigation measures for the IERRT Project. The restrictions for migratory fish sit within a much wider package of mitigation measures for other receptors such as overwintering waterbirds. When you consider all the measures in their entirety, the month of July is the only month when there is no specific

[2] JNCC (2010). Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise.

			seasonal restriction on construction activity (although there are other non-seasonal mitigation measures that would still apply). Given the comprehensive nature of the currently proposed mitigation measures, the addition of more restrictive and complex measures as suggested by the MMO is not considered reasonable or proportionate. Overall, the restrictions that have been proposed by the Applicant for the IERRT Project, which are based on measures that have been accepted and could be employed on the estuary today for the AMEP development, are considered to be far more reasonable and appropriate. **Environment Agency additional condition** The Environment Agency's Principal Area of Disagreement Summary Statement (PAD) **[PDA-010]** requests an additional condition to ensure that no percussive piling takes place at times when adverse water quality conditions, namely water temperatures above 21.5°C and dissolved oxygen concentrations below 5 mg/l, will already be placing increased stress on migratory fish in the estuary. The Applicant has responded to this comment in the Applicant's response to the Relevant Representations **[REP1-013]** at Table 3.4, reference 6.4 to 6.7. In summary, water quality monitoring data has already been collected as part of the GPH project in 2015 and 2016. That data showed no exceedances of 21.5°C and dissolved oxygen concentrations remained above 5 mg/l. Therefore, whilst the Applicant has no objection in principle to installing a monitoring buoy during the time that IERRT marine works are ongoing, based on the data collected, it is considered unlikely to represent value for money or indeed a proportionate condition. The data from the monitoring buoy at Hull – further away from the mouth of the estuary and therefore further along the salinity gradient – shows there were no issues over the summer period and so it is reasonable to predict that conditions at Immingham will be even more benign. The Applicant notes the Environment Agency is still considering whether a condition in the Deemed Marine Licence (DML) to prevent percussive piling taking place when temperatures and/or dissolved oxygen concentrations are at levels that will already be placing salmon at increased stress when migrating through the estuary is necessary **[REP2-014]** at paragraph 4.1. The Applicant will continue to engage with the Environment Agency in respect of this and looks forward to receiving an update in due course.

8 Navigation and Shipping

ExQ2	Question to:	Question	Applicant's Response
NS.2.01	Applicant, Harbour Master Humber and Port of Immingham Dock Master	**Responsibility for safety management in the Port of Immingham** Based on the contents of the "Immingham and River Humber – Management Control and Regulation" note **[REP1-014]** is the ExA correct in believing that it is the Port of Immingham SHA which has responsibility and authority for the safety management system applicable to the Port itself, acting in liaison with the Humber Harbour Master as Competent Harbour Authority (CHA) responsible for pilotage services and as the SHA operating Vessel Traffic Services?	This is a correct summary of the position – with the emphasis being placed on the close liaison between both SHA's for the reasons enumerated in **[REP1-014]**.
NS.2.02	Applicant	**Harbour Authority and Safety Board (HASB) decision to defer impact protection to the IOT trunkway** The Applicant's explanation in **REP1-014** concerning the HASB's decision on risk acceptability for the Proposed Development does not fully clarify what consideration was given by the Designated Person and the HASB to the inclusion of adaptive risk control measures, such as IOT trunkway protection measures and/or the relocation of the IOT finger pier, identified and considered by the Applicant's consultants in the NRA report **[APP-089, para 9.9.3]**. Accordingly, the Applicant should submit copies of: a) any recommendation report for the Proposed Development submitted to the HASB meeting of 12 December 2022; and b) the minutes of that meeting relating to the consideration of the Proposed Development. With respect to the submission of the HASB recommendation report and meeting minutes, if they contain any material that the Applicant would not wish to be placed in the public domain then a full set of the minutes should be submitted for the ExA's confidential use together with a redacted set for publication in the Examination Library.	During ISH3, Captain McCartain explained how the HASB is involved in the wider decision-making process, including in relation to the Applicant's consideration of the Proposed Development. The presentation given to the HASB meeting, circulated in advance of the meeting for the consideration and review of members of the HASB and the minutes of that meeting are provided at document **10.2.39 – Written Summary of the Applicant's Oral Submissions at Issue Specific Hearing 3** submitted at Deadline 3.
NS.2.03	Applicant	**The "Designated Person"** Having regard to the DFDS submissions [pages 23 and 24 in **REP2-039** and **REP3-022]**, advise on: a) What role Gareth Robins, as the named Designated Person (DP) in the *"Port of Immingham Marine Safety Management System"* (September 2023 version) **[REP3-017]**, has had in advising the HASB about the Proposed Development. b) Whether Mr Robins attended the HASB's meeting on 12 December 2022, when the draft NRA for the Proposed Development was considered by the HASB prior to its submission as an application document. c) When Mr Robins was appointed as the DP. d) Whether the DP has been asked to review the NRA **[APP-089]** in the light of the written and oral representations that have been raised about it by IPs; and has made any further recommendations to the HASB about any aspect of the Proposed Development in the light of those representations. e) Whether the DP is a direct employee of Associated British Ports or an advisor fulfilling this role as a contractor.	a) Gareth Robins has had no role in the Proposed Development as he was not in post at the time. James Clark was the DP at the time and provided advice with respect to marine risk and simulation results. b) Mr Clark, as the Designated Person, attended the HASB Meeting on 12 December 2022. It will be noted from the minutes (which are provided as **Appendix 4 to document 10.2.39 – Written Summary of the Applicant's Oral Submissions at Issue Specific Hearing 3)** that discussions at the meeting were captured but were not specifically attributed to individuals. c) Mr Robins was appointed on the 24 August 2023. As explained during ISH3, however, Mr Robins has since been required to provide urgent cover for a marine operational role in ABP's Welsh Ports and is not currently acting as the DP. d) The DP was consulted on representations as was the Marine Adviser acting as the DP in his absence.

		Documentary evidence of any advice given to the HASB by the DP about the Proposed Development and any subsequent consideration of the Proposed Development undertaken by the HASB since December 2022 should accompany the answer to this question.	e) As is common practice, the DP is a direct employee of ABP and as Captain McCartain explained at ISH3, acting in his temporary capacity as Designated Person, the DP's duties and obligations encompass all of ABP's twenty one ports, across England, Wales and Scotland – not a single standalone port – thereby ensuring consistency of approach and review. As noted above, the HASB minutes provide a correct record of the comments made at the HASB, without attribution. That said, subject to decisions yet to be made by the Applicant in terms of the proposed changes, it will be necessary for the Applicant's HASB to reconsider the scheme and the changes proposed at the appropriate time.
NS.2.04	Applicant	**Decision making with respect to the installation of the impact protection measures (IPM)** Further to the Applicant's reply to the ExA's first written question NS.1.13 **[REP2-009]**, and the IOT Operators' response to the applicant's reply to NS.1.13 **[REP3-026]**, explain precisely the decision making process that would culminate in a decision being made by the HASB as to whether the IPM subject to proposed Work No. 3 would or would not be installed. The response to this question must at the very least address the following matters: a) Who would initiate the process for considering whether there might be a need to install the IPM? b) When/how would the process for considering whether or not there might be a need to install the IPM be initiated, i.e., prior to the commencement of the Proposed Development, prior to the first operation of the Proposed Development or following the use of the Proposed Development having commenced and in response to general experience or an incident? c) What information would be relied on to compile "relevant assessments/reports" and who would be involved in compiling those reports/assessments and be responsible for preparing any recommendation report for the HASB's consideration? d) How long would it take for a decision to be taken from the initiation of the consideration process to the HASB making a decision? e) In the light of the drafting for Requirement 18 included in the dDCO **[REP3-002]**, explain precisely what roles the SHA for the Humber Estuary and the SHA for the Port of Immingham would have in assisting with the consideration of whether the IPM would or would not be installed. The ExA does not consider that the Applicant's reply to question NS.1.13 provided in **REP2-009**, when read in conjunction with the information provided in **REP1-014**, provided a sufficient level of detail.	As the ExA is aware, this question may become of less direct relevance if negotiation between the Applicant and the IOT Operators in relation to IPM reach a conclusion. The Applicant will ensure that the ExA is kept fully informed as to the progress of those negotiations and if those negotiations prove constructive, what scheme of IPM will be included in the Applicant's pending Changes Application. Subject to the outcome of those negotiations, the Applicant intends to set out a further reply to the additional questions posed by the ExA as necessary.
NS.2.05	Applicant, CLdN, DFDS	**Stakeholder input to assessment of risks** Further to the Maritime and Coast Guard Agency's (MCA) advice in **[REP1-021]** that the organisation responsible for Port Marine Safety "*should strive to maintain consensus …through … stakeholder engagement and …review of risk assessments*	It should be noted at the outset that the MCA's advice simply reflects their published advice detailing how the Port Marine Safety Code should be implemented **[REP1-021]**.

	and IOT Operators	*with users…"* what are the main obstacles to achieving consensus and what are the prospects of achieving consensus by Deadline 5 of this Examination?	It is certainly the case that a statutory harbour authority "*strive[s] to maintain consensus"* and the MCA guidance does indicate how this can be achieved, namely via stakeholder engagement and the review of risk assessments. As the ExA is aware, the Applicant has explained how stakeholders have been kept fully involved in this process with a view to achieving consensus but the MCA's Guidance does, of course, not require consensus to be achieved and it is inevitable that there may sometimes be disagreement between stakeholders given their different aspirations or commercial objectives. As an experienced SHA and to whom this type of exercise is far from novel, the level of engagement and consultation undertaken to date has far exceeded that which would normally be the case and the SHA has acted fully in accordance with the guidance in seeking to achieve consensus. In the circumstances where commercial considerations are in play for stakeholders, and notwithstanding the efforts made to achieve consensus, it has not been possible so to do. As far as the prospects of achieving consensus by D5 are concerned, the SHA will continue to seek to do so, but the main obstacles are the different commercial aspirations and objectives of certain stakeholders. In producing purported alternative NRAs which have not been made subject to the requisite engagement with the relevant bodies, the IPs are pursuing their own commercial agenda. Those NRAs have not been the subject of consultation which of itself necessarily reduces any chance of achieving consensus. In many respects they largely follow the same format as the Applicant's own NRA – save for the insertion of individual judgements by these other commercial stakeholders in relation to tolerability which rather predictably support the stakeholders' own commercial objectives but – without any consideration given to the views of the SHA which actually has the statutory duty safely to manage the Port. In light of the above, it is difficult to see how consensus can ultimately be achieved. It should be noted that as SHA, all regulatory oversight of the management of the Port remains the responsibility of the SHA – and no other party. The SHA will continue to take account of the information provided by the other stakeholders including what is now included in these alternative NRAs, but the SHA will also continue to fulfil its own statutory duties objectively by reference to what its responsibilities require and as a result of overall assessment of all the relevant issues taking account of the full range of information including that provided by persons with both particular experience and expertise in this area including persons like the Harbour Master Humber and the Dock Master.
NS.2.06	Applicant	**Inputs informing HASB judgements of risk control cost effectiveness** What assumptions on cost and risk consequences were presented to the HASB in deciding to potentially defer the implementation of IOT trunkway protection measures until after the Proposed Development had become operational and to discount the relocation of the IOT finger pier all together?	The HASB received a detailed presentation which set out the process which had been undertaken to complete the navigational risk assessment (NRA) including a discussion and consideration of the likelihood/consequence tables, the tolerability approach and the cost/benefit exercise which helped determine whether or not a risk was as low as reasonably practicable (ALARP) and tolerable. As the ExA is aware, the Applicant's NRA, a draft of which was provided in advance to members of the HASB for their consideration, concluded that all risks were both

			tolerable and ALARP without the need to introduce impact protection measures and without the relocation of the finger pier. Following careful discussion and consideration, the HASB confirmed that, on the basis of the information provided: • It was satisfied with the approach taken to the marine navigational risk in relation to the future development of IERRT; and • It agreed with and approved the conclusion that the risks identified were as low as reasonably practicable (ALARP) and tolerable. In addition, the HASB took into account – • The consideration of costs and benefits which formed part of the NRA process – as is described in the NRA **[APP-089]**; • The analysis demonstrated that any residual risks in respect of the finger pier were tolerable such that relocation was simply not required; and • The risk assessment considered the risk to be ALARP.
NS.2.07	Applicant, CLdN, DFDS and IOT Operators	**Examples of any comparable Ro-Ro berths and fuel import/export berths siting relationships** Give examples of any port layouts in the United Kingdom where Ro-Ro berths and fuel import/export berths have comparable siting relationships with what is being proposed for the Port of Immingham.	The Applicant provided a verbal response to this at ISH3. The best and most obvious example of comparable Ro-Ro berths in proximity to fuel import/export berths is the Port of Immingham itself in its existing condition. As outlined by James Hannon during ISH3, but also discussed in more detail in evidence, there are existing Ro-Ro berths at the Immingham Outer Harbour currently operated on a daily basis at all stages of the tide by DFDS in close proximity to fuel import/export berths, both at IOT, the finger-pier but also at the Western and Eastern Jetty. In addition Ro-Ro ferries on a daily basis access the Inner Harbour at Immingham through the Immingham Dock in close proximity to the Western and Eastern Jetty. Both operations and manoeuvres already take place in the vicinity of the IOT jetty, the western and eastern jetties and the Immingham Bulk Terminal, with Ro-Ro vessels manoeuvring in and out of berths and in and out of Immingham Lock at all states of the tide and in a manner which requires the required levels of knowledge to operate safely (with pilots or PEC) in a way which is safely controlled by the Harbour Master Humber and the Dock Master. That situation has existed for many years. As already pointed out at ISH2 and ISH3, there is a notional “risk” in respect of such existing operations as there would be for the Proposed Development, but such risks are operated at tolerable levels and ALARP through the combination of measures in relation to operations by the Harbour Master Humber and Dock Master with the assistance of tugs as and when necessary to ensure safe operations throughout the day and year. For reasons addressed in the detailed evidence, the safe operations of those vessels remain the responsibility of the SHA. The operation of the Proposed Development has been fully assessed already by the SHA with the relevant input from stakeholders and those with expertise to demonstrate how the Proposed Development would operate safely and the limiting conditions have already been tested and would continue to be tested in the implementation of the Proposed

			Development in due course. What is being proposed for the Proposed Development is, therefore, no different in principle to what is already being operated successfully and safely at the Port of Immingham. Whilst the layout of the Proposed Development is necessarily different in certain ways to the current arrangements, the principles of the manoeuvres and the mechanisms for ensuring safe operations are all fundamentally the same, where the operations have already been simulated using the type of vessels that would be used in all sorts of different conditions with the involvement of not just the masters of the vessels, but tug operators and the Harbour Master. The fact remains that the DFDS operations at the Immingham Outer Harbour and the Ro-Ro operations into and out of the lock all present their own challenges, none of which are fundamentally different in nature to those for the Proposed Development and which simply require safe operating procedures to be adopted. Vessels currently enter and exit the existing berthing facilities in close proximity to IOT in a safe manner where the risks are at a tolerable level and ALARP and that will continue to the case with the Proposed Development. Indeed, as pointed out at ISH3, whereas the existing operations take place without the Proposed Development in place (where the IOT trunkway has no impact protection measures in place), the Proposed Development itself will introduce a further de facto barrier in respect of the trunkway itself (although it is clear that the existing arrangements are already accepted by all to be safe, tolerable and ALARP in any event). As a result of all the work that has been done by the Applicant, the Applicant fundamentally disagrees that there is any issue in relation to the safe operations of the Proposed Development in conjunction with any of the existing infrastructure. As to other ports and harbours, it is of course the case that no two ports or their operations will be the same but in this case the existing Port of Immingham, already provides the best example of the relationships that are proposed (as set out above). As a consequence of obvious differences between all ports, one would not expect to be able to identify direct equivalents with the same navigational arrangements, constraints and topographical features. Having sounded that basic caveat, as explained at ISH3 in more detail and looking at ports where Ro-Ro ships are having to manoeuvre in proximity to fuel berths or similar infrastructure, there are a number of examples where the port environment and relevant marine infrastructure require similar degrees of navigational knowledge and expertise in order to achieve the safe arrival and departure of Ro-Ro vessels whilst in close proximity to critical infrastructure and oil/fuel transfer and storage marine facilities. This is managed in the usual way by the SHA for those ports. As noted during ISH3, examples include marine facilities at Purfleet, on the Thames close to the Dartford Crossing, Milford Haven and Portsmouth. In addition, attention is also drawn to the Port of Rotterdam outside the UK. All vessel operations in these ports are perfectly well controlled within a tidal environment and are managed in the normal and safe way. There are large vessels, moving in close proximity to important infrastructure and assets of a critically important nature for the UK. The SHAs manage and control navigational safety and risk through Risk Assessment, using controls, procedures and guidance to reduce

			the risk to ALARP. All of these operations are different in terms of tidal flow, manoeuvring room, berthing manoeuvres and essential infrastructure. Plans of typical ports are attached as **Appendix 1 to document 10.2.39 – Written Summary of the Applicant's Oral Submissions at Issue Specific Hearing 3,** with a brief explanation as to the issues arising at each port.
NS.2.08	Applicant	**Equally challenging manoeuvres undertaken on the Humber** Under item 32 in your post Issue Specific Hearing (ISH) 2 written submissions **[REP1-009]** reference has been made to "…challenging manoeuvres currently undertaken on the Humber …" by pilots and masters with pilot exemption certificates. Provide examples of situations where challenging manoeuvres are currently being undertaken on the Humber.	The use of the word "challenging" simply describes navigational manoeuvres which require navigational skills from a master or a pilot or PEC master. The safe manoeuvring of a vessel in any tidal estuary, be it the Humber, the Solent, the Mersey or elsewhere in the UK – by the very nature of tidal estuaries which are hydrodynamically variable with varying tidal forces, water levels, shifting morphology and, of course, changeable weather conditions all fall within the category "challenging." It simply denotes that it requires skill and control and is reliant on a number of factors including training, the use of tugs (in appropriate circumstances), the observance of SHA directions etc. As far as typical examples on the Humber are concerned, the operating conditions at the Immingham Outer Harbour are obvious examples which fall within the same definition of the word "challenging" as is the case for vessels using Immingham Lock. The ExA will be aware that at ISH3 the Applicant has asked the operators of the Outer Harbour RoRo berths to produce any recent navigational simulations undertaken in relation to vessel access and departure from the Inner Dock. It should be noted that the Outer Harbour has been operating safely for just under 20 years. In addition, both Stena and DFDS vessels currently use the Port of Immingham's Inner Dock with an approach beam to tide and crossing a flow gradient with a departure from lock at Immingham on an ebb tide. All without incident.
NS.2.09	Applicant	**Pilotage Incidents and consequences** Explain what actions were taken in response to the incidents that were subject to investigations undertaken by the Marine Accident Investigation Branch (MAIB), as cited in DFDS's Relevant Representation **[RR-008]**.	It is understood that a response to this question is being provided by the Humber Harbour Master.
NS.2.10	MCA, Applicant and DFDS	**Responsibility for safe navigation** If a marine incident occurs within a port, who is ultimately responsible: ship's master; pilot; or port/harbour authority and are any spatial constraints on vessel manoeuvring a defence against culpability?	If a marine incident occurs within a port, and the vessel concerned was without a pilot/PEC, consequent investigation and review would be the responsibility of the Port of Immingham SHA. If a vessel is involved in a marine incident and it was carrying a pilot or had a controlling PEC, then that would lead to a joint investigation between, in the context of incidents on the Humber, the Port of Immingham SHA and the Humber SHA, through Humber Estuary Services. The investigation would involve a joint MARNIS incident report and would be led by the Humber harbour Master/HES. Responsibility for safe navigation, therefore, rests with a number of different bodies and individuals, all with specific legal duties and obligations and whose remits will inevitably on occasion, quite properly, overlap. The safe management of a Port cannot be run in management silos. Whilst it is incumbent upon the relevant SHA to exercise powers of direction over vessels within its harbour authority area, the complex nature of vessel movements

			within the marine environment will often mean that marine incidents can have multiple, and sometimes compounding, causes. Ultimately, the ship's master is in command of the vessel at all times. The pilot is only present in an advisory capacity. That said, however, ignoring the pilot's advice could in many circumstances result in further safety breaches. Whilst the SHA exercises powers of direction, ultimately it does not directly control the vessel. In the context of the question generally, it should be noted that the provisions of the Dangerous Vessels Act 1985 empowers harbour masters to give directions prohibiting vessels from entering the areas of jurisdiction of their respective harbour authorities or to require the removal of vessels from those areas if it is considered that those vessels present a grave and imminent danger to the safety of any person or property, or risk of obstruction to navigation. In all cases the relevant SHA in accordance with the provisions Harbour, Docks, Piers Clauses Act 1847 has overall control and jurisdiction for incident management and will take the lead in any such incident or event. Assistance can be provided (depending on the nature of the incident) by the MCA (HM Coastguard), local authorities, emergency services or the Secretary of State's Representative for Counter Pollution and Salvage. Primacy, however, remains with the SHA through the relevant appointed person be it the Humber harbour Master or in this context, the Port of Immingham Dock Master.
NS.2.11	Harbour Master Humber	**Closure of river due to a marine incident** Under what circumstances it might it become necessary to wholly or partially close the river Humber to commercial shipping after an incident involving a tanker or pipeline infrastructure and what might be the duration and consequences of such closure?	
NS.2.12	Applicant	**Humber Estuary Serious Marine Emergency Plan** Submit a copy of the Humber Estuary Serious Marine Emergency Plan (HESMEP) which has been listed in the Abbreviations/Acronyms section of the Navigation Risk Assessment (NRA) [APP-089] and explain its relevance to the Proposed Development and adjoining sites.	The Applicant has provided this at **Appendix 2** to this document**.**
NS.2.13	MCA	**The MCA's views about the adequacy of the Applicant's risk assessment methodology** Further to the submission of the IOT Operator's Written Representation **[REP2-062]** does the MCA continue to be content about the adequacy of the risk methodology applied by the Applicant in its NRA [APP-089]?	
NS.2.14	IOT Operators	**Consequence classifications for effects to property and business** Signpost or explain the benchmarks used to derive consequence classifications for effects to property and business referred to in paragraph 208 of your NRA **[REP2-064]** and whether any internationally recognised safety classification provide authority for the classifications stated in Table 5 of your NRA.	

NS2.15	Applicant	**Potential consequences of collision with a tanker berthed at the IOT** IOT's Written Representation in commenting on ExQ NS1.17 **[REP2-062]** describes a catastrophic potential chain of events consequent were a Ro-Ro to come into contact with a vessel on Berth 8 whilst it is loading motor spirit. Provide clarification as to whether and how such a consequence was assessed in the Applicant's NRA and confirm if and when a "chain of events" similar to that described was raised in stakeholder consultation for the Proposed Development.	The Applicant's NRA **[APP-089]** at Appendix C, Table C1 contains the Hazard Log detail for the risk that corresponds to this scenario, namely an allision/contact between a Ro-Ro vessel and a vessel moored on the Finger Pier. In the 'worst credible scenario' section of the Hazard Log (Table C1) there is a chain of disastrous events which was considered by the participants at the HAZID workshops by reference to questions of credibility in the worst of all instances. During the HAZID workshop each risk was first identified in the within the 'operation' category and was then discussed in detail with the Interested Parties – all of whom contributed with their respective robust views. These views which informed the risk assessment, were then recorded in Hazard Log Table C1.
NS.2.16	Applicant	**Grading residual IOT allision risk As Low As Reasonably Practicable (ALARP)** The Applicant's Deadline 3 interim response to the IOT Operator's NRA at paragraph 1.16 **[REP3-012]** states "*the applicant has not ruled out impact protection. These two controls along with a substantial list of other controls identified by the Applicant are sufficient to reduce the risk associated with allision to the point where the risk is considered ALARP and tolerable by the SHAs."* Confirm if this means that impact protection is considered necessary for the risk to be considered as ALARP, and if so, why is the protection subject to Requirement 18 and why is the above statement at odds with the statement made in the Applicant's response to the DFDS alternative NRA [paragraph 1.7 in REP3-009] and its answer to ExQ NS.1.12 **[REP2-009]**?	Negotiations between the Applicant and the IOT continue to take place, but without prejudice to the Applicant's basic position that impact protection measures are not necessary in light of the Applicant's NRA and the assessment of safety that has been undertaken. As has been explained during ISH3 and underlined in the Applicant's responses submitted for D3 **[REP3-009, REP3-011]**, the Applicant's position remains that the conclusions of its submitted NRA are correct and have not in any way been undermined by the alternative NRAs submitted by DFDS and IOT Operators - both of whom it is suggested are pursuing their own aspirations in terms of commercial objection or improvement of their own facilities. On that basis, the Applicant maintains, that for the reasons that have been rehearsed in the NRA and reviewed by the Applicant's HASB, impact protection measures are not required and are not necessary for the risk to be ALARP and the interim response did not alter that. It was simply summarising the position that with the measures identified in the NRA itself all risks have been reduced to ALARP and tolerable without such impact protection measures, but they remain available to be introduced if the Harbour Master were to recommend their introduction. As the ExA is aware, however (and without prejudice to that basic position informed by the NRA), in light of the IOT Operators' position and the wish of the Applicant to maintain good relations with it as one its tenants, the Applicant has indicated during ISH3 that it is prepared to continue negotiations with the IOT Operators with a view to providing impact protection measures. If these can be agreed by the ExA and otherwise incorporated, the Applicant will propose amendments to the provisions of the draft DCO – although the ExA will understand that it has not been possible to provide the necessary revisions by Deadline 4 in that the revisions themselves will be subject to the acceptance by the ExA of the Applicant's pending Changes Application.
NS.2.17	Applicant	**Standard for acceptability of societal risk** Comment on the summary conclusion reached by the IOT Operators in its NRA [paragraph 194 in **REP2-064**] that "*an appropriate standard of acceptability for societal risk, in relation to harm to people is a figure of one fatality in 100 years could be adopted, which is the limit between Tolerable subject to ALARP and Intolerable. An appropriate and robust Navigation Risk Assessment should therefore adopt these parameters*."	In the context of any proposed marine infrastructure development and/or marine licensing, the exercise of Navigation Risk Assessment (NRA) when forming part of required Environmental Impact Assessment (EIA) is to seek to identify, assess and if necessary, propose mitigation to ensure that the proposed development does not have a significant impact on shipping and navigation receptors – and in the context of development within the Port of Immingham, the already implemented MSMS and

			underpinning Formal Risk Assessment (FRA) as outlined in the Port Marine Safety Code (PMSC). Assessment as part of an NRA is not required to include the assessment of societal risk nor is it required to identify and address COMAH Hazards which are subject to their own regulations and different considerations apply. That said, there is nothing to prevent an NRA informing the Societal Risk Assessment (which is produced as a distinct exercise) or COMAH risk and how the COMAH site operator should control and mitigate any identified risk. The point to be noted, however, is that the NRA is not the principal vehicle for such assessment exercises – at best, it can merely be used to inform. The HSE does not regulate the maritime, marine, or navigational functions of the port or the terminals therein. COMAH and the use of COMAH and HSE Societal risk applies to landside. The use of an NRA to make decisions on COMAH and Public Safety hazard ID and control is completely inappropriate and wrong in principle and no precedent has been identified for this approach and it is not an approach required by the HSE – which is responsible for COMAH. Moreover, the Maritime and Coastguard Agency (MCA) guidance states (only guidance existing that references marine based assessment against HSE guidance) – *The HSE is careful to note that any quantitative 'unacceptable' limits must be used with great caution. The concepts used in establishing them are complex, and the quantitative predictions that might be compared against them are fraught with uncertainty. It may not be helpful to attempt to define quantitative limits, and developers should consider whether there are other ways to define what is unacceptable. The HSE guidance document Reducing Risks Protecting People (R2P2) notes that what is unacceptable "…is often spelled out or implied in legislation, ACOPs, guidance, etc or reflected in what constitutes good practice" such that there is no need to set an explicit quantitative boundary. Developers should therefore carefully justify any unacceptable limits they propose.*
NS.2.18	Applicant	**Maximum number of passengers and drivers on board Ro-Ro vessels** Clarify the maximum number of passengers (non-ship's crew) expected to be on board a Ro-Ro vessel arriving at or departing from the Proposed Development and comment on the figure of up to *"300 passengers"* made by IOT in its NRA **[REP2-064]** and the implications for the related conclusions. In answering this question, the Applicant should make clear the number of lorry drivers it is envisaged would be on board Ro-Ro vessels and how this category of person has been accounted for in arriving at the conclusions included in the Applicant's NRA [APP-089].	The intention at present is that once operational, only vessels on the Immingham – Hook of Holland route will carry passengers and then only at weekends and as noted in the draft DCO, with numbers limited to a maximum of 100 passengers. No passengers will be carried on the Immingham to Rotterdam route. When there is sufficient capacity for passengers to travel, it is anticipated that the vessel will also carry between 30 and 69 freight drivers. The Hook of Holland vessels have ample accommodation for both passengers and freight drivers. The Applicant has no idea how and why the IOT Operators' NRA references 300 passengers – which in the context of the exercise would seem to be a surprising error – particularly bearing in mind the clear wording of the limitation in the draft DCO.

NS.2.19	IOT Operators	**HSE-imposed acceptability levels** When were the HSE-imposed acceptability levels to risk referenced in the IOT's NRA [paragraph 201 in **REP2-064**] previously "*provided to IERRT developers with the Standards of Acceptability to IOT Operators as a COMAH site under UK Health and Safety Executive regulations*"?	
NS.2.20	Applicant	**Further Controls to be applied to control risks of collision or allision in relation to IOT** Confirm or correct the assumptions made in paragraphs 333 to 339 of the IOT Operator's NRA **[REP2-064]** on further Risk Controls that would be committed to and applied by the Applicant if the DCO is made.	As the authors of the IOT Operator's NRA accept, the risk controls identified in their alternative NRA simply constitute good practice which is already in place as part of the Applicant's day to day safe management of the Port. The references to the MSMS are misleading – the Applicant has published the MSMS Manual but is not able to publish the MSMS itself for the reasons already explained. As far as the point raised about the Marine Liaison Plan is concerned, this is dealt with in the Applicant's response to NS.2.21 below. In brief, therefore, all of the controls identified by the Applicant's NRA and reflected in the IOT Operators' NRA either already constitute operational good practice within the port or will be put in place for the Proposed Development as the SHA considers to be appropriate.
NS.2.21	Applicant	**Port Liaison Role and Marine Liaison Plan details** A 'Port Liaison Officer' role is referenced in [paragraph 1.12 in **REP1-013**] "*to ensure that there is a suitable marine liaison plan and that it is followed*". Signpost or provide further detail on the scope and responsibilities of such a role, its initiation and duration and reporting line(s) and clarify when a Marine Liaison Plan would be produced, what it would comprise and how this role is secured in the dDCO.	Section 9.9.14 of the NRA **[APP-089]** explains that a 'port liaison officer' was included as an added control for the risk associated with a collision between a craft associated with the marine works and a Ro-Ro vessel, in the event that construction and operation occur simultaneously. This captures an important requirement for liaison to occur between the works contractor, Dock Master, VTS and Pilotage (CHA), to ensure that the works are coordinated and carried out safely, with clear lines of communication established. In practice, this role will be fulfilled by the Assistant Dock Master (ADM) function which provides 24/7 coverage of the marine operations at the Port of Immingham. The contractor will also be required to allocate a key point of contact who is responsible for keeping the ADM informed of marine construction works. This will be initiated prior to the commencement of the relevant construction activities and the lines of communication captured within a marine liaison plan specific to the works. The roles and responsibilities and reporting lines are described below: The Immingham Dock Master is responsible for all marine activities at Immingham and is supported by the Deputy Dock Master. There is a shift on permanent duty at Immingham to oversee the marine activities at the Port and each shift is under the control of an Assistant Dock Master (ADM). In addition to the ADM, each shift consists of two Marine Supervisors, a Radio Operator (RO) and six persons under a composite staffing arrangement. The number of staff in a shift may vary depending on workloads and staff changes. Marine Supervisors supervise the berthing of vessels on the East and West Jetties, the mooring of vessels entering the lock, the berthing and mooring of vessels in the enclosed dock and Humber International Terminal, in addition to preparing the berths for vessel arrivals. The Marine Supervisors attend the berthing of vessels in the Outer Harbour and ensure that Safe Systems of Work are complied with and that Port

			Authority By Laws and Merchant Shipping regulations are adhered to. Both report to the ADM who is responsible to the Dock Master. The Radio Operator is responsible to the ADM for all communications with vessels on passage to Immingham and for liaison with VTS Humber for logging arrival and departure data and general telephone enquiries. The six additional staff work to the instructions of the Marine Supervisors. The scope of the Marine Liaison Officer will be to liaise with the contractor undertaking the IERRT construction works and ensure there are clear lines of communication between all parties to allow the safe planning and berthing of vessel movements alongside construction activities.
NS.2.22	Applicant	**Consequences of reduced space for operations at IOT Berth 8** Signpost where and how the NRA has taken into account the risk consequences of reduced manoeuvring space adjacent to IOT berth 8, specifically with regard to the use of tugs to help vessels arrive at or depart from IOT berth 8; and with regard to the IOT answers to ExQ NS.1.9 and 1.10 **[REP2-062]** that "de-slopping" to barges would further reduce the clearance between a vessel berthed at Berth 8 and the Proposed Development.	Appendix C, Tables C2 and C3 within the Applicant's NRA **[APP-089]** describe the risks considered and assessed in relation to the operation of barges and tankers at the IOT Finger Pier. Further discussion on these risk assessment hazard logs can be found within Section 9 of the NRA. The necessary manoeuvres were considered in the navigational simulations and the simulations using the design vessels - which were agreed by APT prior to the navigational simulations - demonstrated that the reduced space made no significant difference to the navigational limits at which the vessels arriving or departing Berth 8 would be able to operate. It was, however, advised that additional training would be required to familiarise pilots and PECs and tug masters with the techniques applied in the simulations. As far as de-slopping is concerned, it is understood that this is not currently part of the IOT Operators' operations and is not, therefore, considered in the NRA. Should a de-slopping operation be required in the future, both parties would work together to agree safe operating procedures.
NS.2.23	Applicant and IOT Operators	**Relocation of the Immingham Oil Terminal (IOT) finger pier berths 8 and 9** In the Applicant's interim response to the DFDS alternative NRA [paragraph in 1.27 in **REP3-009**], it is stated that "'*RC06: Moving finger pier' – This control has been considered and determined not be in line with the principle of ALARP"* and paragraph 1.28 confirms that assumes removal and reconstruction of the whole pier, which IOT is now suggesting would not be necessary. On a 'without prejudice' basis (preferably on a joint basis) comment on how the following risk control measures proposed by the IOT Operators in its NRA [paragraph 352 in **REP2-064**] might be incorporated and secured as an amendment to the application: a) relocation of IOT berths 8 and 9 to the landward face of the IOT river pier (outside the proposed Order limits) or alternatively the extension of the Finger Pier to enable the relocation of berth 8 to the riverward face of the Finger Pier, as in paragraph 5.4 of IOT's Written Representation **[REP2-062]**; and b) an impact protection "island" between Proposed Development and the IOT finger pier (within the proposed Order limits), as an alternative to the impact protection measures subject to proposed Work No. 3 in the dDCO **[REP1-005]**.	As already noted, without prejudice discussions as to the provision of IPM are currently ongoing with the IOT Operators and an update as to the current position of these discussions will be provided by the Applicant for Deadline 5.

		In responding to this question consideration should be given to how any amendment(s) to the Proposed Development might be: 1) advanced during the remainder of the Examination; 2) secured through a provision or provisions (Requirement or any other means) of the dDCO; 3) any compulsory acquisition implications, including implications for the interests of the Crown Estate; 4) any implications under the Environmental Impact Assessment Regulations and the Habitat Regulations; and 5) any other legal considerations.	
NS.2.24	IOT Operators	**Cost effectiveness assessment in the IOT Operators' NRA** Confirm that the cost effectiveness assessment in the IOT Operators' NRA was based on relocation of IOT berths 8 and 9 to the landward face of the IOT river pier and the impact protection for the Proposed Development's berths, as described in paragraphs 343 to 345 and 352 of **REP2-064**.	
NS2.25	IOT Operators	**Cost effectiveness differential between low and high energy impact protection** Please clarify the cost-effectiveness differential assessed between protection measures against low and high energy impact and how a ratio of 20 has been derived for this risk control measure, as reported in IOT Operators' NRA [**REP2-064**].	
NS.2.26	Applicant	**Cost of the IPM for the IOT trunkway** What is the total capital cost for the Proposed Development? What sum has been set aside for implementing the IOT trunkway IPM, i.e. what is the current estimated construction cost for Work No. 3, should it be concluded that the installation of those measures were necessary?	The ExA will appreciate that in the current UK financial climate with its attendant uncertainties and bearing in mind the competitive climate within which the Applicant is operating including the need to secure competitive tenders, the anticipated capital cost of the project is, at present at least, commercially confidential. As far as the likely cost of the IPM is concerned, this is currently being reviewed in light of the ongoing discussions referred to during ISH3 on IPM despite the conclusion reached in the Statutory Harbour Authority's NRA to the effect IPM are not required. Subject to any issues of commercial confidentiality, the Applicant will revisit an answer to this question in the light of the ongoing work that is taking place.
NS.2.27	Applicant	**Betterment** Explain in what ways is it considered that the implementation of the IPM and the full or partial relocation of the IOT Finger Pier would constitute betterment for the IOT Operators [Table 7.17 in **REP1-013** and section 5 of **REP3-011**]?	Existing operations at the IOT, including the finger pier, already take place in the existing operating environment at the Port of Immingham and have done safely with all appropriate controls and measures already identified without IPM. The introduction of IPM in circumstances where they are not considered necessary for the Proposed Development (as set out in the NRA conclusions) will result in betterment of the existing facilities, as would the partial or full relocation of the IOT finger pier, as inevitably any such changes will introduce further enhanced facilities for the IOT (for example by of enhanced protections for their own operations) in circumstances where those measures are not considered to be required as a result of the Proposed Development. As with the response provided to NS.2.23, negotiations as to the provision of IPM are currently ongoing – and the Applicant will address the issue of betterment further in light of the outcome of such negotiations. It is intended that a comprehensive update will be provided at Deadline 5.

NS.2.28	Applicant	**Impact speeds and forces for the proposed IOT trunkway IPM** Identify what vessel speeds and impact forces the proposed IPM for the IOT trunkway, subject to proposed Work No. 3, have been designed to accommodate.	As noted above, negotiations as to the provision of IPM are currently ongoing with the IOT Operators – those discussions including issues such as vessel speeds and impact forces. It is intended that a comprehensive update will be provided at Deadline 5.
NS.2.29	Applicant and Harbour Master Humber	**Towage as embedded risk control for berthing and unberthing** On the basis of that the Applicant's explanation **[REP2-009]** that although towage would be one of the embedded risk controls, the provision of towage services should not and cannot be secured by a made DCO explain how the Immingham and Humber SHAs would each respond to ensure that the identified risks associated with berthing or unberthing at the Proposed Development would be controlled to ALARP in the event that suitable towage were to be unavailable to meet the demand.	The SHA is responsible for ensuring the safe operation of the Port in any conditions. The simple and straightforward position is that a berthing or unberthing manoeuvre would not be completed if there is no tug availability where a tug is required. The vessel would stay on berth until safe to sail (if leaving) or turn around and go back to anchorage until it was safe to berth (whether because a tug became available or the conditions no longer required). This is simply reflective of current practice which already applies for the Port of Immingham now. In the very unlikely event that demand for towage outstrips supply then, where the required manoeuvre cannot take place, the manoeuvre would simply not be allowed to take place.
NS.2.30	Applicant	**Vessel propulsion redundancy for dredging and construction vessels** Further to the answer given to ExQ NS.1.8 regarding embedded risk controls, would dredging and construction vessels used in connection with the Proposed Development have "vessel propulsion redundancies" available to them and if that is not known how has that informed the assessment of risk?	In the Applicant's experience undertaking marine construction projects, it is common for construction vessels such as dredgers to have propulsion redundancies in place such as double-engine propulsion systems and back up engines. In addition, the works craft will deploy spud-legs to provide a stable working platform for piling activities and will be equipped with anchors in the unlikely event these also need to be deployed. When a contractor is appointed for the works, there will be a requirement to liaise with the SHA for the Port of Immingham and HMH to ensure that safe operating processes and systems are implemented that are satisfactory to both SHAs and incorporated to the MSMS. The Humber Harbour Works Consent process is an established control. The Applicant has explained this process, and its ongoing discussions with the Harbour Master Humber in relation to this process, in its response to ISH3 Action Point 25.
NS.2.31	Applicant	**Visibility restrictions on navigation as risk control** Respond to the IOT Operators' comments in **REP3-026** relating to the references to visibility and harbour directions for Ro-Ro vessels as a risk control for the Proposed Development made by the Applicant in **REP2-009** in answering ExQ NS.1.8.	It is understood that the Humber Harbour Master will be responding to this question.
NS.2.32	Applicant, Harbour Master and DFDS	**Use of tugs with Ro-Ro vessels** Comment on the concerns made by the IOT Operators in **REP3-026** further to the Applicant's answer to ExQ NS.1.8 regarding the disadvantages or hazards inherent in using towage tugs with Ro-Ro vessels.	The comments made by the IOT Operators have been made without any justification. They are considered to be completely unfounded and represent a lack of understanding and expertise informing the IOT Operators' alternative NRA. The practical fact is that tugs are employed in an 'assistance' capacity for Ro-Ro and Ro-Pax operations in ports around the UK. It is important to note that a tug will only be required to fulfil its "assistance" role if the conditions or situation so demands. It is not intended that tugs will operate as a full time berthing requirement for the Proposed Development.

			For assistance, by way of example, "Towage Guidance" for Portsmouth International Port, which operates Ro-Ro, Ro-Pax, cruise ships and general cargo vessels explains and underlines the routine nature of tug assistance with Ro-Ro vessels.
NS.2.33	Applicant, DFDS and Stena	**Effects arising from contingency of lack of tug availability** What would be the typical consequences if an additional tug was unavailable for a planned passage if a master during an "*act of pilotage*" for an arriving vessel (whether with a Humber pilot engaged or acting with the benefit of a Pilotage Exemption Certificate) determined dynamically that an additional tug would be required to make a safe manoeuvre at its commencement, having regard to the DFDS Written Representation **[REP2-040]** and the Harbour Master's answers to ExQ NS.1.14 **[REP2-058]** and NS.1.15 **[REP2-059]**?	The Applicant refers to the answer above to NS2.29. The basic point is simple. If a tug is required for a safe manoeuvres (for whatever reason, whether determined dynamically or not) and there is no tug available, then the manoeuvres will not take place until such time as a tug is available or the conditions have changed to make a tug unnecessary. It is also understood that the Humber Harbour Master will respond to this question.
NS.2.34	Applicant, Harbour Master Humber, Dock Master and DFDS	**Current direction in the approach area to the Proposed Development berths** In what way might a differential of 10 to 15 degrees in current direction between that simulated at the location of the Proposed Development berths and that identified by Interested Parties and the Harbour Master in the immediate vicinity of the Proposed Development affect towage requirements (at certain states of tide and wind) and the likelihood of and consequence of allision of a Ro-Ro vessel with a moored vessel or infrastructure at the Eastern Jetty or the adjacent tug barge?	A differential of 10 to 15 degrees would clearly have a significant impact and it is for that reason that establishing the flows accurately at the IERRT location was a priority and undertaken. In this context, it should be noted that the flows are not bi-directional – they are more variable as noted in the Applicant's response to NS.2.08. It should also be noted that flow direction is not the only issue as flow speed, and the frequency of the flow effect also needs to be taken into account as has been done. These environmental variations were considered and fully taken into account by HR Wallingford in April 2022 and led to expert advice being provided as to the best orientation of the berth infrastructure as now proposed in the Applicant's submitted DCO application. With regard to the reference to the variation in flow direction in the vicinity of the eastern jetty, this will be managed in the same way that pilots and PECs already manage it – daily - during approaches to the Immingham Lock
NS.2.35	Applicant	**Differential current directions related to validity of simulations** Respond to the case made by DFDS in answering ExQ NS1.1.21 and NS.1.23 **[REP2-037]** that a difference in current direction between that measured at the location of the Proposed Development's berths and that existing differentially in the space between the end of the IOT river pier and the lock bell mouth undermines the validity of the simulations informing the assessment of levels of risk for the loss of control of vessels approaching or leaving the Proposed Development.	HR Wallingford have every confidence in the validity of the flows between the end of the IOT pier and the bell mouth. Depending on prevailing conditions, manoeuvring to approach IERRT may require pilots or a PEC in the light of the prevailing wind and flow at the time – but this is common practice, experienced daily as vessels successfully enter or depart from the Immingham lock or DFDS vessels approach or depart from the Outer Harbour. The pilot and PEC will manoeuvre the vessel back towards the IERRT. In doing this the vessel will experience a change in flow speed and direction, which will need to be managed, but to nothing like the same extent as when a vessel enters the bell mouth. In reality, the manoeuvres are very similar – even if the challenges are slightly different.
NS.2.36	Applicant	**Assessment of risk of allision or collision at the Eastern Jetty** a) Comment on the contention made by DFDS in its NRA [paragraph 2.4.4.3 in **REP2-043**] that one of the biggest risks to existing port operations arising from the Proposed Development would concern the operation of the Eastern Jetty's	a) This contention was discussed further during ISH3 and this perceived risk has been raised as part of DFDS's commercial objection to the scheme, but in circumstances where the presence of the Eastern Jetty has been fully assessed in the NRA. The DFDS contention fails to acknowledge that their vessels are already having to undertake a similar manoeuvre to enter the

		"chemical berth" and vessels berthed there, specifically with reference to the effects of tidal currents and wind on Ro-Ro vessels crabbing across to the inner berth of the Proposed Development. b) Respond to DFDS' concern that only one of the 73 simulations modelled manoeuvring to or from the Proposed Development berth nearest to the Eastern Jetty (Berth 3). c) Comment whether or how the tidal current effects on vessels berthing at the Proposed Development or at the IOT Finger Pier are different to those berthing at the Outer Harbour.	Outer Harbour, safely passing the Western Jetty and vessels safely enter into and come out of Immingham Lock on a daily basis and in all tidal conditions in conjunction with the Eastern Jetty. As the ExA is aware, the Applicant has requested sight of the DFDS navigational simulations for entry and departure from the Outer Harbour. In any event, DFDS do in fact also acknowledge within their own NRA that risk of allision with the Eastern Jetty can be mitigated to a tolerable state anyway (Annex B, HAZ ID 20) b) As explained during ISH3, simulations for entry and departure from Berth 3 – and a Berth 4 which was included as part of an earlier formulation of the Proposed Development – were undertaken in early 2022 (when in fact the berths were orientated in a less favourable position). The Applicant is currently considering whether these simulations could usefully be published. c) The currents for all three harbour facilities are very similar during the initial swing and set up for the manoeuvre. Vessels operating in IOH have to contend with a significant change in flow speed as they cross the boundary into the harbour behind IBT. Vessels at the finger pier and in due course, the Proposed Development, will manage a stronger but what in fact is a more consistent flow during their approach. It should be noted that vessel manoeuvres on the Humber – including vessel manoeuvres for the Port of Killingholme – are undertaken in tidal conditions which are not unique. The majority of deepwater Ports in the UK are located within tidal estuaries or rivers with naturally occurring deep water channels which provide the necessary depth and ease of access. Scheduled ferry services often have river berths because of the tight schedules and their requirements for access and egress at all states of the tide. Examples of this include multiple Ro-Ro terminals on the River Thames, and cross Channel ports with Ro-Pax operations such as Portsmouth, Poole, Plymouth.
NS2.37	Applicant	**Design life for Proposed Development as basis for risk assessment** Justify why the Applicant's NRA [APP-089] has been based on assessment of risks over a nominal 50-year period, while at paragraph 3.2.25 in APP-039 it has been stated that the Applicant intends that the Proposed Development would continue in use beyond its nominal 50-year design life; and explain what would be the effect on the risk assessment if the period were 75 years instead?	As there is no industry standard for risk descriptors (consequence or likelihood) a time period was not specifically identified other than to consider risk over a 50 year lifetime as an initial starting point. Broader terms were used to help guide the SHA in their understanding of the risk so that they could chose the appropriate timeline when they conduct further work to embed the data in the Hazard Logs (Appendices A-C) into their MSMS. As risk assessment and management of risks is an iterative process this will be updated and amended on numerous occasions prior to this initially assessed period having run its course. Of particular note in this context is the fact that the NRA [APP-089] does not specifically define that the risks are only assessed up to 50 years but instead the frequency is described as the potential for a risk to occur. The only instance where the NRA does consider the 50-year design life is in the assessment of the Future Baseline in Section 5 of the NRA **[APP-089].** There is no impact on the validity of a risk assessment if the development is used for a longer period of time than is forecast in that a series of review cycles will occur

			throughout the development's lifetime ensuring that future considerations are fully taken into account.
NS.2.38	Applicant	**Predicted vessel movements** In responding to ExQ NS.1.26 [pages 88 and 89 in **REP2-009**] it has been stated that while the Proposed Development could generate up to 42 vessel movements per week, there would in effect be a net increase of 28 vessel movements per week because Stena Line would relocate from the inner dock. Confirm: a) Is that proposition correct because it assumes that the part of the inner dock currently used by Stena Line would not be used by another party? b) If the above-mentioned proposition is correct what implications does it have for the case made by the Applicant about the Proposed Development adding to port capacity and resilience?	a) The Applicant can confirm that the IERRT development could generate an additional 42 movements per week, which has been derived from the IERRT providing three new berths for Ro-Ro operations at the Port of Immingham. The figure that was also presented in the answer to EXQ NS.1.26 for Stena Line's service relating to its current inner dock operations was for transparency and context only. It is correct that the inner dock area currently used by Stena Line could be used by another party – indeed that is the Applicant's aspirations for that area - and the Applicant's assessments have taken this into account - i.e. that the IERRT berths are providing additional infrastructure and would generate entirely new vessel calls to the current baseline at the Port of Immingham. b) The IERRT development is providing three new in-river Ro-Ro berths together with functionally well designed land side storage and facilities. The Proposed Development will make a significant contribution to port capacity, resilience and competition. These are matters which go beyond just simply considering the number of vessels proposed to be handled. For example, the new berths will, amongst other things, provide suitable marine berthing infrastructure for large Ro-Ro vessels without those vessels having to pass through a lock and at the same time will enjoy suitably sized landside storage areas, benefiting from necessary supporting infrastructure. In addition, the Terminal will be able to be operated in a competitive way.
NS.2.39	Applicant	**Port of Immingham Statutory Harbour Authority's (SHA) assessment of effects of the Proposed Development** In **[REP1-013]** in response to DFDS' Relevant Representation [paragraphs 5.1 to 5.5 in RR-008] it is stated that the SHA concluded that the projected increase in vessel traffic *"… is not material to the efficient operation of the estuary …"*, referring to the assessment in ES Chapter 16 [APP-052]. Elaborate on that statement to clarify whether any congestion effects within the Port of Immingham have been assessed, in particular by the Port of Immingham SHA.	The Applicant's position, as previously indicated, is that the Proposed Development will not lead to vessel congestion in the Humber. If that were not the case, the Humber Harbour Master would have commented adversely – and he has not done so. Information in this respect has already been provided with regard to stemming areas and as far as the Applicant is aware, the Humber Harbour Master has not raised any concerns.
NS.2.40	Harbour Master Humber	**Humber river commercial vessel capacity** In terms of daily shipping movements, what number of commercial shipping movements do you consider the Humber river can accommodate safely and efficiently, and how do mean and maximum shipping movements in 2023 to date compare with that capacity number?	
NS.2.41	Applicant	**Evidence from the Port of Immingham SHA of its contentment with the risk assessment as presented to the HASB** Submit evidence that both Dock Master and the Head of Marine Humber are content with the risk assessment that was presented to the HASB on 12 December 2022 and any subsequent contentment that they have that all identified risks in that assessment would be controlled or mitigated to ALARP following the decision made by the HASB at the meeting.	The NRA submitted by the Applicant **[APP-089]** describes the approach that was taken in conducting this assessment, including multiple rounds of HAZID Workshops and consultation to ensure that the risks were accurately assessed. The findings from the HAZID process and subsequently the NRA have been discussed at length with senior representatives of both the Port of Immingham SHA and the Humber SHA. All have confirmed their contentment with the assessment and have noted that it conforms to PMSC guidance, ABP's risk assessment

			approach within the context of the PMSC and, the tolerance thresholds thereby set by ABP as the SHA. Final approval is evidenced by the consideration and approval given to the Proposed Development at the meeting of the HASB.
NS.2.42	Applicant	**Automatic Identification Systems (AIS) tracks for tanker vessels to and from the IOT Finger Pier** Comment specifically on Figures 24 and 25 in the IOT Operators' NRA **[REP2-064]** showing AIS tracks for tanker vessels and the descriptive paragraphs 242 to 247 and how that evidence correlates to data used in the Applicant's NRA [APP-089] and its consequences for conclusions on risk controls to reduce risk of collision or allision to ALARP.	Due to the nature and limitations of AIS grouping, Bunker Vessels/Barges fall into the category of 'Tanker'. As a consequence, the AIS data tracks for 'Tankers' includes, albeit misleadingly, the AIS signatures of bunker barges. There is no method or process to further disseminate the class of tanker using AIS sourced information. For its assistance, the ExA should note that AIS is intended, primarily, to allow ships to view marine traffic in their area and to be seen by that traffic. AIS was not designed nor was it intended as a data collection tool for assessing navigational risk. The fact that this information can be corrected and used to provide track analysis is useful but the limitations and inaccuracies of the information as presented must be taken into account.
NS.2.43	Applicant	**Wind data** Submit additional information identifying the wind speeds and frequencies in Figure 1 of Appendix 1 of **REP1-009** that are illegible and a commentary note on differentials between the wind rose for Immingham Dock and the (Figure 2) 2019-22 wind rose for Humberside Airport and what relevance that differential might have for the NRA simulations, in particular the apparent difference in wind speeds from the NE sector and how important that might be to limit states for berthing at the Proposed Development.	The navigational simulations deliberately focussed on the poorest weather conditions rather than prevailing which included the greatest wind speeds from the North East. This has been rehearsed previously, but in brief a record of wind conditions is important for the Applicant's marine staff to be aware of the meteorological environment around the port. Precise details of wind characteristics on particular dates is, however, irrelevant for the purposes of marine simulation. A navigational simulation process is designed specifically, first, to test the overall viability of the Proposed Development, second to test the limiting parameters under which a facility could operate together with the potential options available such as tug assistance which could assist in terms of mitigation and the risks associated with operating under those limiting conditions, and third, as a training exercise for pilots and Mariners to determine how manoeuvres can and should be safely accomplished. The differential in wind speeds between the two sites shown, whilst not representing a significant deviation, is simply not germane to the simulation process as pilots will have specifically chosen extreme conditions representing the most challenging manoeuvres for the purposes of testing limiting parameters. Just testing vessel arrival and departure in benign weather conditions would simply not be a valuable educational experience.
NS.2.44	Applicant	**Sensitivity testing** The Applicant has stated that it expects to carry out sensitivity testing on the findings arising from berthing simulations. Does it intend to submit a report of such testing to the ExA, and if so, when?	The Applicant is unsure as to the purpose of this question. It does not intend to carry out sensitivity testing on the findings arising from berthing simulations.
NS.2.45	Applicant	**International Maritime Organisation (IMO) guidelines for Formal Safety Assessment** Submit a copy of the IMO Guidelines for Formal Safety Assessment (FSA) MSC-MEPC.2/Circ.12/Rev.2.	Please see **Appendix 3** to this document**.**

NS.2.46	Applicant	**Maritime Coastguard Agency (MCA) Methodology for Assessing Marine Navigational Safety** Submit a copy of Annex 1 to the MCA MGN 654 Methodology for Assessing the Marine Navigational Safety, etc.	Please see **Appendix 4** to this document.
NS.2.47	DFDS	**MAIB reports** Submit copies of the MAIB reports cited in your Relevant Representation [RR-008] at paras 3.5.1 and 3.5.5 (incidents affecting the IOT).	
NS.2.48	IOT Operators	**'MarNIS' incident reports** Provide a narrative of [APP-089 Figure 19] 'MarNIS(MARNIS)' reported incidents at the Port of Immingham and their relevance to the Proposed Development.	
NS.2.49	IOT Operators	**Locations for incidents elsewhere in the UK referred to in Table 11 in the IOT Operators NRA** For each entry in Table 11 in the IOT Operators' NRA **[REP2-064]** identify where each incident occurred by reference to a port/harbour name or other locational descriptor.	
NS.2.50	Applicant	**Evidence of future tug provision** With respect to tug availability, provide evidence from SMS and Svitzer to support the statement at page 185 of **REP1-013** that those tug operator fleets will "*grow to meet conditions as required*", noting DFDS concerns, as expressed in [RR-008], with the availability of tugs in sufficient numbers and capabilities when the need arises.	Please see **Appendix 5** to this document.
NS.2.51	Applicant	**Evidence of tug environmental performance** With respect to tug environmental performance, provide evidence from SMS and Svitzer of plans to improve the environmental performance of their tug fleet noting DFDS contention, as expressed in [RR-008], that environmental performance of port plant and equipment is a material consideration to the application for the Proposed Development.	Please see **Appendix 5** to this document.

9 Socio-Economic

ExQ2	Question to:	Question	Applicant's Response
		No questions at this time	

10 Terrestrial Transport and Traffic

ExQ2	Question to:	Question	Applicant's Response
TT.2.01	Applicant	**Sensitivity testing accompanied vs unaccompanied freight** Confirm whether the information in Appendix 7 *"Sensitivity test of accompanied vs unaccompanied freight against Table 8 of Transport Assessment"* (post ISH2 submissions **[REP1-009]**) in the three "Totals" columns is arithmetically correct and has been presented accurately throughout the whole of this appendix? The numbers quoted in column 4 (the first of the total columns included in Appendix 7) do not appear to correspond with the numbers quoted in the comparable column included in Table 8 of the Transport Assessment [AS-008], while the totals presented in the seventh column of Appendix 7 do not add up to the sum of the fifth and sixth columns. If there are arithmetical errors in Appendix 7 in **REP1-009**, what implications does that have for what has been stated in the final paragraph in the response to post ISH2 action point 13. For Example, for the hour between 09:00 and 10:00 the increase in vehicles would appear to be more than 37.	This is a printing error and the corrected version is attached **at Appendix 2 to document 10.2.39 – Written Summary of the Applicant's Oral Submissions at Issue Specific Hearing 3)** As confirmed at ISH3, the final columns remain correct and confirm a change of minus 4 and minus 9 HGVs per hour in the AM and PM peaks respectively. The textual conclusions of **[REP1-009]** therefore remain valid and it was conformed at ISH3 that all IPs agreed with those conclusions. It is in any event agreed with the IPs that sufficient evidence has been provided to support the ratio of Unaccompanied / Accompanied Freight units adopted in the Transport Assessment **[AS-008].** This is recorded in **[REP3-022]**, Para 40 for DFDS and at page 6 of **[REP3-020]** for CLdN.
TT.2.02	Applicant, North East Lincolnshire Council (NELC), North Lincolnshire Council and National Highways	**Scoping out of committed schemes from the Transport Assessment** Why have a number of committed developments been excluded from the agreed scope for the Transport Assessment **[AS-008]** for the Proposed Development, as referred to in the Applicant's response to DFDS's Deadline 1 submissions [page 20 in **REP2-010**]?	The ES Volume 1 Chapter 20 **[APP-056]** sets out the process undertaken to identify the committed developments schedule to be generally tested through the ES. The process under which these were translated to the TA and the list of committed schemes included for the specific purposes of the TA are set out at Para 6.1.2 of **[AS-008]**. The list of committed developments for specific inclusion in the TA were provided by NELC by email (19/01/22) and supplemented by a request from NLC to include Able Logistics Park (email 24 June 2022). GHD have included more sites than the Applicant was asked to consider as summarised below. DFDS and CLdN have now agreed that the committed development baseline, as set out in the TA and agreed with the Highways Authorities is correct.

Committed Development List	DTA	GHD (DFDS)
Able Marine Energy Park	✓	✓
South Humber Bank Power Station (DM/1070/18/FUL)	✓	✓
Velocy's (DM/0664/19/FUL) (referred to by DFDS as Altalto)	✓	✓
Stallingborough Interchange (DM/0302/21/REM)	✓	✓
Queens Road (DM/0147/16/FUL)	✓	✓
New Link Road (DM/0094/18/FUL)	✓	×
Highfield House (DM/0728/18/OUT)	✓	✓
Able Logistics Park (PA/2009/0600)	✓	×
Petrol Filling Station (PA/2019/1789)	×	✓

North Killingholme Power Project (EN010038)	×	✓
VPI Immigration OCGT (EN010097)	×	✓
Peter Ward Homes Residential (DM/1175/17/FUL)	×	✓
Station Road Habrough Residential (DM/0950/15/OUT-DM/0211/20/REM)	×	✓

Dealing with each of the “additional” sites in turn:

Petrol Filling Station (PA/2019/1789) – The development to which this application relates was open to the public in early November 2021 and was operational at the time of the traffic counts and is therefore within the base line.

North Killingholme Power Project (EN010038) – The only impact arising from this would be during construction, when 24% of staff are expected to arrive in the AM Peak (0700-0800) and 33% leave in the PM Peak (1600-1700) – Reference Table 6-1 of ES Appendix 8.1 for this project.

Table 6-2 confirms that peak construction will take place 2025 (and therefore not coincide with operation of IEERT). Further construction in 2028 (Operation of Generating Station as CCGT Plant with subsequent construction of the Gasification Plant) would generate 230 trips in the AM Peak period (0700-0800) In the PM peak (1600-1700). Any cumulative impact arising from this development in capacity terms would be temporary and short lived and would not therefore justify mitigation (by IERRT) in the context of NPPF 110 / 111.

VPI Immigration OCGT (EN010097) – Chapter 7 of ES confirms that peak construction flows will be 4HGVs and 22 cars in the AM Peak (0700-0800) and 4 HGVS and 13 light vehicles in the PM Peak (1600-1700). This will have no material impact on the outcome of the assessment and will in any event be temporary.

Peter Ward Homes Residential (DM/1175/17/FUL) – This modest development (of 145 homes) is already in construction. The site was allocated and therefore growth is included in the Tempro growth forecasts. The scheme will generate around 43 trips in the AM (0700-0800) and 50 in the PM peak (1600-1700). Based on table 3 of the supplementary TA, only 16.2% of this is forecast to route towards the A160 corridor (7 and 9 in the AM and PM peaks respectively). 31% are forecast to route towards the Port - 14 and 18 in the AM and PM peaks respectively). On that basis there will be no material change in background flows as a result of the development and therefore will have no material impact on the outcome of the assessment.

Station Road Habrough Residential (DM/0950/15/OUT-DM/0211/20/REM) – This modest development (of 118 homes) is already in construction. The site was consented in 2015 therefore growth is included in the Tempro growth forecasts. The scheme will generate around 35 trips in the AM (0700-0800) and 47 in the PM peak (1600-1700). Based on Figure 13 of the TA, only 60% of this is forecast to route towards the A160 corridor (21 and 28 in the AM and PM peaks respectively). 24% are forecast to route towards Immingham - 8 and 11 in the AM and PM peaks respectively). On that basis there will be no material change in background flows as

			a result of the development and therefore will have no material impact on the outcome of the assessment. Cumulatively these sites will have no material impact on the outcome of the assessment.
TT.2.03	Applicant	**Road signage strategy** Advise as to whether a traffic signage strategy has been/is being developed in liaison with the highway authorities, further to the comments made by DFDS at paragraph 164 in its Written Representation **[REP2-040]**. If a signage strategy has been/is being developed: a) how might its operation affect the distribution of vehicles entering or exiting the Port of Immingham via the Eastern and Western Gates; and b) how might its operation be secured?	Internal to the facility and on the exit, signage will be provided to direct all drivers leaving to use the East Gate. As part of pre-application discussions with NELC, NLC and NH, proposals were put forward for improving signage for inbound vehicles from the A180. These included amendments to the strategic signposting on the A180 principally in advance of the A160 to direct East Gate traffic to continue on the A160. The changes will require Section 278 Highway Agreements with both NELC and NH. Whilst ABP, as the operator of the Port, is intent on pursuing these as part of wider information provision these proposals do not form part of the DCO and are not being promoted as part of the mitigation strategy (or otherwise) nor has ABP committed to them in any way. It is, therefore, not appropriate to assess the impact of any changes to the strategic signage strategy as part of the DCO.
TT.2.04	Applicant and any other IPs	**Accompanied and unaccompanied unit ratio** Has agreement been reached regarding determining an appropriate split for the handling of accompanied and unaccompanied units associated with the operation of the Proposed Development?	Yes. This will formally be confirmed in the Statement of Common Ground on highway matters but the IPs have confirmed that sufficient evidence has been provided to support the ratio of Unaccompanied / Accompanied Freight units adopted in the Transport Assessment **[AS-008]**. This is recorded in **[REP3-022]** at paragraph 40 for DFDS and at page 6 of **[REP3-020]** for CLdN.
TT.2.05	Applicant and any other IPs	**Tractor-only movements** Has agreement been reached regarding an appropriate allowance for tractor only movements, further to DFDS's and CLdN's representations at ISH2 that the 10% allowance in the Transport Assessment (TA) **[AS-008]** is insufficient.	No, this is not agreed. The Applicant's position is that the 10% adopted in the TA is robust (see [**REP2-010]** at Page 14). In any event the precise number is not material to the outcome of the assessment. Adopting 19% suggested by DFDS will increase daily movements from 1944 (in the TA) to 2074 and increase AM Peak flows by 4 HGVs and PM peak flows by 11HGVs. This is not material to the outcome of the assessment. As part of the sensitivity testing being prepared for the Statement of Common Ground, the figure of 19% proposed by DFDS will be tested.
TT.2.06	Applicant and any other IPs	**East and West Gate ratio** Has agreement been reached between the parties about the proportion of traffic generated by the Proposed Development predicted to enter the Port of Immingham via the East and West Gates?	No, this is not agreed. It is intended that a position on this will be confirmed as part of the Statement of Common Ground. It was agreed at the meeting between the traffic consultants of the Applicant and the IPs on 28 September 2023 that the parties would seek to agree a baseline position in terms of local facilities and haulage yards in the vicinity to allow this to be considered further. As part of the Statement of Common of Ground, the Applicant is preparing a sensitivity test which will consider higher levels of traffic using West Gate. This will be reported when available.

TT.2.07	Applicant	**National Highways proposed requirements** National Highways in its Deadline 2 submission **[REP2-017]** has proposed the following for inclusion in the DCO requirements: *"provision of a Construction Traffic Management Plan (CTMP) prior to works commencing that is agreed to by National Highways."* What is the Applicant's view on this?	This is acceptable to the Applicant and can be included in the DCO requirements, as necessary.
TT.2.08	Applicant	**Network Rail proposed amendments** Network Rail has set out proposed amendments to the DCO (para.6.1 of **[REP2-022])** to address concerns regarding the lighting strategy and level crossings, together with their standard protective provisions at Appendix 2. How are the matters raised by Network Rail being progressed?	Positive negotiations with Network Rail's team, both engineering and legal, are ongoing. It is hoped that these discussion will be positively evidenced in the form of an amended protective provision for Deadline 5.
TT.2.09	Applicant and CLdN	**Protecting rights in respect to use of rail network** CLdN in its Deadline 1 submission **[REP1-025]** contends it would be reasonable and proportionate to have its legal rights in respect of connecting to the rail network similarly protected (as per Part 6 of Schedule 9 of the Able Marine DCO) with appropriate protective being incorporated into any made DCO. What are the Applicant's views about this? CLdN should provide further justification as to why it considers such a protective provision would be necessary, given the Applicant has stated it does not expect the Proposed Development would make use of the rail network and the Proposed Development would not involve the undertaking of any physical works that would affect the rail line that serves the Port of Killingholme.	The Applicant does not understand CLdN's concerns. Quite simply, the Proposed Development does not contemplate any movement by train and the Applicant has to question whether CLdN have actually understood the scheme proposals.
TT.2.10	Applicant	**Securing ANPR installation and operation** Paragraph 6.4.10 of TA [AS-008] states *"It is also proposed to implement Automatic Number Plate Recognition (ANPR) for staff which will again increase the capacity of the gate and reduce queuing times"*. Given that ANPR is part of the mitigation strategy to help reduce queuing at the East Gate arising from the Proposed Development, how would installation and operation of ANPR be secured in any made DCO?	At present, the Transport Assessment **[AS-008]** makes no specific allowance for the introduction of ANPR in terms of specific mitigation for the scheme. It remains an intention of ABP to implement such a scheme as part of ongoing operation of the port but does not form part of the DCO.
TT.2.11	Applicant	**East Gate Safety Audit and Queuing Assessment** Provide an update on the East Gate Road Safety Audit and East Gate Queuing Assessment which are both referred to in NELC's Principal Area of Difference Summary Statement [PDA-001].	The Applicant has commissioned the Road Safety Audit and this will be shared with NELC for review. The draft report has been received and is not highlighting any issues which require significant redesign of the scheme. The Applicant has discussed the queuing assessment with NELC in July 2023 and had understood this point to be resolved. However, in light of actions arising from ISH3, the Applicant is preparing a wider assessment of queueing at both East and West Gates and will issue this at D5 for review.

11 Water Environment, Flood Risk and Drainage

ExQ2	Question to:	Question	Applicant's Response
		No questions at this time	

12 Glossary and List of Acronyms

ABP	Associated British Ports
ADM	Assistant Dock Master
AEoI	Adverse Effect on Integrity
ALARP	As Low As Reasonably Practicable
AOD	Above Ordnance Datum
BoR	Book of Reference
CA	Compulsory Acquisition
CEMP	Construction Environmental Management Plan
CLdN	CLdN Ports Killingholme Limited
COMAH	Control of Major Accident Hazard
CoPA1974	Control of Pollution Act 1974
CTMP	Construction Traffic Management Plan
dDCO	Draft Development Consent Order
DFDS	DFDS Seaways Limited
DML	Deemed Marine Licence
DP	Designated Person
EIA	Environmental Impact Assessment
EM	Explanatory Memorandum
ES	Environmental Statement
ExA	Examining Authority
FRA	Flood Risk Assessment
FSA	Formal Safety Assessment
GtGP	Guide to Good Practice on Port Marine Operations (MCA)
HASB	Harbour and Safety Board
HE	Historic England
HESMEP	Humber Estuary Serious Marine Emergency Plan
HOTT	Humber Oil Terminals Trustee Ltd
HRA	Habitats Regulations Assessment
HRAr	Applicant's Habitats Regulation Assessment report
IERRT	Immingham Eastern Ro-Ro Terminal (the Proposed Development)
IMO	International Maritime Organisation
IOT	Immingham Oil Terminal
IOT Operators	Associated Petroleum Terminals (Immingham) Limited and Humber Oil Terminals Trustee Limited
IP	Interested Party
ISH	Issue Specific Hearing
LHA	Local highway authorities (North East Lincolnshire Council and North Lincolnshire Council)
LIR	Local Impact Report
LPA	Local Planning Authority
MAIB	Marine Accident Investigation Branch
MarNIS/MARNIS	ABPMer's Port Assessment Toolkit for operational risk management, accident/incident reporting and data management
MCA	Maritime and Coastguard Agency
MGN	Marine Guidance Note
MHW	Mean High Water
MLW	Mean Low Water
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MPS	Marine Policy Statement

(M)SMS	(Marine Safety) Management System
NavSim	Navigational (and Pilotage) Simulation
NH	National Highways
NE	Natural England
NELC	North East Lincolnshire Council
NLC	North Lincolnshire Council
NPPF	The National Planning Policy Framework
NPSfP	National Policy Statement for Ports
NR	Network Rail
NRA	Navigation Risk Assessment
NSIP	Nationally Significant Infrastructure Project
OREI	Offshore Renewable Energy Installation(s)
PA2008	The Planning Act 2008
PEC	Pilotage Exemption Certificate
PINS	Planning Inspectorate
PMSC	Port Marine Safety Code
PP	Protective Provision
PTS	Permanent Threshold Shift
Ro-Ro	Roll on Roll off
RR	Relevant Representation
SAC	Humber Estuary Special Area of Conservation
SFAIRP	So Far As Is Reasonably Practicable
SHA	Statutory Harbour Authority
SLBV	Stena Line BV
SoCG	Statement of Common Ground
SoST	Secretary of State for Transport
SPA	Humber Estuary Special Protection Area
SSSI	Site of Special Scientific Interest
TP	Temporary Possession
TH	Corporation of Trinity House of Deptford Strond
WR	Written Representation

Appendix 1 – Updated Shortsea Traffic Volume Data referred to in the answer to Question BGC.2.08

Table 1: Humber Shortsea Traffic - Tonnes

Total Humber Shortsea Traffic -Tonnes	Year/Unit	2017	2018	2019	2020	2021	2022
Ro-Ro Accompanied	Tonnes	2,076	2,078	2,150	1,883	1,488	1,559
Ro-Ro Unaccompanied	Tonnes	10,251	10,840	10,474	9,985	10,407	11,209
Ro-Ro	Tonnes	12,326	12,918	12,624	11,868	11,895	12,768
Lo-Lo	Tonnes	4,034	4,125	4,034	4,219	5,114	4,119
Accompanied Share of Ro-Ro	%	16.8 %	16.1 %	17.0 %	15.9 %	12.5 %	12.2 %
Accompanied Share of Ro-Ro & Lo-Lo	%	12.7 %	12.2 %	12.9 %	11.7 %	8.7 %	9.2 %

Table 2: Humber Shortsea Traffic - Units

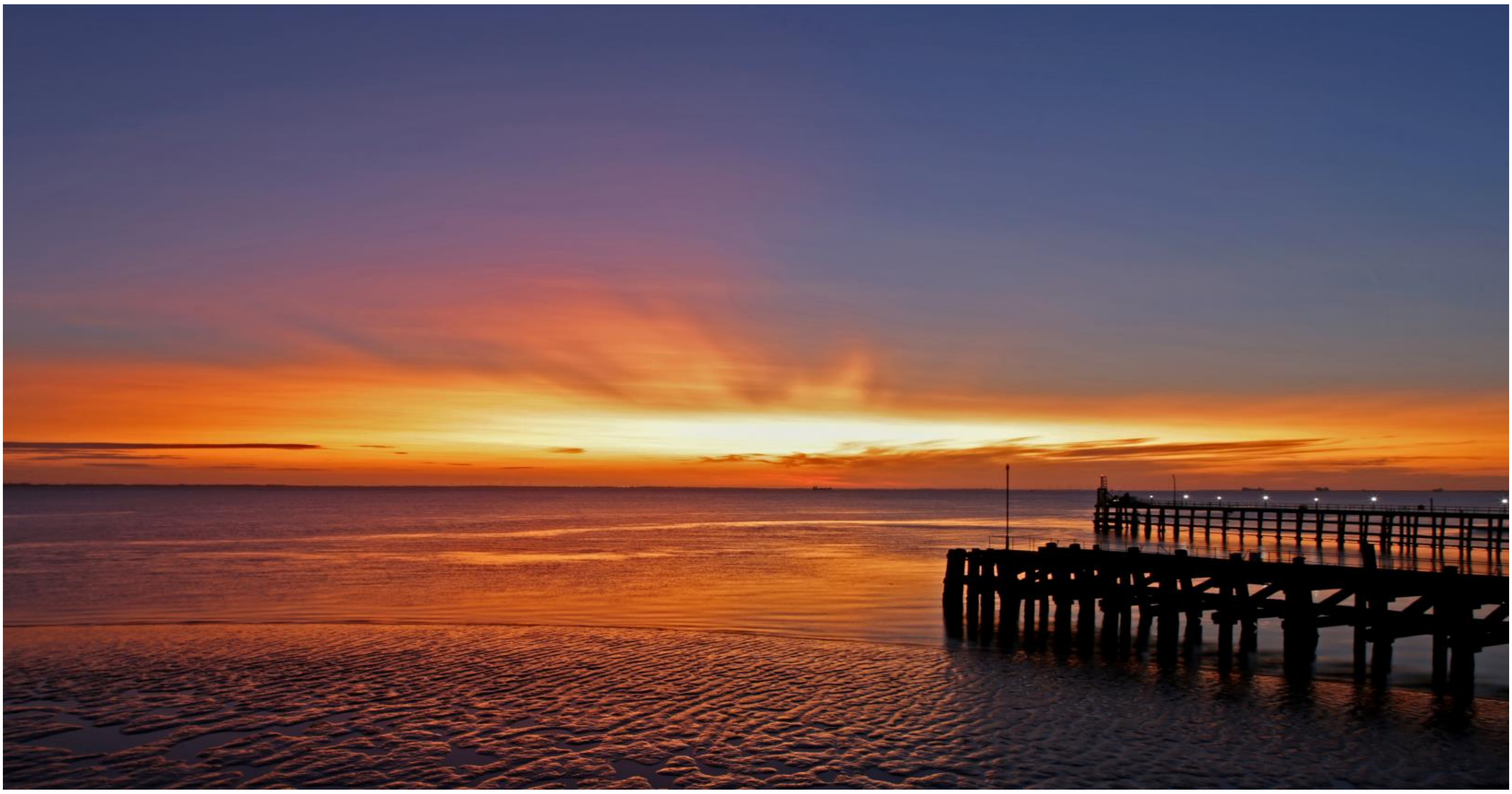
Total Humber Shortsea Traffic-Units	Year/Unit	2017	2018	2019	2020	2021	2022
Ro-Ro Accompanied	Units	171	171	172	149	125	185
Ro-Ro Unaccompanied	Units	650	665	661	653	746	768
Ro-Ro	Units	821	836	833	802	870	953
Lo-Lo	Units	340	347	350	351	415	341
Accompanied Share of Ro-Ro	%	20.8 %	20.5 %	20.7 %	18.6 %	14.3 %	19.4 %
Accompanied Share of Ro-Ro & Lo-Lo	%	14.7 %	14.5 %	14.5 %	12.9 %	9.7 %	14.3 %

Appendix 2 – Associated British Ports Humber Estuary Serious Marine Emergency Plan (HESMEP) 2018 requested a question NS.2.12

KEEPING BRITAIN TRADING

ASSOCIATED BRITISH PORTS

HUMBER ESTUARY SERIOUS MARINE EMERGENCY PLAN



H E S M E P

2018

1. Definition of Plan & Responsibilities

1.1 Introduction

The Port Marine Safety Code (**PMSC**) requires the Safety Management System (**SMS**) to manage the hazards and risks along with any preparations for emergencies. The Humber Estuary Serious Marine Emergency Plan (**HESMEP**) has been formulated after discussion with and in agreement by the appropriate authorities on the Humber; it sets out the action to be taken in the event of a Serious Marine Emergency occurring within the limits of the Humber Harbour Area as laid down in the Humber Navigation Byelaws 1990.

Responsibility for the production of the plan and the co-ordination of interested organisations has been undertaken by Associated British Ports as the Harbour Authority.

The Plan focuses on various types of emergencies and the provision of an appropriate response. If the incident involves oil pollution, then **Humber Clean** will be invoked. It should be noted however, that one type of emergency may frequently escalate into another and therefore **HESMEP** is closely aligned to Humber Clean.

The purpose of this plan is to provide a means of raising the alarm and the communication and co-ordination between the various organisations and vessels involved, providing a framework for the management of the incident and cargoes involved.

Each organisation involved in a Humber Serious Marine Emergency, will be responsible for implementing their individual plans and procedures. A number of organisations operate on or adjacent to the Humber Area and have their own individual emergency response plans which have been designed to interface with **HESMEP**. Details of these can be found in section 6.

ABP are a Category 2 Cooperating Body under the Civil Contingencies Act 2004.

1.2 Definition

A **Serious Marine Emergency** is an accident affecting shipping in the Humber which creates, or is likely to create, a significant danger to navigation, life, property or the environment. It may include, but not be limited to; **Fire, Explosion, Collision, Grounding, Sinking, Release of cargo and Toxic Vapours or Serious Oil Pollution** and which requires for its proper control, resources not immediately available to the ships master or others at the scene.

1.3 *Raising the Alarm*

The Master of a vessel or others at the scene, involved in a serious incident (which falls within the definition of a "**Serious Marine Emergency**" as defined in section 1.2,) should call VTS Humber or HMCG, endeavouring to pass all relevant information which may include: -

(5) Type of emergency

(b) Precise location

(c) Name of vessel

(d) Number of survivors

(e) Number of casualties

(f) Details of cargo (including the classification of any dangerous substances on board vessel)

(g) Actual or risk of a release of flammable or toxic liquids or vapour

(h) Risk of danger to other vessels or installations

(i) Bunker quantities

(j) Details required by the Incident Assessment form (Appendix 2)

Having raised the alarm, the Master of the vessel should proceed as directed by the Harbour Master or his designated deputy; if the circumstances are such that the Master cannot comply with the direction he shall take all necessary precautions to avoid creating a danger to other vessels or installations.

1.4 Implementation of the plan

Following a report of a Serious Marine Emergency, the decision to initiate the plan may be taken by: -

The Harbour Master Humber, his designated deputy or persons with delegated Powers of Harbour Master.

The Harbour Master Humber may make the decision to initiate the plan after an escalation of a relatively minor incident at the request of the Master of the vessel and in consultation with other emergency services, including HM Coastguard.

1.5 Co-ordination

Overall co-ordination of the plan will be the responsibility of the Harbour Master Humber.

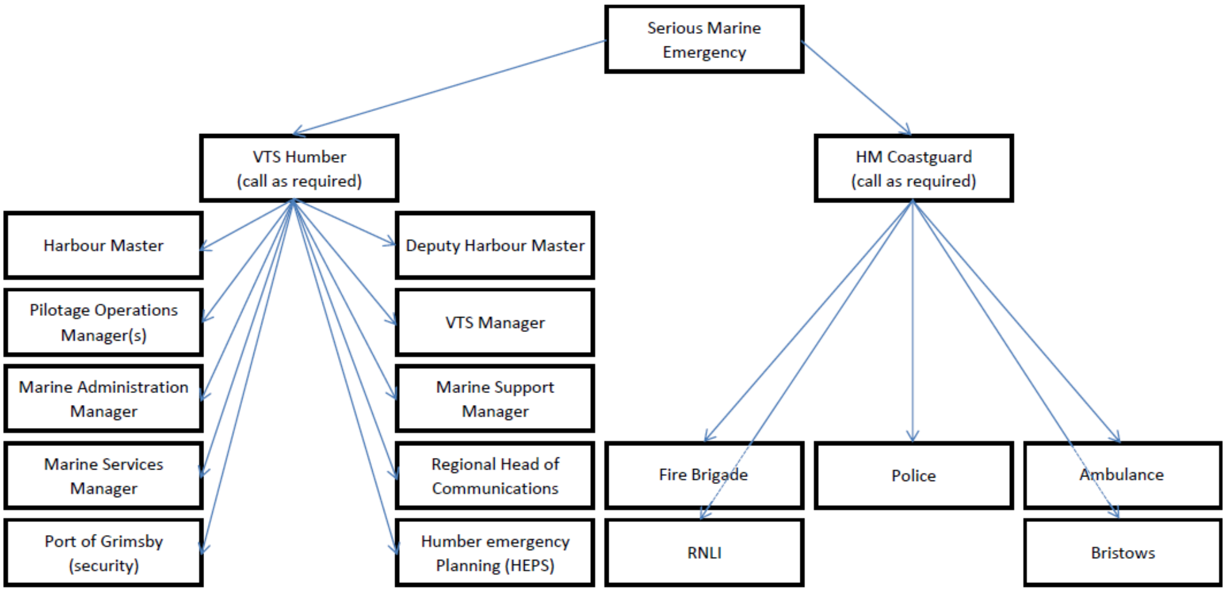
1.6 Action by VTS Humber

VTS, Humber (call sign Vee Tee Ess Humber) is located at the Humber Marine Control Centre in Grimsby and maintains a continuous 24 hour listening watch on international marine VHF Channels 16, 15, 14 and 12.

On receipt of call relating to a Serious Marine Emergency, VTS Humber may, dependent on the nature and size of the incident, contact the following: -

HM Coastguard
Harbour Master, Humber
Deputy Harbour Master, Humber
Pilotage Operations Manager(s)
Vessel Traffic Services Manager, Humber
Marine Administration Manager
Marine Support Manager
Regional Head of Communications (Head Office Press Officer)
Marine Services Manager
Humber Emergency Planning
Port of Grimsby security to activate Marine Response Centre (ABP MRC)

1.7 Activation Call-Out Matrix



1.8 Associated British Ports Marine Response Centre (ABP MRC)

The ABP Incident Management Team provides the personnel who man the Associated British Ports Marine Response Centre (ABP MRC). The ABP MRC is located at the Port Office, Grimsby.

The Marine Response Centre will be the focal point for all HESMEP and Humber Clean Tier 2 and Tier 3 incidents as required. The MRC will be manned for all Tier 2 and Tier 3 incidents, and at the discretion of the Incident Controller for Tier 1 incidents. Note that manning of the ABP MRC can take place 24 hours a day, seven days a week and is activated by the Assistant Harbour Master VTS, Humber.

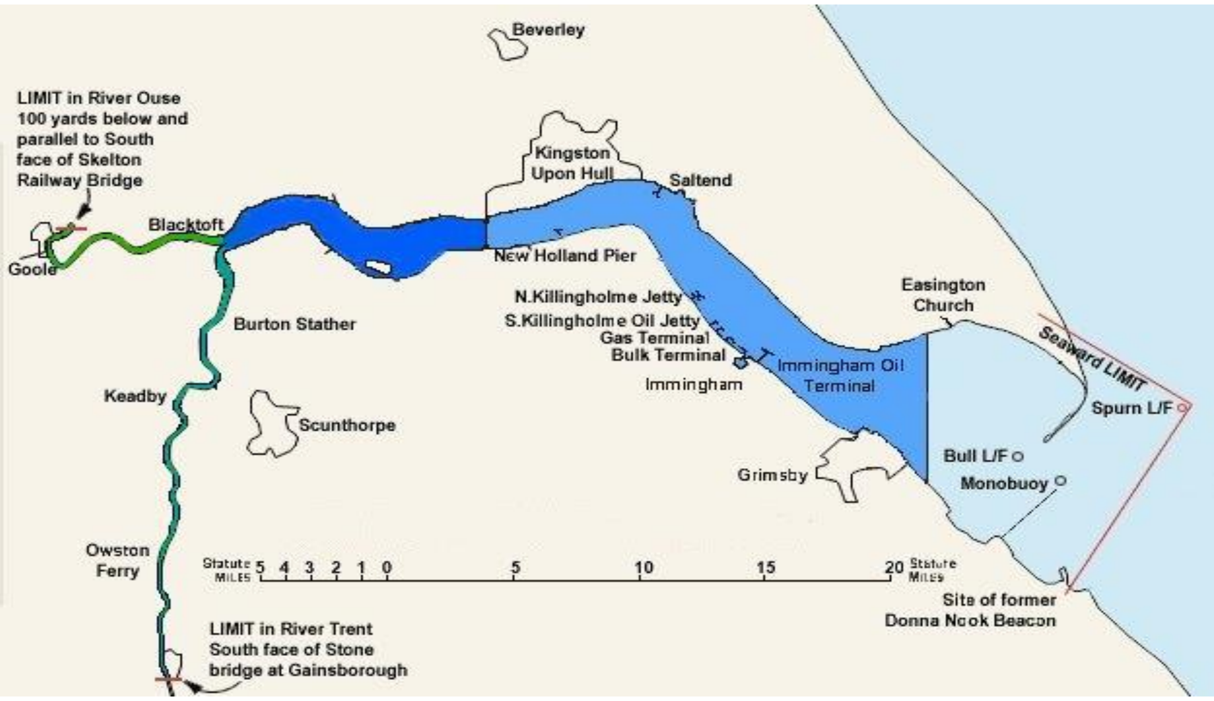
2. Emergency Assessment

Vessel types and cargoes are not exhaustive lists, but are a comprehensive representation of predominant marine traffic upon the River Humber.

Associated hazards are either cargo specific, or specific to the type, size or area of operation of vessels upon the River Humber.

Formal operational risk assessments have been carried out for all areas of the river in the 'MarNIS' risk assessment program.

Assessment Areas	
LOWER HUMBER	Tetney Haven and River Humber approaches.
MIDDLE HUMBER	Ports of Grimsby, Immingham, Immingham Oil Terminal, Immingham Bulk Terminal, Humber International Terminal, North Killingholme Haven and the C.Ro Port Killingholme, Salt End, Port of Hull, Old Harbour, New Holland, Hessle, Barton and Barrow Havens.
UPPER HUMBER	Above Humber Bridge.
RIVER OUSE	Blacktoft Jetty and the Port of Goole.
RIVER TRENT	Burton Stather, Flixborough, Neap House and Grove wharfs. Keadby and Gunness wharf.



Vessel Type	Cargo	Traffic Area	Associated Hazards
Oil tanker & Bunker barges	• Crude oil • Fuel oil • Gas oil • Diesel oil • Marine gas oil • Medium fuel oil • Heavy fuel oil • Refined products • Lube oil • Vegetable oil	All areas	• Pollution • Fire • Explosion • Grounding • Collision

A high number of visits per year of vessels of all sizes, operating at times with minimal under keel clearance in confined waters. The possibility of instantaneous release of product in small amounts during discharge/loading operations, large amounts due to hose failure and high discharge rates or due to collision in congested areas. Bunkering operations also account for a considerable risk element to the above.

Soft sediments mean that grounding is unlikely to result in pollution through loss of containment.

Vessel Type	Cargo	Traffic Area	Associated Hazards
Gas tanker	• Liquid propane gas • Liquid butane	Lower and Middle Humber	• Gas release • Explosion • Fire • Collision • Grounding

Despite lower visit figures for this type of vessel the risk of a serious emergency developing is still substantial owing to the nature of the cargoes carried in high density traffic areas. Emergencies are more likely to occur as a result of collision with other vessels or structures due to the volatility of cargo. Vessels are structurally well founded however.

Soft sediments and the structural design of vessels mean a lower risk due to grounding through loss of containment.

Vessel Type	Cargo	Traffic Area	Associated Hazards
Chemical tanker	• Benzene • Methanol • Ethanol • Acetic acid • Ammonia • Acids & Alkalis • Petroleum • Butane • Feedstock chemicals	Lower and Middle Humber	• Pollution • Release • Fire • Explosion • Contamination • Collision • Grounding

The nature of cargoes carried and their volatility produces higher risks. The effects of release and subsequent vapour clouds can be hazardous to large areas. Vessels somewhat vulnerable to collision with structures and other vessels, however structural integrity is of a high degree.

Vessels transit through high density traffic areas. Due to soft sediments and vessel design, grounding would be an unlikely cause of release.

Even small vessels can pose a threat to large areas of the estuary and adjacent shorelines, the weather playing a critical role in the event of a release situation.

Vessel Type	Cargo	Traffic Area	Associated Hazards
General cargo vessel	• Steel coils • Break bulk • Timber • Wind turbines • Heavy lifts • Paper • Edible oils • Radioactives • Products • Foodstuffs	All areas	• Cargo shift • Pollution • Loss of cargo • Fire • Collision • Grounding • Contamination

Present in all areas of the Humber in higher numbers than many types of ship, but vessels transiting through the harbour do so in sheltered waters with little hazard posed from excessive cargo shift or loss. Mostly inert cargoes except for specific specialised transports, little risk exists for pollution from such cargo.

Vessel strength is good but stability issues can be significantly enhanced if a vessel is damaged structurally due to collision, perhaps allowing the ingress of water.

Grounding poses little risk of damage or pollution due to the nature of the soft river bed.

<table>
<tr><th>Vessel Type</th><th>Cargo</th><th>Traffic Area</th><th>Associated Hazards</th></tr>
<tr><td>Bulk carrier</td><td>Coal
Ores and Minerals
Scrap metal
Grain
Fertilisers
Aggregates
Agribulks
Animal feed
Biomass
Road salt
Cement
Cocoa/Sugar</td><td>All areas</td><td>Cargo shift
Pollution
Fire
Explosion
Break up
Capsize
Grounding
Collision</td></tr>
<tr><td colspan="4">Vessels present in all areas of the estuary in various sizes.

Vessel design may present stability issues when faced with collision or grounding from water ingress. Vessels have the potential to break up due to structural failure, enhanced by dense heavy cargoes and the extreme stresses that they can exert upon a vessel’s framing system.

In the event of a vessel sinking, beaching areas should be used, where possible, to aid future salvage operations.

Shifting cargo is a present danger for these vessels in rough seas, the Humber providing a higher degree of protection leads to lower risk levels.

Deep seated fires can develop in self heating cargoes which are difficult to extinguish. Some may react with water.</td></tr>
</table>

Vessel Type	Cargo	Traffic Area	Associated Hazards
Container vessel (LO/LO)	• 20/40/45 ft TEU's • Reefer units Solids bulks, liquids and gases. Products, foodstuffs and consumables (Various dangerous good Classes 1-9 under IMDG code).	Lower, Middle, Upper Humber and Ouse.	• Fire • Explosion • Grounding • Collision • Loss of Cargo

The diverse nature of cargoes carried by such vessels even when segregated and isolated from each other will always present certain risks.

Fires are not uncommon and can be difficult to deal with, especially when involving the many classes of dangerous goods that such vessels carry.

Damage due to collision and grounding present minimal risks of serious events, although the risk of pollution occurring is always a possibility.

Vessel Type	Cargo	Traffic Area	Associated Hazards
Passenger vessel	• Passengers • Some general cargo • Dangerous goods (Various dangerous goods Classes 1-9 under IMDG code).	Lower and Middle Humber	• Fire • Pollution • Collision • Grounding • Capsize

Very few visits to the Humber and tend to be summer seasonal which means a low risk element occurs for passenger vessels. Ships of this type in the Humber are relatively small hence carrying less passengers, and minimal levels of cargo.

The risk of grounding/capsize and subsequent problems developing are low in most areas. Soft sediments prevail and ship construction leads to a high degree of structural integrity in most situations.

Fire / Collision and the need to evacuate passengers is the predominant issue.

Vessel Type	Cargo	Traffic Area	Associated Hazards
Ferry (RO/PAX)	• Passengers/Drivers • Lorries and trailers • Reefer units Solids bulks, liquids and gases. Products, foodstuffs and consumables. (Various dangerous goods Classes 1-9 under IMDG code).	Lower and Middle Humber	• Fire • Explosion • Collision • Capsize • Pollution • Release
High number of vessels carrying diverse and isolated cargoes in many forms which include all types of dangerous cargo. Fire, collision and water ingress can cause significant problems for this type of vessel with regard to stability. Higher windage, possible cargo shift, and susceptibility to bad weather conditions present a risk, but waters in Middle Humber area are mostly sheltered. In the Middle Humber area, soft sediments prevail and minimise the risk of loss of containment due to grounding.			

Vessel Type	Cargo	Traffic Area	Associated Hazards
Car carrier	• Vehicles	Lower and Middle Humber	• Fire • Collision • Pollution • Cargo shift • Capsize

A regular but smaller number of vessels transiting through high traffic areas carrying specific and relatively inert cargo.

Higher windage, possible cargo shift, and susceptibility to bad weather conditions present a potential risk, but waters in Middle Humber area are mostly sheltered.

Larger vessels experience enhanced safety routing through VTS, and employ multiple tugs during berthing and sailing operations reducing the risk of collision. Collision with structures whilst maneuvering is the major issue with these vessels. Even small amounts of water ingress can seriously affect the stability of the vessel through free surface effect acting on large open decks.

Vessel Type	Cargo	Traffic Area	Associated Hazards
Tugs and tows	• Workbarges • Heavy lifts • Specialist cargo • Lash Barges	All areas	• Collision • Pollution • Capsize • Loss of tow

No specific risks can be attached to cargoes; however tows can be difficult to manoeuvre in a tidal river through dense traffic areas. Passages are well planned, monitored, protected and enhanced by other harbour tugs if necessary.

Collision with other vessels, structures or navigation marks remain as present dangers for these transports but being few in number and well organised still results in a lower element of risk.

Vessel Type	Cargo	Traffic Area	Associated Hazards
Timber ship	• Bulk timber cargo • Timber deck cargo	All areas	• Cargo shift • Loss of cargo • Pollution • Collision
Within sheltered waters, inert and buoyant timber makes for a low risk cargo. Timber deck cargoes can be subject to shift or loss but unlikely within the estuary. Structurally sound vessels, soft sediments and type of cargoe warrant low risks.			

Vessel Type	Cargo	Traffic Area	Associated Hazards
Jack up platform	• Drill rigs • Offshore platforms	Lower and Middle Humber	• Capsize/Sinking • Collision
Very few in number, enhanced protection for passages, well planned, and almost completely stable when sat in position, these platforms offer little in the way of risk except when in the process of lowering down legs. Owner commissions a pre-arrival survey of the river bed to confirm suitability of the bottom. Weather is a big factor but passages do not take place in unfavourable conditions. No specific cargo risks. See Tugs and tows above.			

Vessel Type	Cargo	Traffic Area	Associated Hazards
Fishing vessel	• Frozen cargoes • Wet Fish	Lower and Middle Humber	• Fire • Collision • Capsize
High in number and transiting/crossing busy channels, but no specific risks can be associated with cargo or vessels. Smaller craft may be susceptible to poor weather conditions.			

Vessel Type	Cargo	Traffic Area	Associated Hazards
Crew transfer vessel	• Personnel	Lower Humber	• Collision • Capsize • Fire
High in number and transiting/crossing busy channels, but no specific risks can be associated with vessel. Smaller craft may be susceptible to poor weather conditions.			

Vessel Type	Cargo	Traffic Area	Associated Hazards
Pleasure craft	• Nil	All areas	• Grounding • Collision • Capsize
High in number, particularly over summer months with generally more risks associated to vessels in the Upper Humber area. Poor planning and navigation within shoaling areas can contribute towards groundings. Smaller craft may be susceptible to poor weather conditions.			

3. HESMEP Response Strategy

Once the type of Serious Marine Emergency has been confirmed, ensure that the type of response that is initiated is suitable to the incident type. The following possible Serious Marine Emergency types have been identified:

3.1 Oil Pollution

*Refer to the current version of the Oil Spill Response Plan '**Humber Clean**'.*

3.2 Fire

Obtain as much information as possible

Dispatch Fire Tug

Alert other vessels in the area

Alert nearest port facility in vicinity

Alert Coastguard who will call Emergency Services

Obtain crew / passenger / casualty numbers

Inform Harbour Master / on call Duty Manager

Obtain more details from vessel

Re-assess Incident and action taken

Alert other port facilities

Obtain Hazardous cargo list from Data Centre / PAVIS

Promulgate hazard sheet as required

Update interested parties

3.3 Sinkings

Obtain as much information as possible

Dispatch nearest suitable vessels to standby to take on casualties

(Fire tug, pilot launch, work boats or any low freeboard vessels)

Alert Coastguard

Obtain crew / passenger / casualty numbers.

Inform Harbour Master / on call Duty Manager

Re-assess incident and action taken

Update interested parties

3.4 Chemical / Gas Release from Ship or Shore

Obtain as much information as possible

Ascertain extent of affected area

Warn other vessels taking wind strength and direction into account

Ascertain quantity and type of substance released

Obtain crew / passenger / casualty numbers

Alert Coastguard who will advise Fire Brigade

If applicable, instruct vessel to proceed to a position so as to minimise danger to other vessels or populated areas

In consultation with coastguard, set up a sea and/or air exclusion zone around vessel

Direct traffic away from the affected area.

If a vessel, obtain crew / passenger / casualty numbers

Inform Harbour Master / on call Duty Manager

Re-assess Incident and action taken

Update interested parties

3.5 Serious Grounding

Obtain as much information as possible

Obtain accurate position of the vessel and its status

Dispatch available tugs

Obtain crew / passenger / casualty numbers

Ascertain if there is any pollution

Alert Coastguard

Inform Harbour Master / on call Duty Manager

Re-assess Incident and action taken

Update interested parties

3.6 Collisions between Vessels and Structures

Obtain as much information as possible

Are vessels in danger of sinking, on fire or does risks of explosion exist?

Dispatch nearest vessels (e.g. FIRE TUG)

Alert Coastguard

Obtain crew / passenger / casualty numbers

Inform Harbour Master / on call Duty Manager

Keep involved vessels informed

Re-assess incident and action taken

Update interested parties

4. HESMEP Response Organisation

Matrix of Roles for HESMEP Incident Command System

TEAM ROLE	INCIDENT COMMAND				
Initial Team Leader	VTS Humber Assistant Harbour Master				
TEAM ROLE	INCIDENT COMMAND	MARINE OPERATIONS	LOGISTICS	PLANNING	ADMIN / FINANCE
Team Leader	Harbour Master	VTS Manager	Procurement Manager	Pilotage Operations Manager (1)	Marine Administration Manager
Deputy Team Leader On Scene Commander	Deputy Harbour Master / Senior Pilotage Operations Manager	Assistant Harbour Master (VTS) Pilot	Marine Services Manager (Reports to Alex Dock)	Hydrographer - Humber Pilotage Operations Manager (2) (relief team)	Assistant Port Accountant
Team Member	Legal Advisors	Launch Coxswains & Deckhands	Local Engineering Manager	Hydrographic Surveyor	Marine Information Officer
Team Member	ABP Head Office Press Officer	Svitzer	ABP Dock Master (if required)	ABP OPRC Tier 2 contractor	Clerk (as appointed)
Team Member	VTS Operator	Phillips 66 Tetney Harbour Master	Phillips 66	Head of Safety	HES Secretary
Team Member	Clerical Personnel	ABP OPRC Tier 2 contractor	Clerical Personnel	VTS Operator	Human Resources Personnel
Team Member		APT Immingham	Svitzer		
Additional as required	Dock Master	Assistant Dock Master	ABP OPRC Tier 2 Contractor		

5. Action Checklists

5.1 Use of Section

This section outlines the actions that may be undertaken by the HESMEP Management Team in the response to a serious marine emergency. It must be borne in mind, however, that co-ordinators and response teams must be prepared to adapt their actions as the incident develops and conditions change. The table below provides the Teams for which the checklists are drawn up.

Action Plan Layout

Response Initiation	**Actions to be undertaken during the alert phase of the incident and actions to be performed in the initial stages of incident response**
Actions	Key actions to be performed during the incident response and as and when required
Final Actions	Actions required at the close of the incident response and on stand-down

Personnel Action Plans

5.2	VTS Assistant Harbour Master – Initial Incident Controller
5.3	Initial On-Scene Commander: Incident Assessment & Response
5.4	Incident Controller
5.5	Marine Operations Team
5.6	Planning Team
5.7	Logistics Team
5.8	Administration and Finance Team
5.9	Public Relations and Media Unit

5.2 VTS Assistant Harbour Master – Initial Incident Controller

Following the implementation of HESMEP, the VTS Assistant Harbour Master will co-ordinate the mobilisation and allocation of pilot launches for use as rescue craft and arrange for the boarding of pilots to assist in the removal of vessels from the incident area if required and may also detail a Pilot to act as "**On-Scene Commander**"

Responsibilities • Overall initial responsibility for, and control of, all aspects of the response to the incident.		
Stage	**Actions**	**Additional Advice**
Response Initiation	❑ Confirm activation of MRC with Harbour Master. Ensure that Grimsby Port security is instructed to open the ABP Humber MRC (Grimsby Port Office and out of hours). ❑ If incident is associated with potentially toxic vapours and/or requirement for a search and rescue function MRCC Humber (HM Coastguard) will call-out emergency services.	Ensure that you maintain an incident log. Blank logs are available in computerised format at VTS Humber. Records of telecoms, emails etc should be maintained. Confirm if this has taken place.
Actions	❑ Establish communication with vessel(s) / facility involved in incident and request their current status and intended actions. ❑ Ensure a VHF Channel has been designated for the Incident (Ch. 10 preferred if available). ❑ Request details of the incident from the Pilot who is acting as Duty On-Scene Commander. ❑ Determine the weather and marine conditions.	Ensure communications systems are operational. For the stricken vessel and the ABP response vessels is ESSENTIAL to feed back information to the ABP MRC; ensure the On-Scene Commander does this.
Final Action / Stand Down	On arrival of Harbour Master, Humber or Deputy at ABP MRC, carry out formal handover of incident response command. Ensure that handover is recorded in an Incident Log.	Be prepared to continue to assist in incident response if requested to do so by Harbour Master, Humber.

STATUS OF WEATHER AND MARINE CONDITIONS

Parameter	Actual	Predicted		
		6 hrs	12 hrs	24 hrs
Wind speed				
Wind direction from				
Sea State				
Present State of Tide				
Tide Speed				
Tide Direction (to)				

5.3 Initial On-Scene Commander – Incident Assessment & Response

Responsibilities • Surveillance; assisting in intervention response and deployment of tugs etc.		
Stage	**Actions**	**Additional Advice**
Response Initiation	❑ **Proceed to incident site and check communications systems with VTS Humber, ABP MRC and other vessels. This is ESSENTIAL to ensure passing of information to response teams onshore.** If communications are proving difficult, seek immediate help from VTS Humber. ❑ Ensure that incident area is safe. There may be a vapour cloud. If so, on no account enter area as there will be a danger of asphyxiation.	For the stricken vessel and the ABP response vessels it is ESSENTIAL to feed back information to the ABP MRC.
Initial Actions	❑ Confirm incident type and immediately notify Duty Incident Controller. Assess situation at site and confirm any further assistance required if possible.	
Ongoing Activities	❑ Monitor effectiveness of response and continue to feed back information to the ABP MRC.	
Final Action / Stand Down	❑ Provide report to Harbour Master at Grimsby Port Office	

5.4 Incident Controller

Responsibilities • Overall responsibility for, and control of, all aspects of the response to the incident.		
Stage	**Actions**	**Additional Advice**
Response Initiation	❑ On arrival at own office / ABP MRC establish status of incident. Accept situation report & handover of incident response operations from Duty Incident Controller. ❑ Ensure coverage of response team functions. ❑ Appoint a log keeper to assist Planning Team. Request Team to assemble, distribute and maintain Status and Situation Reports. ❑ Appoint a deputy to delegate responsibility if required to attend SCU or press briefings.	Ensure handover is recorded in Incident Log and that log is maintained throughout incident. Pre-planned allocation of functions is given in Matrix of Roles, Section 3.1. These are intended as guide only. Use the Matrix to ensure all aspects of the response are covered.
Initial Actions	❑ Obtain results of incident and establish response priorities. ❑ Chair planning meeting with Incident Management Teams as soon as possible.	Inform HO Chief Executive; maintain liaison during incident. Consider Incident Email. Guidance for media relations and prepare Holding Statements.
Ongoing Activities	❑ Organise and lead regular team briefings; these are essential to ensure that all team members are aware of objectives and response options, incident status, any problems that have arisen; exchange of information for updating Situation Map and boards. ❑ Determine requirements for relief arrangements for team members. Ensure that all handovers are recorded on incident logs. ❑ If salvage is involved in the response, liaise with Salvage Unit in MRC. Close co-operation between the salvage operations and incident response operations will be essential for minimising the environmental impact of a marine casualty. ❑ Ensure information is supplied to Communications for preparation of regular, updated media releases; authorise release of press statements & attend press briefings & conferences.	Consider aerial surveillance and reports via the MCA who will provide data for this assessment. It is important that any questions asked of the Communications by the media are fed back to the Incident Controller at the ABP MRC to ensure accurate and appropriate answers are given.
Final Action / Stand Down	❑ Consider incident stand down after confirming there is no potential for further incidents. ❑ Complete incident log. ❑ Call a debrief meeting for Incident Management Teams. ❑ Request Logistics to consolidate costs.	

5.5 Marine Operations Team

Responsibilities

- Responsible for all field operations and decision making in the incident response.

Stage	Actions	Additional Advice
Response Initiation	❑ Start Marine Operations Incident Log. ❑ Assess status of incident. Confirm incident classification.	Refer Appendix 2 for Incident Log proforma. It is most important that LOGS ARE MAINTAINED.
Initial Actions	❑ Nominate a team member to establish and maintain communications link with site. ❑ Conduct meeting with On-Scene Commander (if available) and Incident Controller. Formulate and agree response strategy. ❑ Determine immediate and future equipment and manpower requirements. ❑ Provide details to Logistics Team for sourcing. ❑ Refer to Section 7 for details of equipment and mobilisation procedures.	It is crucial that good communications links are maintained with incident site.
Ongoing Activities	❑ Attend regular planning meeting. ❑ Mobilise back-up equipment resources as required. ❑ Monitor effectiveness of response strategy. ❑ Monitor levels of equipment & manpower; maintain regular liaison with Logistics re support required. ❑ Provide information to Media Advisor as required.	Note that there is an agreement in place between MCA and UKPIA to supply specialist advice and manpower for major incidents.
Final Action / Stand Down	❑ Stand down equipment and manpower. ❑ Provide Administration Unit with incident log.	

5.6 Planning Team

Responsibilities

- Planning and preparation of medium-long term planning objectives.
- Collection and evaluation of information on all aspects of the incident.
- Advising the Incident Controller on liaison with various organisations and agencies involved in incident.

Stage	Actions	Additional Advice
Response Initiation	Start Team Incident Log. A Log Keeper from the team may be appointed to support this team function. Log keeper should be directed to carry out following activities: Maintain operation of white boards, and dissemination of all incoming information.	In addition, produce coherent log of events, which cross references all relevant media releases, meeting notes, assessment reports, briefing notes. Refer Appendix 2 for Incident Log.
Initial Actions	❑ Assess current situation from Incident Controller/Marine Operations Team and develop situation map and resource status boards. ❑ Obtain initial weather report.	
Ongoing Activities	❑ Arrange ongoing planning meetings, prepare brief agenda. Organise attendees. Provide ongoing feedback from statutory authorities, especially any directions or recommendations for ongoing actions and notifications. ❑ At meetings obtain information on proposed response option in order to inform statutory bodies. ❑ Develop medium term plan with possible alternative strategies based on outline response strategy (Marine Operations). ❑ Obtain regular weather forecasts. Update situation map & resource status boards. ❑ Present data for the next operational period at planning meetings.	Ensure incident boards, resource boards and Situation Map are being kept up to date with essential information
Final Action / Stand Down	❑ Confirm status of incident and confirm stand down with Incident Controller. ❑ Close out resource status boards. ❑ Provide Administration Unit with incident log. ❑ Attend Incident Management Team debrief.	

5.7 Logistics Team

Responsibilities • Responsible for addressing the needs of the incident site and arranging provision of facilities, services and materials and manpower in support of the incident. • Responsible for arranging provision of additional communications.		
Stage	**Actions**	**Additional Advice**
Response Initiation	❑ Start Team Incident Log ❑ Make contact with Incident Controller and ascertain the extent of initial anticipated requirements for: • Catering and accommodation; • Communications; and Aerial surveillance. • Marine response transportation.	Incident Log provided in Appendix 2. Ensure that all documentation is filed and retained for logging.
Initial Actions	❑ Attend planning meeting and determine immediate future requirements. ❑ Address the immediate needs at site. ❑ Liaise with Finance Unit re Purchase Order and Applications for Expenditure (AFE) system that they are intending to run during the incident. ❑ Ensure that an effective communication network is operative in MRC. ❑ Appoint and supervise personnel to serve as telephone and fax operators.	Ensure Equipment and Manpower Unit and Support Services & Transportation Unit are aware of the systems to be used.
Ongoing Activities	❑ Attend planning meeting. ❑ Address needs of field. ❑ Arrange provision of facilities, services and materials in support of the incident response. ❑ Determine ETA's on equipment and personnel to be obtained.	
Final Action / Stand Down	❑ Ensure return of all equipment; determine need for any remedial action re equipment. ❑ Provide Administration Unit with incident log. ❑ Attend incident debrief. ❑ Prepare incident report.	Stand down personnel, transport and equipment and organise return as needed. Log any damaged equipment. Collate transport, equipment and personnel costs incurred during the response.

5.8 Administration and Finance Response Team

Responsibilities

- Keeping accurate financial records for subsequent preparation and support of claims for the recovery of money spent.
- Financially securing the requirements of Logistics Team.
- Establishing appropriate filing systems to ensure that accurate records of what was done and why are available in support of financial claims for recovery of money spent.
- Provision of secretarial services.
- Implementing Security Arrangements as required.

Stage	Actions	Additional Advice
Response Initiation	❑ Start Team Incident Log. ❑ Set up Administration, Finance and Legal Units.	
Initial Actions	❑ Attend planning meeting and inform other teams of financial and administration systems in place and legal advice available. ❑ Determine requirement for additional communications systems, e.g. more lines, more phones, etc.	
Ongoing Activities	❑ Hold team meeting prior to planning meeting – ❑ Attend planning meeting and notify teams of any necessary changes to operating systems. ❑ Financially secure the requirements of Logistics Team. ❑ Keep accurate financial records for subsequent preparation and support of claims for the recovery of money spent.	Determine any systems failures and methods of resolving the failures.
Final Action / Stand Down	❑ Provide Administration Unit with incident log.	

5.9 Public Relations and Media Unit

Responsibilities		
	• Provision of prompt accurate information to the news media at the incident site. • Liaison and co-operation with MCA Media Team if involved	
Stage	**Actions**	**Additional Advice**
Response Initiation	❑ Proceed to ABP MRC. ❑ Start Public Relations/Media Unit Log.	ABP Regional Head of Communications to proceed to Grimsby soonest.
Initial Actions	❑ If Holding Statement has been issued, obtain copy. ❑ Prepare to draft initial press statement having first established incident facts including: • Nature of incident. • Location and time occurred or began. • Facilities, vessels involved. • Casualties suffered. • Cause of incident if known. • Actions being taken in response. ❑ Issue draft statement to the other involved parties for comment and co-ordination. ❑ Issue initial press release. ❑ Provide clear, concise information. ❑ Provide information **ONLY** known to be fact at the time; do not speculate or attempt to answer for others. ❑ Do not be hostile with the media.	**Sample Press Statements and Guidelines for dealing with the Media are provided in Appendix 9**. Note that it is important that individuals having a legitimate interest in the incident are provided with relevant facts with maximum speed and minimum confusion. Under no circumstances should any personnel data be released before notification of next of kin. (caution required because full incident investigation may be on-going) Determine likely media reaction:- Local / National / International. The Incident Controller is unlikely to be available to attend interviews and press conferences but may be available subsequently when initial responses are complete.
Ongoing Activities	❑ Attend planning meeting; provide data to Incident Controller & team leaders on media issues associated with incident. Brief those to be present on agenda for press briefings. ❑ Arrange news conferences and/or interviews. Ensure senior authorised persons within ABP (other than Incident Controller) are nominated to conduct media interviews and are properly briefed beforehand. ❑ Prepare ongoing press releases.	Constantly monitor news/press coverage. In particular look for gross inaccuracies that should be corrected in the next press release/conference. Ensure that an agenda is prepared for all press briefings and be prepared to terminate briefings as required. For major incidents, the MCA press officer may also be present. Ensure close co-operation between involved parties. Ensure Incident Controller is briefed prior to press conferences.
Final Action / Stand Down	❑ Provide final press release and organise final press conference, etc. ❑ Provide Admin. Unit with incident log.	Include copies of all press statements, photographic documentation, etc.

Media Liaison

In the event of an incident that results in media attention, the ABP Regional Head of Communications will handle all media inquiries, statements and briefings, as well as liaison with media requirements of an affected party.

The Media's Aims

The following encompass the media interests in the event of an incident and their related needs:

- First with news & meet deadlines.
- Publish details of casualties.
- Present facts including statistics.
- Bring stories to life with interviews, quotes and provide human interest stories.
- Show dramatic pictures.
- Describe events as they develop.
- Establish cause.
- Find new angles different from other coverage.

Objectives in Dealing with the Media

The following should be borne in mind:

- Consider granting controlled access to the media to enable filming if safe to do so (If not they will try and gain unauthorised access ashore or afloat).
- To communicate quickly and honestly with all those affected by the emergency to:
    - Give safety information.
    - Explain how your organisation is responding.
    - Limit adverse comments and damage to reputation.
    - Correct errors in reporting.
    - Promote the positive aspects of your organisation.

However, note the following:

- The objective is to ensure all involved parties give a co-ordinated media response - (**no contradiction**).
- Unless you are designated as your organisation's spokesperson **you are NOT authorised to offer a comment** on behalf of the organisation, therefore media requests should be declined.

6. Resources

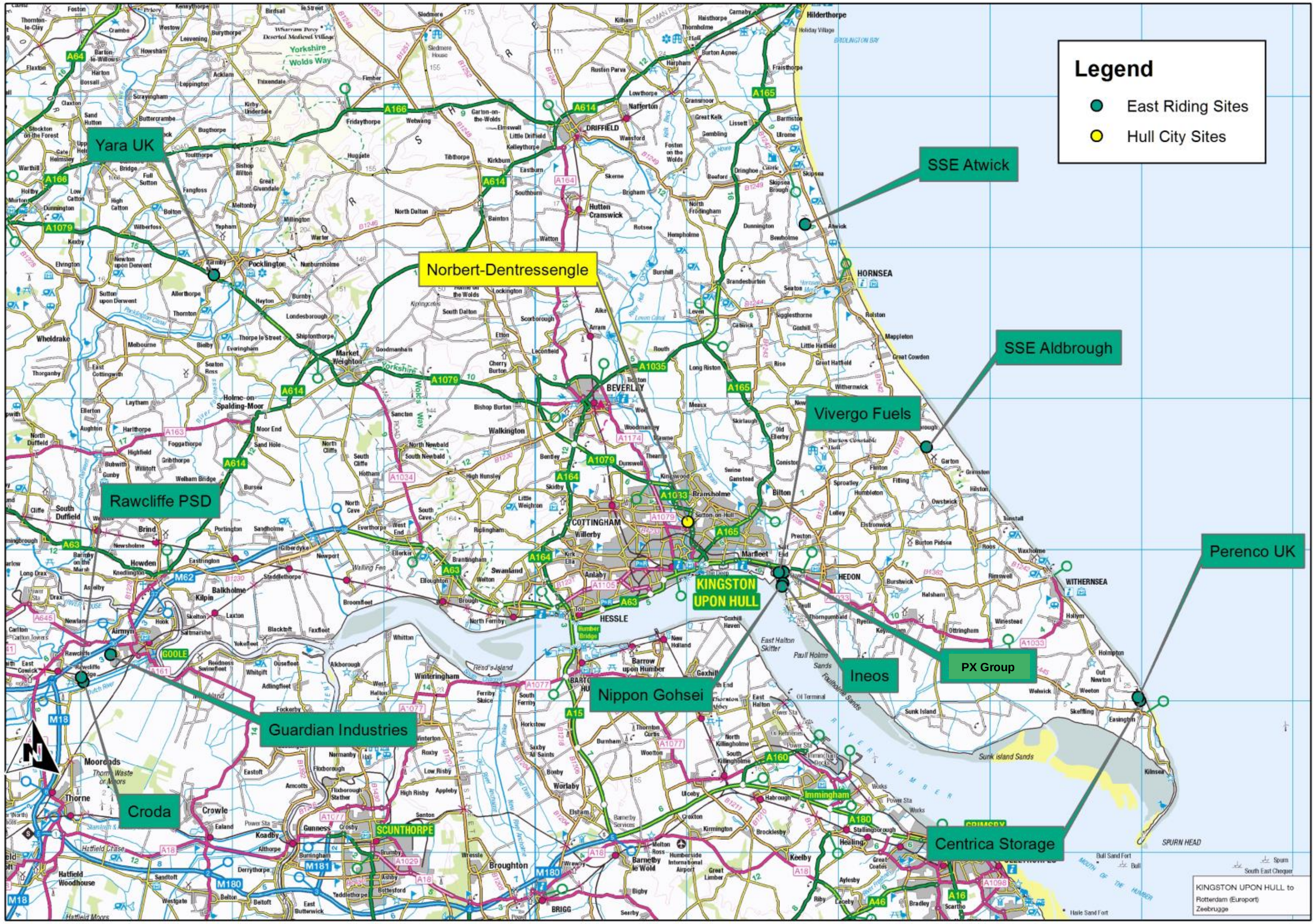
Each organisation involved in a Humber Serious Marine Emergency, will be responsible for implementing their individual plans and procedures. A number of organisations operate on or adjacent to the Humber Area and have their own individual emergency response plans which have been designed to interface with **HESMEP.**

Top Tier Control of Major Accident and Hazards (COMAH) sites adjacent to the Humber Area:

Local Authority	Site Name
East Riding	PX Group, Saltend Chemicals Park
	Centrica Storage Limited
	Croda Europe Ltd
	Guardian Industries Ltd
	INEOS UK
	Nippon Gohsei UK Ltd
	PERENCO
	Rawcliffe PSD
	SSE Aldbrough Gas Storage Facility
	SSE Atwick Gas Storage Facility
	Vivergo
	Yara Phosyn Limited
Hull	XPO (formerly Norbert Dentressangle)
North East Lincolnshire	ABP Fertiliser Terminal
	APT Limited
	BASF Performance Products
	BOC Gases, Stallingborough
	Cristal Pigment
	Immingham Storage East
	Immingham Storage West
	Novartis Grimsby Limited
	Phillips 66 Immingham Pipeline Centre & Immingham Propylene Storage
North Lincolnshire	BOC Gases, Scunthorpe
	BRITISH STEEL
	Jotun Paints
	Killingholme PSD
	Phillips 66 Humber LPG Terminal Limited
	Phillips 66 Humber Refinery
	Total Lindsey Oil Refinery

These sites are located near coastline

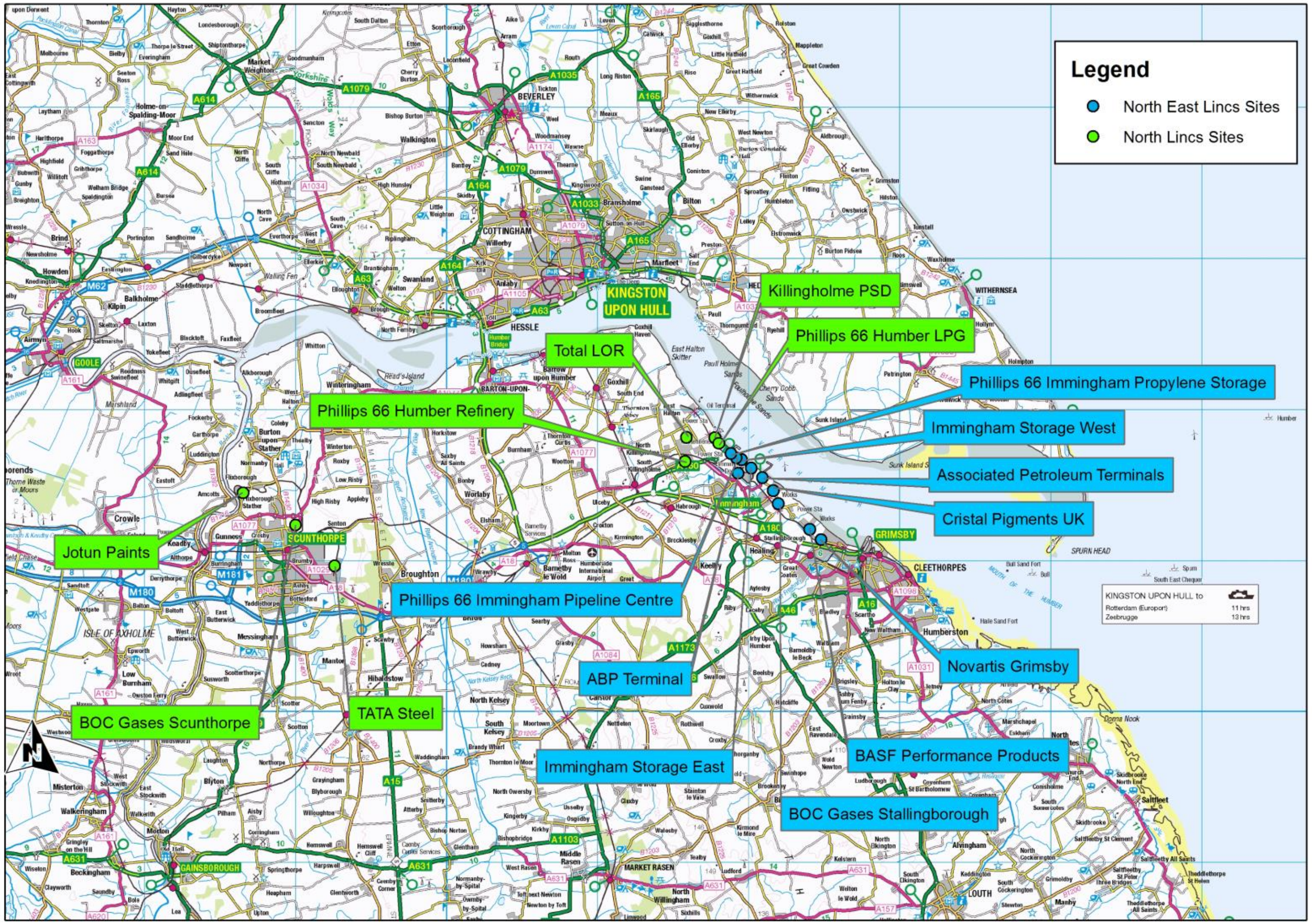
HESMEP



Legend
East Riding Sites
Hull City Sites
Yara UK
SSE Atwick
Norbert-Dentressengle
SSE Aldbrough
Vivergo Fuels
Rawcliffe PSD
Perenco UK
PX Group
Ineos
Nippon Gohsei
Guardian Industries
Croda
Centrica Storage
KINGSTON UPON HULL

HESMEP

KEEPING BRITAIN TRADING



Other Emergency Response Plans: -

Port of Hull Emergency Plan
Port of Goole Emergency Plan
Port of Immingham Emergency Plan
Port of Grimsby Emergency plan
Humber Sea Terminal
Tetney Mono Buoy
Humber Emergency Planning
Humber Clean

7. Personnel Landing Points / Berth Support Facilities & Beaching Areas

7.1 Casualties and Survivors

The following terminology is to be used when referring to persons surviving the incident: -

"SURVIVORS" all surviving personnel whether casualties or not.

"CASUALTIES" those surviving who are injured.

7.2 Casualty and Survivor landing points

The following will be used as casualty and survivor landing points. The National Grid References are as given by the Ordnance Survey standard system of 6 figure references and give a positional accuracy of 100 metres. The references used in this plan can be found on Ordnance Sheets 107 and 113 (1-50,000, Second Series).

e.g. *Spurn Pilot Jetty N.G.R. TA 398110*
100 km square reference TA
Eastings within square 39.8 km
Northings within square 11.0 km

(a) **SPURN PILOT JETTY** N.G.R. TA 398110

Situated at the extreme seaward end of Spurn Peninsula.
Depth of water three metres at Chart Datum. This point is now inaccessible for land based vehicles (for CASEVAC situations).

(b) **GRIMSBY** N.G.R. TA 278114

Landing steps situated at the western side of Royal Dock Basin.
Road access to the landing steps is via the roadway on the western side of Grimsby Royal Dock.
Depth of water one metre at Chart Datum.

(c) **IMMINGHAM** N.G.R. TA 199164

Landing steps situated on the western side of the lock entrance.
Road access to the landing steps is via the roadway on the western side of Immingham Dock.
Depth of water 7.6 metres at Chart Datum.

(d) **KING GEORGE DOCK, HULL** N.G.R. TA 140284

Landing steps situated on the eastern bull nose approach to the lock.
Depth of water 5.5 metres at Chart Datum.

(e) **VICTORIA PIER, HULL** N.G.R. TA 100281

Landing steps (known as Admiral's Steps) at dolphin on front of Pier.
Road access via Queen Street and Nelson Street.
Depth of water 1 to 2 metres at Chart Datum.

(f) **MINERVA PIER, HULL** N.G.R. TA 099281

Landing steps at rear of pier in Hull Marina Basin.
Road access via Queen Street and Nelson Street.
On occasions may dry out across low water.

(g) **BLACKTOFT JETTY, RIVER OUSE** N.G.R. SE 841242

Vertical ladder to the front of the jetty.
Road access via Blacktoft Lane.
Depth of water 5.5 metres at Chart Datum.

7.3 Berth Support Facilities

If it is possible to direct the vessel concerned to an in-dock berth, refer to the relevant port emergency plan for permitted lengths and available facilities.

If it is possible to direct the vessel concerned to a river berth, subject to the berth being clear, the following may be considered: -

Immingham - East and West Jetties
Immingham Bulk Terminal
Humber International Terminal 1 and 2
Immingham Outer Harbour
Humber Sea Terminal
King George Dock, Hull-Approach Jetty
Riverside Quay, Hull
New Holland Pier
Goole Victoria Pier
Blacktoft
Trent Wharves

7.4 Beaching Areas

In order to preserve safe port operations in the event of an incident, every effort should be made to clear navigational channels and reach a suitable beaching area.

This will improve any subsequent salvage operations and help preserve the watertight integrity of the vessel due to the sandy/muddy nature of the bottom in these areas.

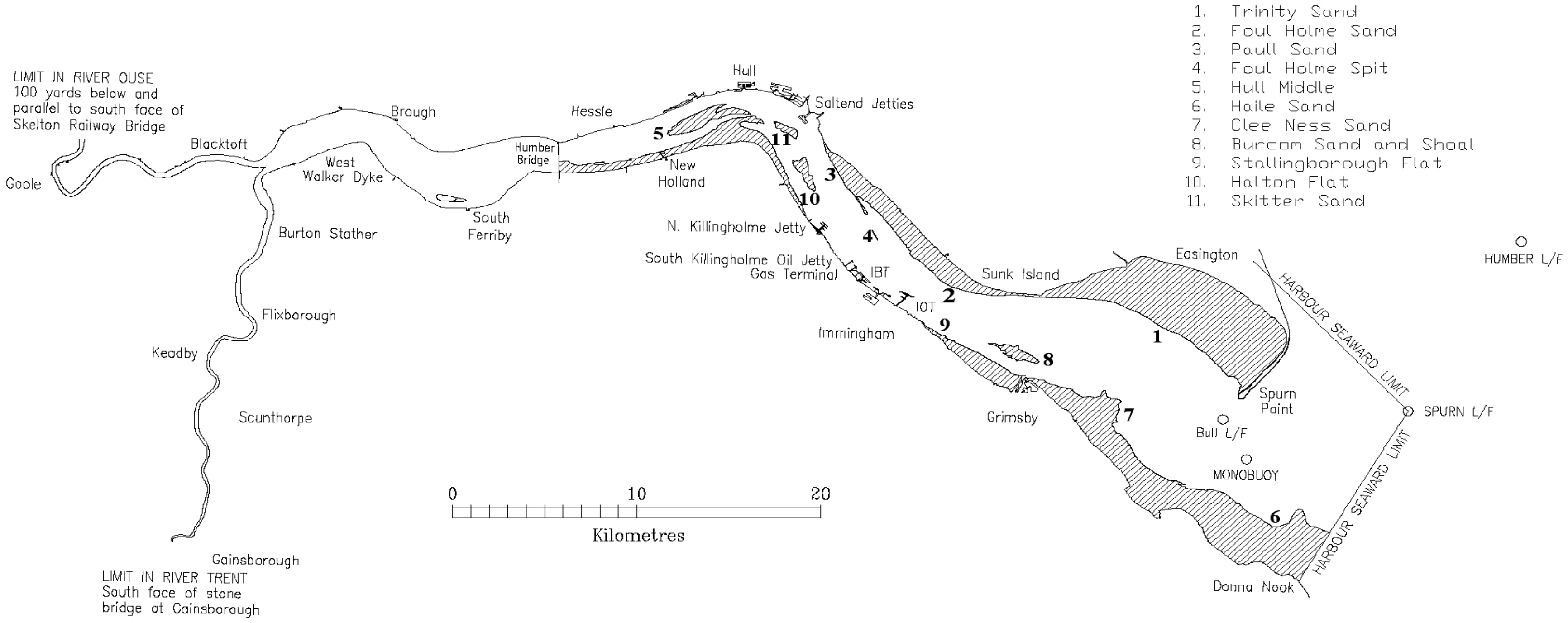
The following beaching areas have been identified:-

NORTH BANK	
(1)	Trinity Sand
(2)	Foul Holme Sand
(3)	Paull Sand
(4)	Foul Holme Spit
(5)	Hull Middle

SOUTH BANK	
(6)	Haile Sand
(7)	Clee Ness Sand
(8)	Burcom Sand
(9)	Stallingborough Flat
(10)	Halton Flat
(11)	Skitter Sand

7.5 Chart

Recommended Beaching Areas (Shaded)
within the limits of "The Harbour of The Humber" as defined in Byelaw 4(i)
of the Humber Navigation Byelaws 1990



8. Contacts

Associated British Ports (ABP)

ABP Humber

ABP VTS Humber Wharncliffe Road Grimsby NE Lincolnshire DN31 3QJ	Assistant Harbour Master Emergency Direct Line Harbour Master Marine Response Centre (manned during incident)	Tel: 01482 212 191 (24 hours) Tel: 01482 212 191 (24 hours) Tel: 01482 327 171 (Office hours) Tel: 01472 263 501 to 01472 263 510 01482 212191 (via VTS) Internal ext No's: 6331 - 6340

ABP Holdings PLC, Head Office, London

ABPH plc 2nd Floor 25 Bedford Street London WC2E 9ES	Corporate Communications Manager	Tel: 020 7406 7825 Fax: 020 7430 7896 Email info@abports.co.uk

Maritime & Coastguard Agency (MCA)

Humber Coastguard Operations Centre (CGOC)

HM Coastguard Limekiln Lane Bridlington East Riding of Yorkshire YO15 2LX	Duty Officer	Tel: 01262 672317 or 01262 606910 (24 hours) Email Zone8@hmcg.gov.uk

Tug Operators

Svitzer UK

Svitzer UK Triton House Immingham Dock Grimsby DN40 2LZ		Tel: 01469 571115 (24 hours) Fax: 01469 571616 *operationssvitzerimmingham@svitzer.com*

SMS Towage Limited

SMS Towage Limited Ocean House Waterside Park Livingstone Road Hessle HU13 0EG		Tel: 01482 350999 Fax: 01482 648284 info@smstowage.com

Power Stations and Industrials

South Humber Power Ltd

South Humber Power Ltd South Humber Bank Power Station South Marsh Road Stallingborough DN41 8BZ	Main Switchboard	Tel: *01469 577236 (24 hours)* Fax: *01469 576466*

Uniper Killingholme Power Station

Uniper Killingholme Power Station Chase Hill Road North Killingholme Immingham DN40 3EH	*(formally National Power, EON and Centrica)* Control Room	Tel: 01469 541348 (24hrs) Fax:01469 504077

Keadby Power Station

Keadby Power Station Trentside, Keadby Scunthorpe North Lincolnshire DN17 3EF	*General inquiries.* *Control room*	*Tel: 01724 788200* *Fax:01724 788217* *Tel 01724 788220 (24 hours)* *Fax 01724 784809*

Cristal Pigment UK Limited

Millennium Inorganic Chemicals Laporte Road Stallingborough P.O. Box 26 Grimsby N.E. Lincolnshire	General enquiries	*Tel: 01469 571000* *Fax: 01469 571234*

Novartis Grimsby Limited

Novartis Grimsby Limited Moody Lane Pyewipe Grimsby, N.E. Lincolnshire DN31 2SR	*General inquiries* *Security*	*Tel:* 01472 355221 Tel: 01472 253242 or 01472 255439

Synthomer Limited

Synthomer Limited South Marsh Road, Stallingborough, Grimsby, N.E. Lincolnshire DN41 8DA	General enquiries	*Tel:* 01469 573 361 *Fax:* 01469 571 346

Humber Oil Pollution Prevention, Preparedness and Response Committee (HOPPRC) Participants

ABP Grimsby & Immingham

ABP Grimsby & Immingham Dock Office Immingham NE Lincolnshire DN40 2LZ	Dock Master	Tel: 01469 571555 (24 hours) Fax: 01469 571559

Associated Petroleum Terminals (Immingham) Ltd

Associated Petroleum Terminals (Immingham) Ltd Queens Road Immingham South Humberside DN40 2PN	Terminal Manager or Jetty Manager	Tel: 01469 570300 Fax: 01469 571321 *Tel 01469 570305 (supervisor)* *Tel 01469 570314 (berthing master)* aptemergencycontrol@aptoil.co.uk berthing.masters@aptoil.co.uk

Phillips 66 Ltd

Phillips 66 Ltd Tetney Oil Terminal Tetney Lock Road Tetney Nr. Grimsby South Humberside DN36 5NX	Manager or Harbour Master	Tel: 01469 571571 Fax: 01469 556246 Tel 01469 556230 (control room)

Inter Terminals Ltd (East & West Jetty) [Simon Storage]

Inter Terminals Ltd Immingham West Terminal West Riverside Immingham Dock Immingham North East Lincolnshire DN40 2QU	West Terminal Terminal Manager or Deputy Terminal Manager East Terminal Terminal Manager or Deputy Terminal Manager	Tel: 01469 572615 (24 hours) Fax:01469 577019 Tel: 01469 563900 (24 hours) Fax:01469 563901

Humber Sea Terminal (North Killingholme)

Simon Storage (North Killingholme) Co Ltd North Killingholme Cargo Terminal Clough Lane North Killingholme South Humberside DN40 3JP	Commercial Manager Or Operations Manager	Tel: 01469 540890 / 540381 Fax: 01469 541121 / 541970 (24 hours)

BP Chemicals Limited, Saltend

PX Group Saltend Chemicals Park Saltend Lane Hull HU12 8DS		Tel: 01482 896251 Fax: 01482 892280 *Tel: 01482 892278 (Logistics)* *Fax: 01482 894960*
	Pier Master	*Tel: 01482 890877*

ABP, Port of Hull & Goole

ABP Hull PO Box 1 Port House Northern Gateway Hull HU9 5PQ	**Dock Master**	**Tel: 01482 617290** Fax: 01482 617295
	Assistant Dock Master Hull	**Tel 01482 617291** Fax 01482 617295
	Assistant Dock Master Goole	**Tel 01405 721128** Fax 01405 766109

Environment Agency

Environment Agency	National Customer Contact **Emergency Hotline**	Tel: 03708 506506 (Office Hours) **Tel: 0800 80 70 60 (24 hours)** ***Email: ics@environment-agency.gov.uk***

Humber Emergency Planning Service

Humber Emergency Planning Service County Hall Beverley Hull HU17 9BA	In the event of an emergency oil pollution incident HEPS is the direct contact. The Duty Officer will contact the appropriate council and team member	**Emergency Contact** **Tel: 0300 330 2080** Email: duty.officer@eastriding.gov.uk Routine Contact **Tel: 01482 393050** Email: heps@eastriding.gov.uk

Marine Management Organisation (MMO) Emergency Contacts

Office Hours (from 0900 to 1700):
Please telephone our dedicated Spill Response number:

0870 785 1050

A member of MMO's Marine Pollution Response Team will give immediate priority to any calls made to this dedicated number.

Outside Office Hours (from 1700 to 0900):
Outside office hours callers should call an MMO Duty Officer on:

Mobile Phone: **07770 977825**.

If there is no reply on either of the above numbers call the 24-hour Defra Duty Room on:

0845 051 8486

The Defra Duty Room should be able to contact an officer in the Marine Management Organisation by home or mobile telephone or pager and will ask them to return your call.

Fax Numbers

Defra Duty Room (provides 24-hour cover for MMO)	**0845 051 8487**
Marine Management Organisation (not 24-hour)	**0191 376 2682**

If action is required by MMO a telephone call must be made in addition to any message sent by fax as the fax machines are not monitored continuously.

(Non emergency contact address: dispersants@marinemanagement.org.uk ,

Marine Management Organisation,

PO Box 1275, Newcastle Upon Tyne, NE99 5BN)

** The Marine and Fisheries Agency (MFA) became part of the Marine Management Organisation (MMO) on 1 April 2010 when the MMO was created as a consequence of the Marine and Coastal Access Act 2009.*

MMO District Inspector of Fisheries, Humberside

MMO Room 13, Ground Floor Crosskill House Mill Lane Beverley HU17 9JB	District / Senior Marine Officer	Tel: 0208 026 0519 beverley@marinemanagement.org.uk

Natural England

Natural England – National Office

Natural England	Marine Pollution Officer	Tel: 0300 060 1200 (24 hours) Marine.Incident@naturalengland.org.uk **In the event of emergency oil pollution incident contact should be made with the National Office.**

Natural England –Yorkshire and Humber Region: York Office

Natural England Foss House, Kings Pool, 1-2 Peasholme Green, York YO1 7PX	Conservation Officer	Tel: 0300 060 1200 (24 hours) **In the event of emergency oil pollution incident contact should be made with the National Office.**

Natural England – Yorkshire and Humber Region: Leeds Office

Natural England 25 Queen Street, Leeds, LS1 2UN	Conservation Officer	Tel: 0300 060 1200 (24 hours) **In the event of emergency oil pollution incident contact should be made with the National Office.**

Natural England – East Midlands Region

Natural England Second Floor Ceres House, 2 Searby Road, Lincoln, LN2 4DT, Lincoln.	Conservation Officer	Tel: 0300 060 1200 (24 hours) **In the event of emergency oil pollution incident contact should be made with the National Office.**

Royal Society for the Protection of Birds (RSPB)

RSPB North of England Regional Office

RSPB 1, Sirius House, Newcastle Business Park, Amethyst Rd, Newcastle upon Tyne NE4 7YL	Senior Conservation Officer Regional Officer Public Affairs Officer	Tel: 0300 7772 676

RSPB Local Warden

Blacktoft Sands	Humber Area Manager	Tel: 01405 704665 (Office hours) Mobile: 07900 907778 Email: blacktoft.sands@rspb.org.uk

Yorkshire Wildlife Trust

Yorkshire Wildlife Trust 1 St George's Place York, YO24 1GN		Tel: 01904 659570 (Office hours) Answer Phone (Out of hours) Fax: 01904 613467 (Out of hours)

Lincolnshire Wildlife Trust

Lincolnshire Wildlife Trust Banovallum House Manor House Street Horncastle Lincolnshire LN9 5HF	Director	Tel: 01507 526667 (Office hours) Fax: 01507 525732 (Out of hours)

RSPCA

RSPCA	Control Room	Tel: 0870 555 5999 (24 hours) Fax 0113 236 3173

Police Service

Humberside Police Police Headquarters Queens Gardens Hull HU1 3DJ	Police Service	Tel: 101 (24 hours) *www.humberside.police.uk*

Fire Service

Humberside Fire Brigade Brigade Headquarters Summergroves Way Hessle High Road Hull HU4 7BB	Control	Tel: 01482 565333 Tel: 01482 610999 (Emergency) Fax: 01482 567447

International Tanker Owners Pollution Federation Ltd (ITOPF)

ITOPF Ltd 1 Oliver's Yard 55 City Road London EC1Y 1HQ	Enquiries Emergency	Tel: 020 7566 6999 (Office hours) Fax: 020 7566 6950 Email: central@itopf.com Emergency Tel: 07623 984 606 (24hrs) Alt Emergency Tel: 020 7566 6998

Marine Accident Investigation Branch (MAIB)

Marine Accident Investigation Branch 1st Floor Carlton House Carlton Place Southampton Hampshire SO15 2AN	Duty Officer	Tel: 023 8023 2527 (24 hours) Fax: 023 8023 2459

H M Revenue & Customs

H M Revenue & Customs 36 Ferensway Hull HU2 8LP		Tel: 0845 300 0627

9. Appendices

9.1 Appendix 1.

Memorandum of Understanding between HM Coastguard, (Humber MRCC) and Associated British Ports, (Humber Estuary Services).

MEMORANDUM OF UNDERSTANDING
BETWEEN
HM COASTGUARD OPERATIONS CENTRE HUMBER

AND

ASSOCIATED BRITISH PORTS, HUMBER ESTUARY SERVICES
ON THE ARRANGEMENTS FOR THE COORDINATION OF MARITIME INCIDENTS

INTRODUCTION

1. **The purpose of this Memorandum of Understanding between HM Coastguard (HMCG) and Associated British Ports Humber Estuary Services (ABP, HES) is to confirm agreements reached on their respective roles and responsibilities, and to define, for the avoidance of doubt, the actions that each organisation has agreed to take, in any given scenario within the area of overlapping responsibilities.**

ASSOCIATED BRITISH PORTS, HUMBER ESTUARY SERVICES

2. The Statutory Jurisdiction of Associated British Ports, Humber Estuary services is defined in The Humber Navigation Byelaws 1990, Byelaw 4., which states:-
"The Humber" means:-
(i) so much of the River Ouse as is within the limits of improvements as defined by Section 3 of the Ouse (Lower) Improvement Act 1884;
(ii) the River Trent below the South side of the Stone Bridge at Gainsborough;
(iii) the River Humber and estuary thereof from the confluence of the Rivers Ouse and Trent to the seaward limits bounded by:-
(a) a straight line drawn from Easington Church (Latitude 53º39'N, Longitude 00º07'E) in a direction 136º true until it intersects the line mentioned below; and
(b) a straight line drawn from the site of the former Donna Nook beacon (Latitude 53º28',38N, Longitude 00º09'.33E) in a direction 029º true;

(iv) *all navigable havens and creeks of the River Trent below the south side of the said Stone Bridge and of the River Humber or the estuary thereof wherein the tide flows and reflows;including, where the context so admits, any land adjoining the Humber but not including any part of the old harbour or haven at Hull (being part of the River Hull and within the jurisdiction of the Kingston Upon Hull City Council as navigation authority), the marina as defined in Section 4 (Interpolation of Part 11) of the Kingston Upon Hull Act 1984 or any enclosed dock;*

Within its area of jurisdiction, ABP, HES is charged with certain responsibilities, principal among which is a statutory responsibility for the maintenance of the safety of navigation and the conservancy of this defined area.

3. Additionally ABP, HES provide a Vessel Traffic Service (VTS) within prescribed limits of coverage defined as follows:-

(i) *So much of the River Ouse as is within the limits of improvement as defined by Section 3 of the Ouse (Lower) Improvement Act 1884;*

(ii) *The River Trent below the south side of the stone bridge at Gainsborough;*

(iii) *The River Humber and the estuary thereof from the confluence of the Rivers Ouse and Trent to the seaward limits; (using geographical references based on WGS 84 datum): -*

a) *A straight line drawn from Easington Church in the County of East Riding of Yorkshire (Latitude 53° 39'. 02 North, Longitude 0° 06'. 90 East) in a direction 086° (T) to a position 53° 40'. 00 North, 0° 30'. 00 East.*

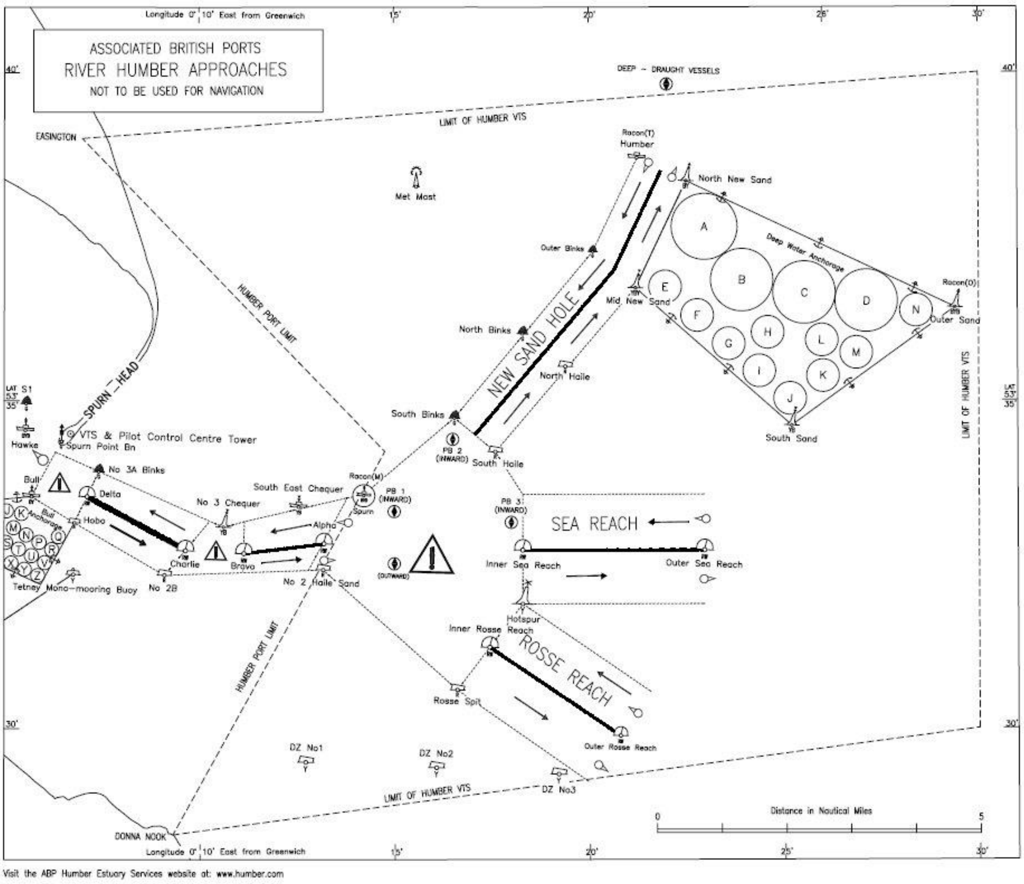
b) *Then a straight line in a direction 180° (T), to a position 53° 30'. 00 North, Longitude 0° 30'. 00 East*

c) *Then a straight line in a direction 262° (T), to the site of the former Donna Nook Beacon in the County of North Lincolnshire (Latitude 53° 28'. 40 North: Longitude 0° 09'. 23 East).*

4. Category of VTS service provided:

(i) *A **Traffic Organisational Service** bounded by the seaward limits and the Humber Bridge.*

(ii) *An **Information Service** bounded by the inland limits in the rivers Trent and Ouse and the Humber Bridge.*



5. To enable ABP, HES to meet these responsibilities they have powers to enforce Byelaws, issue General and Special Directions; are a Competent Harbour Authority and therefore ensure the provision of a pilotage service; and to direct navigation within the Area of Jurisdiction. Additionally, the Dangerous Substances in Harbour Areas Regulations 1987 require the authority to develop and maintain comprehensive emergency plans. ABP, HES has a statutory responsibility to prepare Oil Contingency Plans, report oil spills and respond to oil pollution in terms of the Merchant Shipping, (Oil Pollution, Preparedness and Response Convention), Regulations 1998.

MARITIME & COASTGUARD AGENCY – HM COASTGUARD

6. The Maritime and Coastguard Agency (MCA)- HM Coastguard is responsible for delivering upon six internationally recognised Coastguard functions – Search and Rescue, Maritime Safety, Maritime Security, Pollution Response, Vessel Traffic Management and Accident and Disaster Response. The delivery of these functions supports the developing, promoting and enforcing of standards of marine safety; minimising loss of life amongst seafarers and coastal users; responding to maritime emergencies; minimising the risk of pollution of the marine environment from ships; and where pollution occurs, minimising the impact on UK interests.

7. The modern role of HM Coastguard was clearly defined by the Secretary of State for Transport in the House of Commons in March 1992 when he announced that under the authority given to him by the Coastguard Act 1925 it had been agreed that Her Majesty's Coastguard is responsible for the initiation and co-ordination of civil maritime search and rescue within the United Kingdom Search and Rescue Region which includes the mobilisation, organisation and tasking of adequate resources to respond to persons either in distress at sea, or to persons at risk of injury or death on the cliffs or shoreline of the UK.

RESOURCES

ABP, Humber Estuary Services

8. ABP, HES operates a Vessel Traffic Service on a 24 hour basis from the Humber Marine Control Centre situated at Grimsby. VHF radio coverage exists throughout the area of jurisdiction of the Harbour. Radar coverage is also available through its radars sited at Spurn Point, Grimsby, Stone Creek, Hull and the Humber Gateway giving coverage of the Humber Approaches through to the Humber Bridge. AIS coverage is provided through stations at Grimsby, Hull, Spurn Point and Blacktoft.

9. Any ABP, HES emergency response would be co-ordinated initially through VTS Humber, then, subject to the severity of the emergency, transferred to the Marine Response Centre (MRC) at the Grimsby Port Office. Direct telephone links exist between VTS Humber and the Coastguard Operations Centre (CGOC) at Bridlington, and emergency links can be established quickly between the MRC and the CGOC at Bridlington.

10. Oil Pollution Response in a Tier 2 and Tier 3 will be through the Marine Response Centre at Grimsby. ABP, HES is equipped to deal with a Tier 1 and Tier 2 oil spill. The shoreline clean up response being provided by the Unitary Authorities who will activate their Shoreline Response Centre (SRC) as required.

11. ABP, HES has pilot launches based at Grimsby, which are manned 24 hours per day. Hydrographic survey vessels are usually available during working hours during a normal working week. In an emergency craft can be made available.

12. ABP, HES has no salvage resources.

13. A large proportion of the vessels moving through the Harbour have ABP authorised pilots embarked.

Other Harbour Facilities

14. Several companies based in the Humber region have tugs, work boats and other small craft that could be made available. Some of these craft have the facility to employ oil dispersant.

HM Coastguard

15. HMCG utilises facilities made available by other parts of the UK Maritime SAR organisation, but will also seek assistance from any source likely to be able to make an effective contribution to a SAR operation. In general, facilities which HM Coastguard can call upon are of two kinds, Declared and Additional.

16. Declared Facilities that could be called upon locally include:
   - (i) Rescue Helicopters and fixed wing aircraft provided by the MOD.
   - (ii) RNLI all weather and inshore lifeboats. Locally based at Spurn (Humber), Bridlington, Skegness, Cleethorpes and Withernsea.
   - (iii) Coastguard Rescue Teams (Hull, Cleethorpes, Easington and Withernsea.)
   - (iv) Volunteer Inshore Rescue Services (Humber Rescue).

17. Additional Facilities include:
   - (i) Vessels in the vicinity of the casualty.
   - (ii) Non-declared aircraft and ships made available by the MOD.
   - (iii) Marine craft under the control of various authorities, including lighthouse and pilotage authorities.
   - (iv) HM Revenue & Customs vessels.
   - (v) Civilian helicopters made available by offshore gas operators.
   - (vi) Such facilities as local authorities are able to make available.
   - (vii) Police (road, marine and air assets).
   - (viii) Humberside Fire Service provides a capability to respond to fire-fighting, chemical incidents and the rescue of trapped persons on board vessels within the Harbour limits.

INCIDENT CLASSIFICATION

ABP, HES

18. Any incident occurring within the area of jurisdiction of ABP, HES will be classed as a "serious marine emergency" if it is an accident involving shipping in the Humber which creates, or is likely to create, a significant danger to navigation, life, property or the environment and which requires, for its proper control, resources not immediately available to the ship's Master or others at the scene of the incident

19. In the event of an "oil pollution incident" ABP, HES will respond to a Tier 1, Tier 2 and Tier 3 incident (these Tiers are defined in "Humber Clean").

20. Separate incident plans exist for each local port, haven and jetty. The plans relevant to the area and of common interest are:

    (i) **HUMBER ESTUARY SERIOUS MARINE EMERGENCY PLAN (HESMEP).** This emergency plan, which has been formulated after discussion with and agreement by the appropriate authorities on the Humber, sets out the action to be taken in the event of a serious marine emergency occurring within the limits of ABPs area of jurisdiction.

    (ii) **HUMBER CLEAN.** This plan is written in accordance with the requirements of the Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998. The purpose of the plan is to provide guidance to ABP, HES with respect to the steps to be taken when water borne oil pollution incident has occurred in the area of ABP, HES jurisdiction.

HM Coastguard

21. The MCA has conducted risk assessments identifying possible major incident types. These incident types may be summarised as follows:
    (i) Rescue of large numbers of people from, for example, a passenger ship, an offshore installation, an isolated area, or many small craft in distress simultaneously;
    (ii) Release or potential release of hazardous, noxious or polluting materials at sea or along the coast;
    (iii) The effects of these or other emergencies on MCA and/or its partner organisations' own staff, facilities or infrastructure, potentially limiting ability to respond.

22. Whilst the circumstances surrounding an incident may vary and will reflect the specific nature of that incident, HMCG responsibility for SAR is broadly

unchanged, albeit the level of response will reflect the scale of the incident and consequential demand for resources.

AGREED GUIDELINES ON MAJOR INCIDENT COMMAND AND CONTROL

23. ABP, HES will take responsibility for the control of a major emergency within the area defined under section 2 of this MOU, namely the Humber Port Limits as identified on the chart. Seaward of this area will be the responsibility of HMCG, though assistance will be given by ABP, HES, and if agreed by both parties will continue to organise shipping movements within the defined area of its VTS Traffic Organisation Service (TOS)

GENERAL PRINCIPLES – TASK ORIENTATED

24. Whenever ABP, HES or HMCG becomes aware of a potential or actual major incident, they will immediately inform the other at the earliest possible opportunity. Details of any initial action taken will also be relayed. As the emergency develops, they will communicate and liaise on a frequent basis and keep each other informed of their intentions and action.

25. HMCG will always retain general responsibility for Search and Rescue within any incident, and will always task and subsequently co-ordinate and direct nationally designated (declared) SAR resources, or other craft which subsequently become directly involved in the Search and Rescue operation.

26. ABP, HES will always retain overall responsibility for the safe movement of shipping and for the provision of navigation information and direction within its area of jurisdiction. Within this area ABP, HES will always retain responsibility for the general safety of port traffic; the protection of navigational fairways; the stabilisation and marking of wrecks; the co-ordination of salvage activities; and control of oil pollution protection and clean-up measures under its statutory duty prior to any (subsequent) involvement of the MCA.

27. For salvage incidents, particularly those that originate to seaward of the Humber, SOSREP (The Secretary of States Representative) may assume an overall control of the operation and issue directions.

28. The immediate safety of all marine craft and their on-board passengers and crews remains the responsibility of their respective Masters, irrespective of direction by ABP, HES or tasking by HMCG in any emergency incident.

GENERAL PRINCIPLES – AREA BASED

29. HM Coastguard has statutory jurisdiction for the co-ordination of civil maritime search and rescue throughout the coastal and offshore waters of the UK, including the ABP, HES area of jurisdiction. It has direct call on the all-weather marine and aviation resources necessary to co-ordinate and control a major shipping incident in the North Sea or the sector just outside the jurisdiction of ABP, HES.

30. ABP, HES has jurisdiction for safety of shipping within its area of jurisdiction. It also has a 24-hour capability to co-ordinate a full marine emergency through the resources of ABP, with an extensive communications and radar network, and a fleet of pilot, survey and work boats.

EXCLUSION ZONES

31. In the event of a Major Incident, (involving a vessel or vessels underway, a vessel aground, or a major chemical pollution incident), occurring within the ABP, HES area of jurisdiction, as defined in section 2, then ABP, HES may decide to establish an Incident Exclusion Zone. ABP, HES will liaise with HMCG before establishing any such zone.

32. For a major incident seaward of the Humber Port limits HMCG will liaise with ABP, HES to consider the need to establish a Temporary Exclusion Zone (TEZ).

33. In the event of the risk of fire, explosion or gas release, ABP, HES may elect to establish an Incident Exclusion Zone around the offshore perimeter of any vessel alongside a shore installation involved in a Major Incident. ABP, HES will liaise with the Fire & Rescue Service as to the need for such an Exclusion Zone, particularly where risk of explosion or spread of flammable or toxic fumes exist.

34. HMCG will arrange for the establishment of Air Exclusion Zones, as appropriate. To aid any SAR operation HM Coastguard may request the establishment of a Temporary Danger Area (TDA) and if necessary Temporary Restriction of Flying Regulations (TRFR) over the scene of an incident.

COMMUNICATIONS

35. Close liaison between the CGOC and ABP, HES will be maintained from the commencement of an incident until its conclusion. This will in the main be through VHF radio and telephone links.

36. Within the ABP, HES area of jurisdiction, all VHF communications with the casualty vessels and rescue craft will be in accordance with the communications plan laid down in “Humber Serious Marine Emergency Plan” and/or “Humber Clean”. The Harbour operations VHF Channels – VHF Ch. 12, 14 and 15 – will continue to be used for harbour control purposes, and to pass any necessary alerting instructions to vessels underway.

37. HMCG will co-ordinate the Search and Rescue operation using internationally declared channels. For large scale incidents involving numerous assets a Communications Plan may be established to enhance SAR operations. Normal VHF Channels used will be 16, 67 and 0.

38. ABP, HES will report to HMCG all incidences of oil pollution or incidents involving chemical spillage.

For Her Majesty’s Coastguard

Signed…………………………… Date ………….

B. ALLEN

MARITIME OPERATIONS CONTROLLER – HM COASTGUARD

For Associated British Ports, Humber Estuary Services

Signed…………………………… Date ………….

CAPT A. FIRMAN

HARBOUR MASTER - HUMBER

9.2 Appendix 2. Proforma for Incident Assessment

The Checklist below lists the information that should be obtained from personnel making the On-Scene Incident Assessment.

NOTE THAT INITIAL CATEGORISATION OF THE INCIDENT MAY NEED TO BE REVISED DEPENDING ON THE INFORMATION OBTAINED FROM INCIDENT ASSESSMENT.

A. LOCATION AND TIME OF INCIDENT			
Time:	Date:		
Type of Incident:	Fire/Explosion Sinking/Grounding	Collision Other	
	Confirmed / Probable/doubtful		
Source of spill	Tanker/Vessel	Jetty	Other
Identity of Observer / Reporter			
Number of Deaths	Number of Casualties		

B. SPILLAGE DETAILS	
Approximate Spill Size:	
Type of Oil *e.g.* heavy/medium/light/gasoline	Characteristics *e.g.* liquid/solid/tarry lumps Associated Gas?
Safety Risk	To personnel on vessel At jetty Response Personnel General Public
Who is responsible for the spill?	
Is assistance to be offered by responsible party	YES / NO
If yes, what type of assistance?	
Are other organisations involved?	YES / NO State who
Actions taken so far to contain incident	
Weather forecast updates	Wind direction Wind strength Visibility
What level of Humber Clean Response is required?	TIER 1 TIER 2 TIER 3

Appendix 3 – IMO Guidelines for Formal Safety Assessment (FSA) MSC-MEPC.2/Circ.12/Rev.2 requested at question NS.2.45

INTERNATIONAL MARITIME ORGANIZATION

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MSC-MEPC.2/Circ.12/Rev.2
9 April 2018

REVISED GUIDELINES FOR FORMAL SAFETY ASSESSMENT (FSA) FOR USE IN THE IMO RULE-MAKING PROCESS

1 The Maritime Safety Committee, at its seventy-fourth session (30 May to 8 June 2001), and the Marine Environment Protection Committee, at its forty-seventh session (4 to 8 March 2002), approved the *Guidelines for Formal Safety Assessment (FSA) for use in the IMO rule-making process* (MSC/Circ.1023-MEPC/Circ.392, as amended by MSC/Circ.1180-MEPC/Circ.474 and MSC-MEPC.2/Circ.5).

2 The Maritime Safety Committee, at its ninety-first session (26 to 30 November 2012), and the Marine Environment Protection Committee, at its sixty-fifth session (13 to 17 May 2013), reviewed the above guidelines and approved the *Revised guidelines for Formal Safety Assessment (FSA) for use in the IMO rule-making process* (MSC-MEPC.2/Circ.12).

3 The Maritime Safety Committee, at its ninety-fourth session (17 to 21 November 2014) and the Marine Environment Protection Committee, at its sixty-eighth session (11 to 15 May 2015), approved draft amendments to paragraph 9.3.3 of the aforementioned Revised FSA guidelines, for circulation of the amended revised guidelines as MSC-MEPC.2/Circ.12/Rev.1.

4 The Maritime Safety Committee, at its ninety-eighth session (7 to 16 June 2017) and the Marine Environment Protection Committee, at its seventy-second session (9 to 13 April 2018), approved the amendment to the flow chart shown in figure 2 referred to in paragraph 27 of appendix 10 to the revised FSA guidelines, for circulation of the amended revised guidelines, as set out in the annex, as MSC-MEPC.2/Circ.12/Rev.2.

5 Member States and non-governmental organizations are invited to apply the revised guidelines contained in the annex.

6 This circular supersedes MSC-MEPC.2/Circ.12/Rev.1.

***

ANNEX

REVISED GUIDELINES FOR FORMAL SAFETY ASSESSMENT (FSA) FOR USE IN THE IMO RULE-MAKING PROCESS

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1 INTRODUCTION

1.1 Purpose of FSA

1.1.1 Formal Safety Assessment (FSA) is a structured and systematic methodology, aimed at enhancing maritime safety, including protection of life, health, the marine environment and property, by using risk analysis and cost-benefit assessment.

1.1.2 FSA can be used as a tool to help in the evaluation of new regulations for maritime safety and protection of the marine environment or in making a comparison between existing and possibly improved regulations, with a view to achieving a balance between the various technical and operational issues, including the human element, and between maritime safety or protection of the marine environment and costs.

1.1.3 FSA is consistent with the current IMO decision-making process and provides a basis for making decisions in accordance with resolutions A.500(XII) on *Objectives of the Organization in the 1980s*, A.777(18) on *Work methods and organization of work in committees and their subsidiary bodies* and A.900(21) on *Objectives of the Organization in the 2000s*.

1.1.4 The decision makers at IMO, through FSA, will be able to appreciate the effect of proposed regulatory changes in terms of benefits (e.g. expected reduction of lives lost or of pollution) and related costs incurred for the industry as a whole and for individual parties affected by the decision. FSA should facilitate the development of regulatory changes equitable to the various parties thus aiding the achievement of consensus.

1.2 Scope of the Guidelines

These guidelines are intended to outline the FSA methodology as a tool, which may be used in the IMO rule-making process. In order that FSA can be consistently applied by different parties, it is important that the process is clearly documented and formally recorded in a uniform and systematic manner. This will ensure that the FSA process is transparent and can be understood by all parties irrespective of their experience in the application of risk analysis and cost-benefit assessment and related techniques.

1.3 Application

1.3.1 The FSA methodology can be applied by:

.1 a Member State or an organization in consultative status with IMO, when proposing amendments to maritime safety, pollution prevention and response-related IMO instruments in order to analyse the implications of such proposals; or

.2 a Committee, or an instructed subsidiary body, to provide a balanced view of a framework of regulations, so as to identify priorities and areas of concern and to analyse the benefits and implications of proposed changes.

1.3.2 It is not intended that FSA should be applied in all circumstances, but its application would be particularly relevant to proposals which may have far-reaching implications in terms of either costs (to society or the maritime industry), or the legislative and administrative burdens which may result. FSA may also be useful in those situations where there is a need for risk reduction but the required decisions regarding what to do are unclear, regardless of the scope of the project. In these circumstances, FSA will enable the benefits of proposed changes to be properly established, so as to give Member States a clearer perception of the scope of the proposals and an improved basis on which they take decisions.

2 BASIC TERMINOLOGY

The following definitions apply in the context of these guidelines:

Accident: An unintended event involving fatality, injury, ship loss or damage, other property loss or damage, or environmental damage.

Accident category: A designation of accidents reported in statistical tables according to their nature, e.g. fire, collision, grounding, etc.

Accident scenario: A sequence of events from the initiating event to one of the final stages.

Consequence: The outcome of an accident.

Frequency: The number of occurrences per unit time (e.g. per year).

Generic model: A set of functions common to all ships or areas under consideration.

Hazard: A potential to threaten human life, health, property or the environment.

Initiating event: The first of a sequence of events leading to a hazardous situation or accident.

Probability (Objective/frequentistic): The relative frequency that an event will occur, as expressed by the ratio of the number of occurrences to the total number of possible occurrences.

Probability (Subjective/Bayesian): The degree of confidence in the occurrence of an event, measured on a scale from 0 to 1. An event with a probability of 0 means that it is believed to be impossible; an event with the probability of 1 means that it is believed it will certainly occur.

Risk: The combination of the frequency and the severity of the consequence.

Risk contribution tree: (RCT) The combination of all fault trees and event trees that constitute the risk model.

Risk control measure: (RCM) A means of controlling a single element of risk.

*Risk control option***:** *(RCO)* A combination of risk control measures.

Risk evaluation criteria: Criteria used to evaluate the acceptability/tolerability of risk.

3 METHODOLOGY

3.1 Process

3.1.1 *Steps*

3.1.1.1 FSA should comprise the following steps:

.1 identification of hazards;

.2 risk analysis;

.3 risk control options;

.4 cost-benefit assessment; and

.5 recommendations for decision-making.

3.1.1.2 Figure 1 is a flow chart of the FSA methodology. The process begins with the decision makers defining the problem to be assessed along with any relevant boundary conditions or constraints. These are presented to the group who will carry out the FSA and provide results to the decision makers for use in their resolutions. In cases where decision makers require additional work to be conducted, they would revise the problem statement or boundary conditions or constraints, and resubmit this to the group and repeat the process as necessary. Within the FSA methodology, step 5 interacts with each of the other steps in arriving at decision-making recommendations. The group carrying out the FSA process should comprise suitably qualified and experienced people to reflect the range of influences and the nature of the "event" being addressed.

3.1.2 *Screening approach*

3.1.2.1 The depth or extent of application of the methodology should be commensurate with the nature and significance of the problem; however, experience indicates that very broad FSA studies can be harder to manage. To enable the FSA to focus on those areas that deserve more detailed analysis, a preliminary coarse qualitative analysis is suggested for the relevant ship type or hazard category, in order to include all aspects of the problem under consideration. Whenever there are uncertainties, e.g. in respect of data or expert judgement, the significance of these uncertainties should be assessed.

3.1.2.2 Characterization of hazards and risks should be both qualitative and quantitative, and both descriptive and mathematical, consistent with the available data, and should be broad enough to include a comprehensive range of options to reduce risks.

3.1.2.3 A hierarchical screening approach may be utilized. This would ensure that excessive analysis is not performed by utilizing relatively simple tools to perform initial analyses, the results of which can be used to either support decision-making (if the degree of support is adequate) or to scope/frame more detailed analyses (if not). The initial analyses would therefore be primarily qualitative in nature, with a recognition that increasing degrees of detail and quantification will come in subsequent analyses as necessary.

3.1.2.4 A review of historical data may also be useful as a preparation for a detailed study. For this purpose a loss matrix may be useful. An example can be found in figure 2.

3.2 Information and data

3.2.1 The availability of suitable data necessary for each step of the FSA process is very important. When data are not available, expert judgment, physical models, simulations and analytical models may be used to achieve valuable results. Consideration should be given to those data which are already available at IMO (e.g. casualty and deficiency statistics) and to potential improvements in those data in anticipation of an FSA implementation (e.g. a better specification for recording relevant data including the primary causes, underlying factors and latent factors associated with a casualty).

3.2.2 Data concerning incident reports, near misses and operational failures may be very important for the purpose of making more balanced, proactive and cost-effective legislation, as required in paragraph 4.2 of appendix 8. Such data must be reviewed objectively and their reliability, uncertainty and validity assessed and reported. The assumptions and limitations of these data must also be reported.

3.2.3 However, one of the most beneficial qualities of FSA is the proactive nature. The proactive approach is reached through the probabilistic modelling of failures and development of accident scenarios. Analytical modelling has to be used to evaluate rare events where there is inadequate historical data. A rare event is decomposed into more frequent events for which there is more experience available (e.g. evaluate system failure based on component failure data).

3.2.4 Equally, consideration should also be given to cases where the introduction of recent changes may have affected the validity of historic data for assessing current risk.

3.3 Expert judgment

3.3.1 The use of expert judgment is considered to be an important element within the FSA methodology. It not only contributes to the proactive nature of the methodology, but is also essential in cases where there is a lack of historical data. Further historical data may be evaluated by the use of expert judgment by which the quality of the historical data may be improved.

3.3.2 In applying expert judgment, different experts may be involved in a particular FSA study. It is unlikely that the experts' opinions will always be in agreement. It might even be the case that the experts have strong disagreements on specific issues. Preferably, a good level of agreement should be reached. It is highly recommended to report the level of agreement between the experts in the results of an FSA study. It is important to know the level of agreement, and this may be established by the use of a concordance matrix or by any other methodology. For example, appendix 9 describes the use of a concordance matrix.

3.4 Incorporation of the human element

3.4.1 The human element is one of the most important contributory aspects to the causation and avoidance of accidents. Human element issues throughout the integrated system shown in figure 3 should be systematically treated within the FSA framework, associating them directly with the occurrence of accidents, underlying causes or influences. Appropriate techniques for incorporating human factors should be used.

3.4.2 The human element can be incorporated into the FSA process by using human reliability analysis (HRA). Guidance for the use of HRA within FSA is given in appendix 1 and diagrammatically in figure 4. To allow easy referencing, the numbering system in appendix 1 is consistent with that of the rest of the FSA Guidelines.

3.5 Evaluating regulatory influence

It is important to identify the network of influences linking the regulatory regime to the occurrence of the event. Construction of Influence Diagrams may assist (see appendix 3).

4 PROBLEM DEFINITION

4.1 Preparation for the study

The purpose of problem definition is to carefully define the problem under analysis in relation to the regulations under review or to be developed. The definition of the problem should be consistent with operational experience and current requirements by taking into account all relevant aspects. Those which may be considered relevant when addressing ships (not necessarily in order of importance) are:

.1 ship category (e.g. type, length or gross tonnage range, new or existing, type of cargo);

.2 ship systems or functions (e.g. layout, subdivision, type of propulsion);

.3 ship operation (e.g. operations in port and/or during navigation);

.4 external influences on the ship (e.g. Vessel Traffic System, weather forecasts, reporting, routeing);

.5 accident category (e.g. collision, explosion, fire); and

.6 risks associated with consequences such as injuries and/or fatalities to passengers and crew, environmental impact, damage to the ship or port facilities, or commercial impact.

4.2 Generic model

4.2.1 In general, the problem under consideration should be characterized by a number of functions. Where the problem relates for instance to a type of ship, these functions include carriage of payload, communication, emergency response, manoeuvrability, etc. Alternatively, where the problem relates to a type of hazard, for instance fire, the functions include prevention, detection, alarm, containment, escape, suppression, etc.

4.2.2 For application of FSA, a generic model should therefore be defined to describe the functions, features, characteristics and attributes which are common to all ships or areas relevant to the problem in question.

4.2.3 The generic model should not be viewed as an individual ship in isolation, but rather as a collection of systems, including organizational, management, operational, human, electronic and hardware aspects which fulfil the defined functions. The functions and systems should be broken down to an appropriate level of detail. Aspects of the interaction of functions and systems and the extent of their variability should be addressed.

4.2.4 A comprehensive view, such as the one shown in figure 3, should be taken, recognizing that the ship's technical and engineering system, which is governed by physical laws, is in the centre of an integrated system. The technical and engineering system is integrally related to the passengers and crew which are a function of human behaviour. The passengers and crew interact with the organizational and management infrastructure and those personnel involved in ship and fleet operations, maintenance and management. These systems are related to the outer environmental context, which is governed by pressures and influences of all parties interested in shipping and the public. Each of these systems is dynamically affected by the others.

4.3 Results

The output of the problem definition comprises:

.1 problem definition and setting of boundaries; and

.2 development of a generic model.

5 FSA STEP 1 – IDENTIFICATION OF HAZARDS

5.1 Scope

The purpose of step 1 is to identify a list of hazards and associated scenarios prioritized by risk level specific to the problem under review. This purpose is achieved by the use of standard techniques to identify hazards which can contribute to accidents, and by screening these hazards using a combination of available data and judgement. The hazard identification exercise should be undertaken in the context of the functions and systems generic to the ship type or problem being considered, which were established in paragraph 4.2 by reviewing the generic model.

5.2 Methods

5.2.1 *Identification of possible hazards*

5.2.1.1 The approach used for hazard identification generally comprises a combination of both creative and analytical techniques, the aim being to identify all relevant hazards. The creative element is to ensure that the process is proactive and not confined only to hazards that have materialized in the past. It typically consists of structured group reviews aiming at identifying the causes and effects of accidents and relevant hazards. Consideration of functional failure may assist in this process. The group carrying out such structured reviews should include experts in the various appropriate aspects, such as ship design, operations and management and specialists to assist in the hazard identification process and incorporation of the human element. A structured group review session may last over a number of days. The analytical element ensures that previous experience is properly taken into account, and typically makes use of background information (for example applicable regulations and codes, available statistical data on accident categories and lists of hazards to personnel, hazardous substances, ignition sources, etc.). Examples of hazards relevant to shipboard operations are shown in appendix 2.

5.2.1.2 A coarse analysis of possible causes and initiating events and outcome of each accident scenario should be carried out. The analysis may be conducted by using established techniques (examples are described in appendix 3), to be chosen according to the problem in question, whenever possible and in line with the scope of the FSA.

5.2.2 *Ranking*

The identified hazards and their associated scenarios relevant to the problem under consideration should be ranked to prioritize them and to discard scenarios judged to be of minor significance. The frequency and consequence of the scenario outcome requires assessment. Ranking is undertaken using available data, supported by judgement, on the scenarios. A generic risk matrix is shown in figure 5. The frequency and consequence categories used in the risk matrix have to be clearly defined. The combination of a frequency and a consequence category represents a risk level. Appendix 4 provides an example of one way of defining frequency and consequence categories, as well as possible ways of establishing risk levels for ranking purposes.

5.3 Results

The output from step 1 comprises:

.1 a list of hazards and their associated scenarios (including initiating events); and

.2 an assessment of accident scenarios (prioritized by risk level).

6 FSA STEP 2 – RISK ANALYSIS

6.1 Scope

6.1.1 The purpose of the risk analysis in step 2 is a detailed investigation of the causes and initiating events and consequences of the more important accident scenarios identified in step 1. This can be achieved by the use of suitable techniques that model the risk. This allows attention to be focused upon high-risk areas and to identify and evaluate the factors which influence the level of risk.

6.1.2 Different types of risk (i.e. risks to people, the environment or property) should be addressed as appropriate to the problem under consideration. Measures of risk are discussed in appendix 5.

6.2 Methods

6.2.1 There are several methods/tools that can be used to perform a risk analysis. The scope of the FSA, types of hazards identified in step 1, and the level of failure data available will all influence which method/tool works best for each specific application. Examples of the different types of risk analysis methods/tools are outlined in appendix 3.

6.2.2 Quantification makes use of accident and failure data and other sources of information as appropriate to the level of analysis. Where data is unavailable, calculation, simulation or the use of established techniques for expert judgement may be used.

6.2.3 Sensitivity analysis and uncertainty analysis should be considered in the quantified and/or qualified risk and risk models and the results should be reported together with the quantitative data and explanation of models used. Methodologies of sensitivity analysis and uncertainty analysis would depend on the method of risk analysis and/or risk models used.

6.3 Results

The output from step 2 comprises:

.1 the identification of the high-risk areas which need to be addressed; and

.2 the explanation of risk models.

7 FSA STEP 3 – RISK CONTROL OPTIONS

7.1 Scope

7.1.1 The purpose of step 3 is to first identify Risk Control Measures (RCMs) and then to group them into a limited number of Risk Control Options (RCOs) for use as practical regulatory options. Step 3 comprises the following four stages:

.1 focusing on risk areas needing control;

.2 identifying potential RCMs;

.3 evaluating the effectiveness of the RCMs in reducing risk by re-evaluating step 2; and

.4 grouping RCMs into practical regulatory options.

7.1.2 Step 3 aims at creating risk control options that address both existing risks and risks introduced by new technology or new methods of operation and management. Both historical risks and newly identified risks (from steps 1 and 2) should be considered, producing a wide range of risk control measures. Techniques designed to address both specific risks and underlying causes should be used.

7.2 Methods

7.2.1 *Determination of areas needing control*

The purpose of focusing risks is to screen the output of step 2 so that the effort is focused on the areas most needing risk control. The main aspects to making this assessment are to review:

.1 risk levels, by considering frequency of occurrence together with the severity of outcomes. Accidents with an unacceptable risk level become the primary focus;

.2 probability, by identifying the areas of the risk model that have the highest probability of occurrence. These should be addressed irrespective of the severity of the outcome;

.3 severity, by identifying the areas of the risk model that contribute to highest severity outcomes. These should be addressed irrespective of their probability; and

.4 confidence, by identifying areas where the risk model has considerable uncertainty either in risk, severity or probability. These uncertain areas should be addressed.

7.2.2 *Identification of potential RCMs*

7.2.2.1 Structured review techniques are typically used to identify new RCMs for risks that are not sufficiently controlled by existing measures. These techniques may encourage the development of appropriate measures and include risk attributes and causal chains. Risk attributes relate to how a measure might control a risk, and causal chains relate to where, in the "initiating event to fatality" sequence, risk control can be introduced.

7.2.2.2 RCMs (and subsequently RCOs) have a range of attributes. These attributes may be categorized according to the examples given in appendix 6.

7.2.2.3 The prime purpose of assigning attributes is to facilitate a structured thought process to understand how an RCM works, how it is applied and how it would operate. Attributes can also be considered to provide guidance on the different types of risk control that could be applied. Many risks will be the result of complex chains of events and a diversity of causes. For such risks the identification of RCMs can be assisted by developing causal chains which might be expressed as follows:

causal factors → failure → circumstance → accident → consequences

7.2.2.4 RCMs should in general be aimed at one or more of the following:

.1 reducing the frequency of failures through better design, procedures, organizational polices, training, etc.;

.2 mitigating the effect of failures, in order to prevent accidents;

.3 alleviating the circumstances in which failures may occur; and

.4 mitigating the consequences of accidents.

7.2.2.5 RCMs should be evaluated regarding their risk reduction effectiveness by using step 2 methodology, including consideration of any potential side effects of the introduction of the RCM.

7.2.3 *Composition of RCOs*

7.2.3.1 The purpose of this stage is to group the RCMs into a limited number of well thought out Risk Control Options (RCOs). There is a range of possible approaches to grouping individual measures into options. The following two approaches, related to likelihood and escalation, can be considered:

.1 "general approach" which provides risk control by controlling the likelihood of initiation of accidents and may be effective in preventing several different accident sequences; and

.2 "distributed approach" which provides control of escalation of accidents, together with the possibility of influencing the later stages of escalation of other, perhaps unrelated, accidents.

7.2.3.2 In generating the RCOs, the interested entities, who may be affected by the combinations of measures proposed, should be identified.

7.2.3.3 Some RCMs/RCOs may introduce new or additional hazards, in which case steps 1, 2 and 3 should be reviewed and revised as appropriate.

7.2.3.4 Before adopting a combination of RCOs for which a quantitative assessment of the combined effects was not performed, a qualitative evaluation of RCO interdependencies should be performed. Such an evaluation could take the form of a matrix as illustrated in the following table:

Table: Interdependencies of RCOs				
RCO	**1**	**2**	**3**	**4**
1		Strong	No	Weak
2	Weak		Weak	No
3	No	Weak		No
4	Weak	No	No	

The above matrix table lists the RCOs both vertically and horizontally. Reading horizontally, the table indicates in the first row any dependencies between RCO 1 and each of the other proposed RCOs (2 to 4). For example, in this case the table states that if RCO 1 is implemented, RCO 2, being strongly dependent on RCO 1, needs to be re-evaluated before adopting it in conjunction with RCO 1. On the other hand, RCO 3 is not dependent on RCO 1, and therefore its cost-effectiveness is not altered by the adoption of RCO 1. RCO 4 is weakly dependent on RCO 1, so re-evaluation may not be necessary. In principle, one dependency table could be given for cost, benefits and risk reduction. The interdependencies in the above matrix may or may not be symmetric.

7.2.3.5 Where more than one RCOs are proposed to be implemented at the same time, the effectiveness of such combination in reducing the risk should be assessed.

7.2.3.6 Sensitivity analysis and uncertainty analysis should be considered in the analysis of effectiveness of RCMs and RCOs, and the results of sensitivity analysis and uncertainty analysis should be reported.

7.3 Results

The output from step 3 comprises:

.1 a list of RCOs with their effectiveness in reducing risk, including the method of analysis;

.2 a list of interested entities affected by the identified RCOs;

.3 a table stating the interdependencies between the identified RCOs; and

.4 results of analysis of side effects of RCOs.

8 FSA STEP 4 – COST-BENEFIT ASSESSMENT

8.1 Scope

8.1.1 The purpose of step 4 is to identify and compare benefits and costs associated with the implementation of each RCO identified and defined in step 3. A cost-benefit assessment may consist of the following stages:

.1 consider the risks assessed in step 2, both in terms of frequency and consequence, in order to define the base case in terms of risk levels of the situation under consideration;

.2 arrange the RCOs, defined in step 3, in a way to facilitate understanding of the costs and benefits resulting from the adoption of an RCO;

.3 estimate the pertinent costs and benefits for all RCOs;

.4 estimate and compare the cost-effectiveness of each option, in terms of the cost per unit risk reduction by dividing the net cost by the risk reduction achieved as a result of implementing the option; and

.5 rank the RCOs from a cost-benefit perspective in order to facilitate the decision-making recommendations in step 5 (e.g. to screen those which are not cost-effective or impractical).

8.1.2 Costs should be expressed in terms of life cycle costs and may include initial, operating, training, inspection, certification, decommission, etc. Benefits may include reductions in fatalities, injuries, casualties, environmental damage and clean-up, indemnity of third party liabilities, etc. and an increase in the average life of ships.

8.2 Methods

8.2.1 *Definition of interested entities*

8.2.1.1 The evaluation of the above costs and benefits can be carried out by using various methods and techniques. Such a process should be conducted for the overall situation and then for those interested entities which are the most influenced by the problem in question.

8.2.1.2 In general, an interested entity can be defined as the person, organization, company, coastal State, flag State, etc., who is directly or indirectly affected by an accident or by the cost-effectiveness of the proposed new regulation. Different interested entities with similar interests can be grouped together for the purpose of applying the FSA methodology and identifying decision-making recommendations.

8.2.2 *Calculation indices for cost-effectiveness*

There are several indices which express cost-effectiveness in relation to safety of life such as Gross Cost of Averting a Fatality (Gross CAF) and Net Cost of Averting a Fatality (Net CAF) as described in appendix 7. Other indices based on damage to and effect on property and environment may be used for a cost-benefit assessment relating to such matters. Comparisons of cost-effectiveness for RCOs may be made by calculating such indices.

8.2.3 For evaluation of RCOs focusing on prevention of oil spill from ships, environmental risk evaluation criteria as described in appendix 7 can be used.

8.2.4 Sensitivity analysis and uncertainty analysis should be considered in the cost-benefit analysis and cost-effectiveness, and the results should be reported.

8.3 Results

The output from step 4 comprises:

.1 costs and benefits for each RCO identified in step 3 from an overview perspective;

.2 costs and benefits for those interested entities which are the most influenced by the problem in question; and

.3 cost-effectiveness expressed in terms of suitable indices.

9 FSA STEP 5 – RECOMMENDATIONS FOR DECISION-MAKING

9.1 Scope

9.1.1 The purpose of step 5 is to define recommendations which should be presented to the relevant decision makers in an auditable and traceable manner. The recommendations would be based upon the comparison and ranking of all hazards and their underlying causes; the comparison and ranking of risk control options as a function of associated costs and benefits; and the identification of those risk control options which keep risks as low as reasonably practicable.

9.1.2 The basis on which these comparisons are made should take into account that, in ideal terms, all those entities that are significantly influenced in the area of concern should be equitably affected by the introduction of the proposed new regulation. However, taking into consideration the difficulties of this type of assessment, the approach should be, at least in the earliest stages, as simple and practical as possible.

9.2 Methods

9.2.1 *Scrutiny of results*

Recommendations should be presented in a form that can be understood by all parties irrespective of their experience in the application of risk and cost-benefit assessment and related techniques. Those submitting the results of an FSA process should provide timely and open access to relevant supporting documents and a reasonable opportunity for and a mechanism to incorporate comments.

9.2.2 *Risk evaluation criteria*

There are several standards for risk acceptance criteria, none as yet universally accepted. While it is desirable for the Organization and Member States which propose new regulations or modifications to existing regulations to determine agreed risk evaluation criteria after wide and deep consideration, those used within an FSA should be explicit.

9.3 Results

The output from step 5 comprises:

.1 an objective comparison of alternative options, based on the potential reduction of risks and cost-effectiveness, in areas where legislation or rules should be reviewed or developed;

.2 feedback information to review the results generated in the previous steps; and

.3 recommended RCO(s) submitted in SMART (specific, measurable, achievable, realistic, time-bound) terms and accompanied with the application of the RCO(s), e.g. application of ship type(s) and construction date and/or systems to be fitted on board.

10 PRESENTATION OF FSA RESULTS

10.1 To facilitate the common understanding and use of FSA at IMO in the rule-making process, each report of an FSA process should:

.1 provide a clear statement of the final recommendations, ranked and justified in an auditable and traceable manner;

.2 list the principal hazards, risks, costs and benefits identified during the assessment;

.3 explain and reference the basis for significant assumptions, limitations, uncertainties, data models, methodologies and inferences used or relied upon in the assessment or recommendations, results of hazard identifications and risk analysis, risk control options and results of cost-benefit analysis to be considered in the decision-making process;

.4 describe the sources, extent and magnitude of significant uncertainties associated with the assessment or recommendations;

.5 describe the composition and expertise of groups that performed each step of the FSA process by providing a short curriculum vitae of each expert and describing the basis of selection of the experts; and

.6 describe the method of decision-making in the group(s) that performed the FSA process (see paragraph 3.3).

10.2 The standard format for reporting the FSA process is shown in appendix 8.

11 APPLICATION AND REVIEW PROCESS OF FSA

The Guidance for practical application and review process of FSA is contained in appendix 10.

FIGURE 1

FLOW CHART OF THE FSA METHODOLOGY

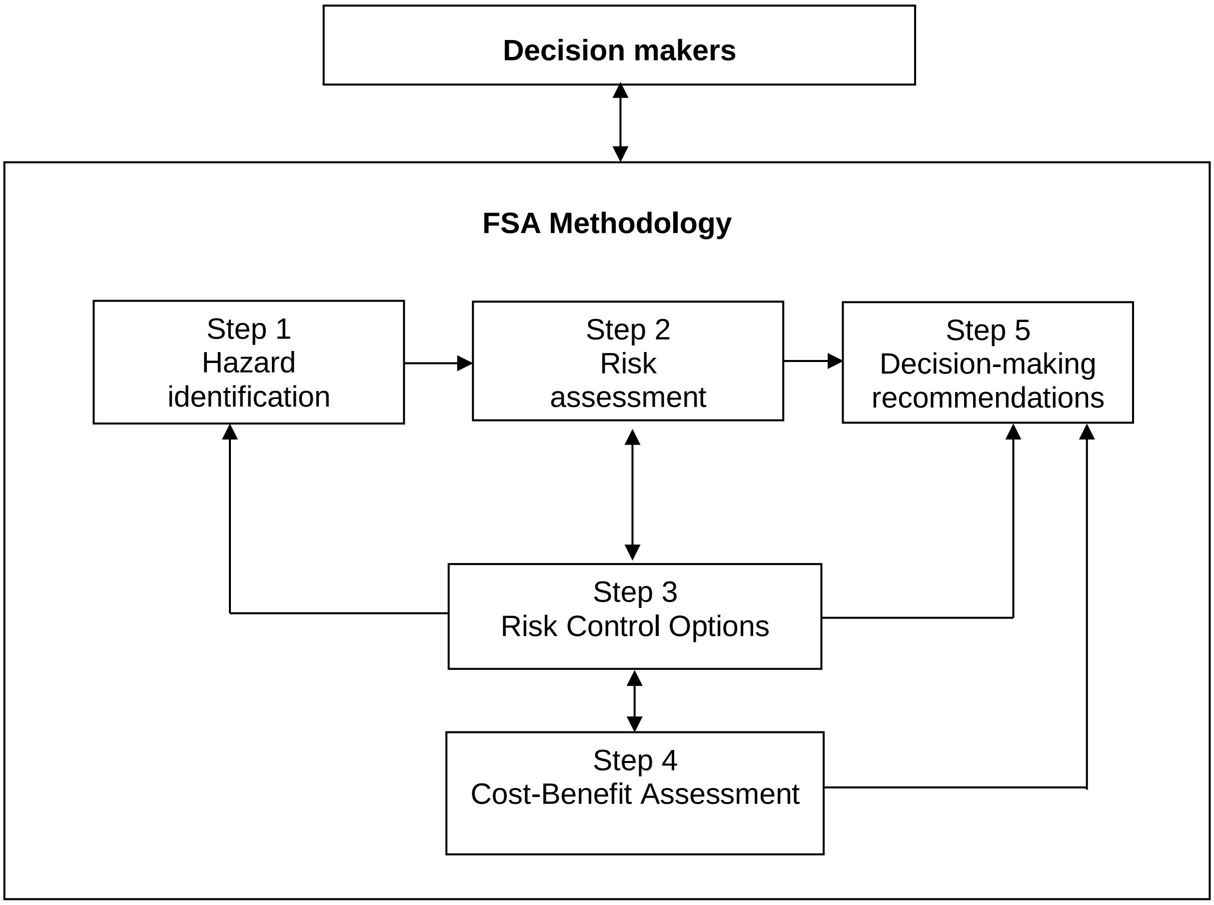


FIGURE 2

EXAMPLE OF LOSS MATRIX

Ship accident loss (£ per ship year)					
Accident type	Ship accident cost	Environmental damage and clean up	Risk to life	Risk of injuries and ill health	Total cost
	£	£/tonne x number of tonnes	Fatalities x £ X m	DALY* x £ Y	£
Collision Contact Foundered Fire/explosion Hull damage Machinery damage War loss Grounding Other ship accidents Other oil spills Personal accidents					
TOTAL					

* DALY = Disabled Adjourned Life Years (The World Health Report 2000; www.who.int)

FIGURE 3

COMPONENTS OF THE INTEGRATED SYSTEM

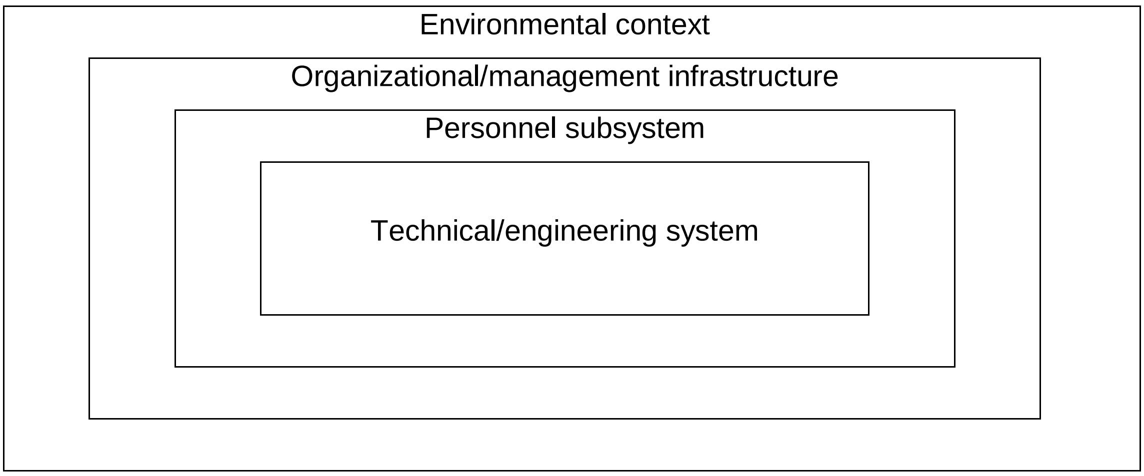


FIGURE 4

INCORPORATION OF HUMAN RELIABILITY ANALYSIS (HRA) INTO THE FSA PROCESS

FSA PROCESS	TASKS REQUIRED TO INCORPORATE HRA
Step 1 Hazard Identification	Human-related hazards (appendix 1-5.2) High level task analysis (appendix 1-5.2) Preliminary description of outcome (appendix 1-5.3)
Step 2 Risk Analysis	Detailed task analysis for critical tasks (appendix 1-6.2) Human error analysis (appendix 1-6.3) Human error quantification (appendix 1-6.4)
Step 3 Risk Control Options	Risk control options for human element (appendix 1-7.2)
Step 4 Cost-Benefit Assessment	
Step 5 Recommendations for Decision-Making	

FIGURE 5

RISK MATRIX

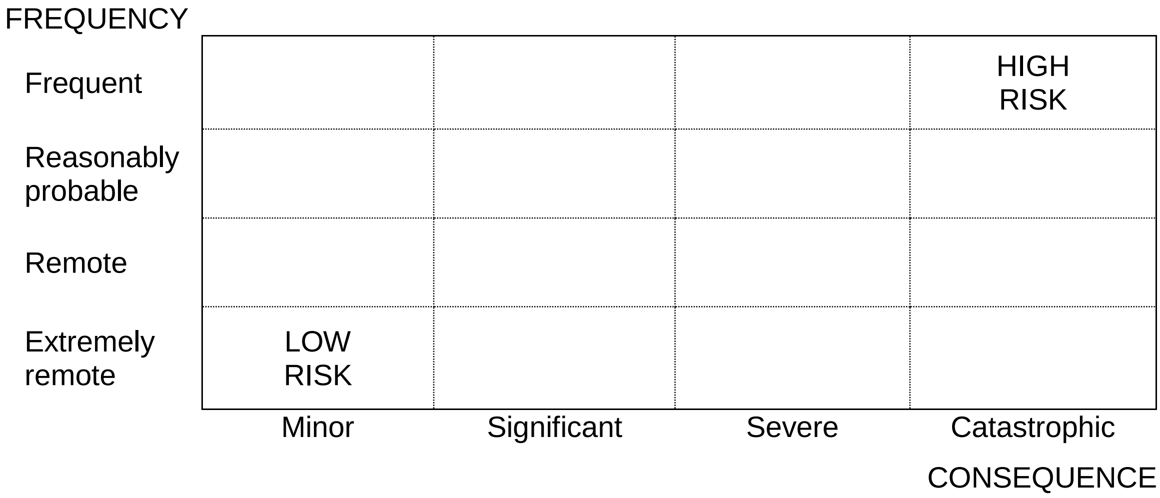
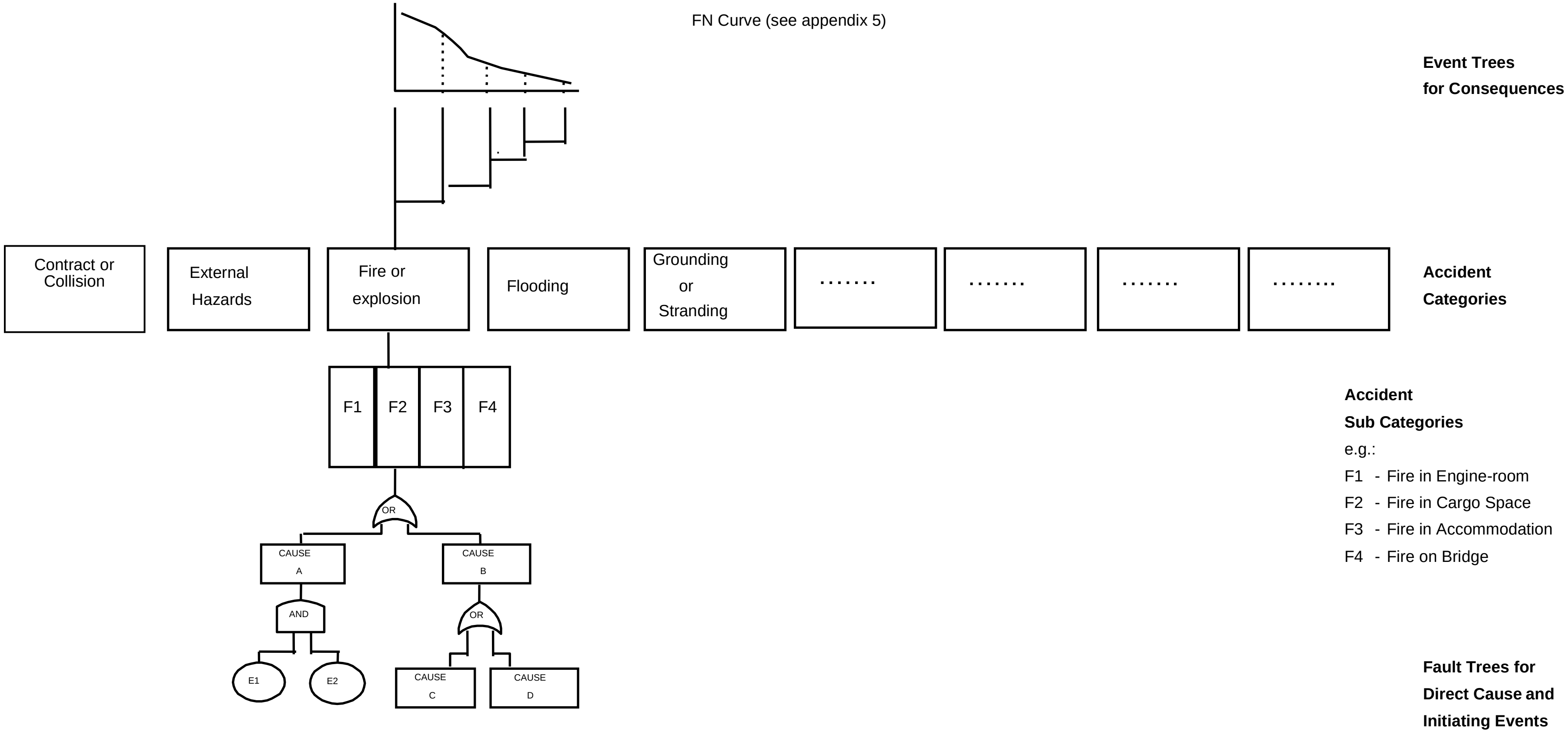


FIGURE 6

EXAMPLE OF A RISK CONTRIBUTION TREE*



* As defined in the context of these Guidelines.

APPENDIX 1

GUIDANCE ON HUMAN RELIABILITY ANALYSIS (HRA)

1 INTRODUCTION

1.1 Purpose of Human Reliability Analysis (HRA)

1.1.1 Those industries which routinely use quantitative risk assessment (QRA) to assess the frequency of system failures as part of the design process or ongoing operations management, have recognized that in order to produce valid results it is necessary to assess the contribution of the human element to system failure. The accepted way of incorporating the human element into QRA and FSA studies is through the use of human reliability analysis (HRA).

1.1.2 HRA was developed primarily for the nuclear industry. Using HRA in other industries requires that the techniques be appropriately adapted. For example, because the nuclear industry has many built-in automatic protection systems, consideration of the human element can be legitimately delayed until after consideration of the overall system performance. On board ships, the human has a greater degree of freedom to disrupt system performance. Therefore, a high-level task analysis needs to be considered at the outset of an FSA.

1.1.3 HRA is a process which comprises a set of activities and the potential use of a number of techniques depending on the overall objective of the analysis. HRA may be performed on a qualitative or quantitative basis depending on the level of FSA being undertaken. If a full quantitative analysis is required then Human Error Probabilities (HEPs) can be derived in order to fit into quantified system models such as fault and event trees. However, in many instances a qualitative analysis may be sufficient. The HRA process usually consists of the following stages:

.1 identification of key tasks;

.2 task analysis of key tasks;

.3 human error identification;

.4 human error analysis; and

.5 human reliability quantification.

1.1.4 Where a fully-quantified FSA approach is required, HRA can be used to develop a set of HEPs for incorporation into probabilistic risk assessment. However, this aspect of HRA can be over-emphasized. Experienced practitioners admit that greater benefit is derived from the early, qualitative stages of task analysis and human error identification. Effort expended in these areas pays dividends because an HRA exercise (like an FSA study) is successful only if the correct areas of concern have been chosen for investigation.

1.1.5 It is also necessary to bear in mind that the data available for the last stage of HRA, human reliability quantification, are currently limited. Although several human error databases have been built up, the data contained in them are only marginally relevant to the maritime industry. In some cases where an FSA requires quantitative results from the HRA, expert judgement may be the most appropriate method for deriving suitable data. Where expert judgement is used, it is important that the judgement can be properly justified as required by appendix 8 of the FSA Guidelines.

1.2 Scope of the HRA Guidance

1.2.1 Figure 4 of the FSA Guidelines shows how the HRA Guidance fits into the FSA process.

1.2.2 The amount of detail provided in this guidance is at a level similar to that given in the FSA Guidelines, i.e. it states what should be done and what considerations should be taken into account. Details of some techniques used to carry out the process are provided in the appendices of this guidance.

1.2.3 The sheer volume of information about this topic prohibits the provision of in-depth information: there are numerous HRA techniques, and task analysis is a framework encompassing dozens of techniques. Table 1 lists the main references which could be pursued.

1.2.4 As with FSA, HRA can be applied to the design, construction, maintenance and operations of a ship.

1.3 Application

It is intended that this guidance should be used wherever an FSA is conducted on a system which involves human action or intervention which affects system performance.

2 BASIC TERMINOLOGY

Error producing condition: Factors that can have a negative effect on human performance.

Human error: A departure from acceptable or desirable practice on the part an individual or a group of individuals that can result in unacceptable or undesirable results.

Human error recovery: The potential for the error to be recovered, either by the individual or by another person, before the undesired consequences are realized.

Human error consequence: The undesired consequences of human error.

Human error probability: Defined as follows:

$$HEP = \frac{Number\ of\ human\ errors\ that\ have\ occurred}{Number\ of\ opportunities\ for\ human\ error}$$

Human reliability: The probability that a person: (1) correctly performs some system-required activity in a required time period (if time is a limiting factor) and (2) performs no extraneous activity that can degrade the system. *Human unreliability* is the opposite of this definition.

Performance shaping factors: Factors that can have a positive or negative effect on human performance.

Task analysis: A collection of techniques used to compare the demands of a system with the capabilities of the operator, usually with a view to improving performance, e.g. by reducing errors.

3 METHODOLOGY

HRA can be considered to fit into the overall FSA process in the following way:

.1 identification of key human tasks consistent with step 1;

.2 risk assessment, including a detailed task analysis, human error analysis and human reliability quantification consistent with step 2; and

.3 risk control options consistent with step 3.

4 PROBLEM DEFINITION

Additional human element issues which may be considered in the problem definition include:

.1 personal factors, e.g. stress, fatigue;

.2 organizational and leadership factors, e.g. manning level;

.3 task features, e.g. task complexity; and

.4 onboard working conditions, e.g. human-machine interface.

5 HRA STEP 1 – IDENTIFICATION OF HAZARDS

5.1 Scope

5.1.1 The purpose of this step is to identify key potential human interactions which, if not performed correctly, could lead to system failure. This is a broad scoping exercise where the aim is to identify areas of concern (e.g. whole tasks or large sub-tasks) requiring further investigation. The techniques used here are the same as those used in step 2, but in step 2 they are used much more rigorously.

5.1.2 Human hazard identification is the process of systematically identifying the ways in which human error can contribute to accidents during normal and emergency operations. As detailed in paragraph 5.2.2 below, standard techniques such as Hazard and Operability (HazOp) study and Failure Mode and Effects Analysis (FMEA) can be, and are, used for this purpose. Additionally, it is strongly advised that a high-level functional task analysis is carried out. This section discusses those techniques which were developed solely to address human hazards.

5.2 Methods for hazard identification

5.2.1 In order to carry out a human hazard analysis, it is first necessary to model the system in order to identify the normal and emergency operating tasks that are carried out by the crew. This is achieved by the use of a high-level task analysis (as described in table 2) which identifies the main human tasks in terms of operational goals. Developing a task analysis can utilize a range of data collection techniques, e.g. interviews, observation, critical incident, many of which can be used to directly identify key tasks. Additionally, there are many other sources of information which may be consulted, including design information, past experience, normal and emergency operating procedures, etc.

5.2.2 At this stage it is not necessary to generate a lot of detail. The aim is to identify those key human interactions which require further attention. Therefore, once the main tasks, sub-tasks and their associated goals have been listed, the potential contributors to human error of each task need to be identified together with the potential hazard arising. There are a number of techniques which may be utilized for this purpose, including human error HazOp, Hazard Checklists, etc. An example of human-related hazards identifying a number of different potential contributors to sub-standard performance is included in table 3.

5.2.3 For each task and sub-task identified, the associated hazards and their associated scenarios should be ranked in order of their criticality in the same manner as discussed in section 5.2.2 of the FSA Guidelines.

5.3 Results

The output from step 1 is a set of activities (tasks and sub-tasks) with a ranked list of hazards associated with each activity. This list needs to be coupled with the other lists generated by the FSA process, and should therefore be produced in a common format. Only the top few hazards for critical tasks are subjected to risk assessment; less critical tasks are not examined further.

6 HRA STEP 2 – RISK ANALYSIS

6.1 Scope

The purpose of step 2 is to identify those areas where the human element poses a high risk to system safety and to evaluate the factors influencing the level of risk.

6.2 Detailed task analysis

6.2.1 At this stage, the key tasks are subjected to a detailed task analysis. Where the tasks involve more decision-making than action, it may be more appropriate to carry out a cognitive task analysis. Table 2 outlines the extended task analysis which was developed for analysing decision-making tasks.

6.2.2 The task analysis should be developed until all critical sub-tasks have been identified. The level of detail required is that which is appropriate for the criticality of the operation under investigation. A good general rule is that the amount of detail required should be sufficient to give the same degree of understanding as that provided by the rest of the FSA exercise.

6.3 Human error analysis

6.3.1 The purpose of human error analysis is to produce a list of potential human errors that can lead to the undesired consequence that is of concern. To help with this exercise, some examples of typical human errors are included in figure 1.

6.3.2 Once all potential errors have been identified, they are typically classified along the following lines. This classification allows the identification of a critical subset of human errors that must be addressed:

.1 the supposed cause of the human error;

.2 the potential for error-recovery, either by the operator or by another person (this includes consideration of whether a single human error can result in undesired consequences); and

.3 the potential consequences of the error.

6.3.3 Often, a qualitative analysis should be sufficient. A simple qualitative assessment can be made using a recovery/consequence matrix such as that illustrated in figure 2. Where necessary, a more detailed matrix can be developed using a scale for the likely consequences and levels of recovery.

6.4 Human error quantification

6.4.1 This activity is undertaken where a probability of human error (HEP) is required for input into a quantitative FSA. Human error quantification can be conducted in a number of ways.

6.4.2 In some cases, because of the difficulties of acquiring reliable human error data for the maritime industry, expert judgement techniques may need to be used for deriving a probability for human error. Expert judgment techniques can be grouped into four categories:

.1 paired comparisons;

.2 ranking and rating procedures;

.3 direct numerical estimation; and

.4 indirect numerical estimation.

It is particularly important that experts are provided with a thorough task definition. A poor definition invariably produces poor estimates.

6.4.3 Absolute Probability Judgement (APJ) is a good direct method. It can be used in various forms, from the single expert assessor to large groups of individuals whose estimates are mathematically aggregated (see table 4). Other techniques which focus on judgements from multiple experts include: brainstorming; consensus decision-making; Delphi; and the Nominal Group technique.

6.4.4 Alternatives to expert opinion are historic data (where available) and generic error probabilities. Two main methods for HRA which have databases of human error probabilities (mainly for the nuclear industry) are the Technique for Human Error Rate Prediction (THERP) and Human Error Assessment and Reduction Technique (HEART) (see table 4).

6.4.5 *Technique for Human Error Rate Prediction (THERP)*

THERP was developed by Swain and Guttmann (1983) of Sandia National Laboratories for the US Nuclear Regulatory Commission, and has become the most widely used human error quantitative prediction technique. THERP is both a human reliability technique and a human error databank. It models human errors using probability trees and models of dependence, but also considers performance shaping factors (PSFs) affecting action. It is critically dependent on its database of human error probabilities. It is considered to be particularly effective in quantifying errors in highly procedural activities.

6.4.6 *Human Error Assessment and Reduction Technique (HEART)*

HEART is a technique developed by Williams (1985) that considers particular ergonomics, tasks and environmental factors that adversely affect performance. The extent to which each factor independently affects performance is quantified and the human error probability is calculated as a function of the product of those factors identified for a particular task.

6.4.7 HEART provides specific information on remedial risk control options to combat human error. It focuses on five particular causes and contributions to human error: impaired system knowledge; response time shortage; poor or ambiguous system feedback; significant judgement required of operator; and the level of alertness resulting from duties, ill health or the environment.

6.4.8 When applying human error quantification techniques, it is important to consider the following:

.1 Magnitudes of human error are sufficient for most applications. A "gross" approximation of the human error magnitude is sufficient. The derivation of HEPs may be influenced by modelling and quantitative uncertainties. A final sensitivity analysis should be presented to show the effect of uncertainties on the estimated risks.

.2 Human error quantification can be very effective when used to produce a comparative analysis rather than an exact quantification. Then human error quantification can be used to support the evaluation of various risk control options.

.3 The detail of quantitative analysis should be consistent with the level of detail of the FSA model. The HRA should not be more detailed than the technical elements of the FSA. The level of detail should be selected based upon the contribution of the activity to the risk, system or operation being analysed.

.4 The human error quantification tool selected should fit the needs of the analysis. There are a significant number of human error quantification techniques available. The selection of a technique should be assessed for consistency, usability, validity of results, usefulness, effective use of resources for the HRA and the maturity of the technique.

6.5 Results

6.5.1 The output from this step comprises:

.1 an analysis of key tasks;

.2 an identification of human errors associated with these tasks; and

.3 an assessment of human error probabilities (optional).

6.5.2 These results should then be considered in conjunction with the high-risk areas identified elsewhere in step 2.

7 HRA STEP 3 – RISK CONTROL OPTIONS

7.1 Scope

The purpose of step 3 is to consider how the human element is considered within the evaluation of technical, human, work environment, personnel and management-related risk control options.

7.2 Application

7.2.1 The control of risks associated with the human interaction with a system can be approached in the same way as for the development of other risk control measures. Measures can be specified in order to:

.1 reduce the frequency of failure;

.2 mitigate the effects of failure;

.3 alleviate the circumstances in which failures occur; and

.4 mitigate the consequences of accidents.

7.2.2 Proper application of HRA can reveal that technological innovations can also create problems which may be overlooked by FSA evaluation of technical factors only. A typical example of this is the creation of long periods of low workload when a high degree of automation is used. This in turn can lead to an inability to respond correctly when required or even to the introduction of "risk-taking behaviour" in order to make the job more interesting.

7.2.3 When dealing with risk control concerning human activity, it is important to realize that more than one level of risk control measure may be necessary. This is because human involvement spans a wide range of activities from day-to-day operations through to senior management levels. Secondly, it must also be stressed that a basic focus on good system design utilizing ergonomics and human factor principles is needed in order to achieve enhanced operational safety and performance levels.

7.2.4 In line with figure 3 of the FSA Guidelines, risk control measures for human interactions can be categorized into four areas as follows: (1) technical/engineering subsystem, (2) working environment, (3) personnel subsystem and (4) organizational/management subsystem. A description of the issues that may be considered within each of these areas is given in figure 3.

7.2.5 Once the risk control measures have been initially specified, it is important to reassess human intervention in the system in order to assess whether any new hazards have been introduced. For example, if a decision had been taken to automate a particular task, then the new task would need to be re-evaluated.

7.3 Results

The output from this step comprises a range of risk control options categorized into 4 areas as presented in figure 3, easing the integration of human-related risk into step 3.

8 HRA STEP 4 – COST-BENEFIT ASSESSMENT

No specific HRA guidance for this section is required.

9 HRA STEP 5 – RECOMMENDATIONS FOR DECISION-MAKING

Judicious use of the results of the HRA study should contribute to a set of balanced decisions and recommendations of the whole FSA study.

FIGURE 1

TYPICAL HUMAN ERRORS

Physical Errors	***Mental Errors***
Action omitted Action too much/little Action in wrong direction Action mistimed Action on wrong object	Lack of knowledge of system/situation Lack of attention Failure to remember procedures Communication breakdowns Miscalculation

FIGURE 2

RECOVERY/CONSEQUENCE MATRIX

	High	May need to consider	MUST CONSIDER
Consequence	Low	No need to consider	May need to consider
		High	Low
		Recovery	

FIGURE 3

EXAMPLES OF RISK CONTROL OPTIONS

Technical/engineering subsystem

- ergonomic design of equipment and work spaces
- good layout of bridge, machinery spaces
- ergonomic design of the man-machine interface/human computer interface
- specification of information requirements for the crew to perform their tasks
- clear labelling and instructions on the operation of ship systems and control/ communications equipment

Working environment

- ship stability, effect on crew of working under conditions of pitch/roll
- weather effects, including fog, particularly on watch-keeping or external tasks
- ship location, open sea, approach to port, etc.
- appropriate levels of lighting for operations and maintenance tasks and for day and night time operations
- consideration of noise levels (particularly for effect on communications)
- consideration of the effects of temperature and humidity on task performance
- consideration of the effects of vibration on task performance

Personnel subsystem

- development of appropriate training for crew members
- crew levels and make up
- language and cultural issues
- workload assessment (both too much and too little workload can be problematic)
- motivational and leadership issues

Organizational/management subsystem

- development of organization policies on recruitment, selection, training, crew levels and make up, competency assessment, etc.
- development of operational and emergency procedures (including provisions for tug and salvage services)
- use of safety management systems
- provision of weather forecasting/routeing services

TABLE 1

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TABLE 2

SUMMARY OF TASK ANALYSIS TYPES

1 High-level task analysis

1.1 High-level task analysis here refers to the type of task analysis which allows an analyst to gain a broad but shallow overview of the main functions which need to be performed to accomplish a particular task.

1.2 High-level task analysis is undertaken in the following way:

.1 describe all operations within the system in terms of the tasks required to achieve a specific operational goal; and

.2 consider goals associated with normal operations, emergency procedures, maintenance and recovery measures.

1.3 The analysis is recorded either in a hierarchical format or in tabular form.

2 Detailed task analysis

2.1 Detailed task analysis is undertaken to identify:

.1 the overall task (or job) that is done;

.2 sub-tasks;

.3 all of the people who contribute to the task and their interactions;

.4 how the work is done, i.e. the working practices in normal and emergency situations;

.5 any controls, displays, tools, etc. which are used; and

.6 factors which influence performance.

2.2 There are many task analysis techniques - Kirwan and Ainsworth (1992) list more than twenty. They note that the most widely used, hierarchical task analysis (HTA), can be used as a framework for applying other techniques:

.1 data collection techniques, e.g. activity sampling, critical incident, questionnaires;

.2 task description techniques, e.g. charting and network techniques, tabular task analysis;

.3 tasks simulation methods, e.g. computer modelling and simulation;

.4 task behaviour assessment methods, e.g. management and oversight risk trees; and

.5 task requirement evaluation methods, e.g. ergonomics checklists.

3 Extended task analysis (XTA)

3.1 Traditional task analysis was designed for investigating manual tasks, and is not so useful for analysing intellectual tasks, e.g. navigation decisions. Extended task analysis or other cognitive task analyses (see Annett and Stanton, 1998) can be used where the focus is less on what actions are performed and more on understanding the rationale for the decisions that are taken.

3.2 XTA is used to map out the logical bases of the decision-making process which underpin the task under examination. The activities which comprise XTA techniques are described in Johnson and Johnson (1987). In summary, they are:

.1 Interview. The interviewer asks about the conditions which enable or disable certain actions to be performed, and how a change in the conditions affects those choices. The interviewer examines the individual's intentions to make sure that all relevant aspects of the situation have been taken into account. This enables the analyst to build up a good understanding of what the individual is doing and why, and how it would change under varying conditions.

.2 Qualitative analysis of data. The interview is tape-recorded, transcribed and subsequently analysed. Methods for analysing qualitative data are well-established in social science and more recently utilized in safety engineering. The technique (called Grounded Theory) is described in detail by Pidgeon et al*.* (1991).

.3 Representation of the analysis in an appropriate format. The representation scheme used in XTA is called systemic grammar networks – a form of associative network – see Johnson and Johnson (1987).

.4 Validation activities, e.g. observation, hypothesis.

TABLE 3

EXAMPLES OF HUMAN-RELATED HAZARDS

1 Human error occurs on board ships when a crew member's ability falls below what is needed to successfully complete a task. Whilst this may be due to a lack of ability, more commonly it is because the existing ability is hampered by adverse conditions. Below are some examples (not complete) of personal factors and unfavourable conditions which constitute hazards to optimum performance. A comprehensive examination of all human-related hazards should be performed. During the "design stage" it is typical to focus mainly on task features and on board working conditions as potential human-related hazards.

2 Personal factors

.1 Reduced ability, e.g. reduced vision or hearing;

.2 Lack of motivation, e.g. because of a lack of incentives to perform well;

.3 Lack of ability, e.g. lack of seamanship, unfamiliarity with vessel, lack of fluency of the language used on board;

.4 Fatigue, e.g. because of lack of sleep or rest, irregular meals; and

.5 Stress.

3 Organizational and leadership factors

.1 Inadequate vessel management, e.g. inadequate supervision of work, lack of coordination of work, lack of leadership;

.2 Inadequate shipowner management, e.g. inadequate routines and procedures, lack of resources for maintenance, lack of resources for safe operation, inadequate follow-up of vessel organization;

.3 Inadequate manning, e.g. too few crew, untrained crew; and

.4 Inadequate routines, e.g. for navigation, engine-room operations, cargo handling, maintenance, emergency preparedness.

4 Task features

.1 Task complexity and task load, i.e. too high to be done comfortably or too low causing boredom;

.2 Unfamiliarity of the task;

.3 Ambiguity of the task goal; and

.4 Different tasks competing for attention.

5 Onboard working conditions

.1 Physical stress from, e.g. noise, vibration, sea motion, climate, temperature, toxic substances, extreme environmental loads, night-watch;

.2 Ergonomic conditions, e.g. inadequate tools, inadequate illumination, inadequate or ambiguous information, badly-designed human-machine interface;

.3 Social climate, e.g. inadequate communication, lack of cooperation; and

.4 Environmental conditions, e.g. restricted visibility, high traffic density, restricted fairway.

TABLE 4

SUMMARY OF HUMAN ERROR ANALYSIS TECHNIQUES

The two main HRA quantitative techniques (HEART and THERP) are outlined below. CORE-DATA provides data on generic probabilities. As the data from all of these sources are based on non-marine industries, they need to be used with caution. A good alternative is to use expert judgement and one technique for doing this is Absolute Probability Judgement.

1 Absolute Probability Judgement (APJ)

1.1 APJ refers to a group of techniques that utilize expert judgement to develop human error probabilities (HEPs) detailed in Kirwan (1994) and Lees (1996). These techniques are used when no relevant data exist for the situation in question, making some form of direct numerical estimation the only way of developing values for HEPs.

1.2 There are a variety of techniques available. This gives the analyst some flexibility in accommodating different types of analysis. Most of the techniques avoid potentially detrimental group influences such as group bias. Typically the techniques used are: the Delphi technique, the Nominal Group Technique and Paired Comparisons. The number and type of experts that are required to participate in the process are similar to that required for Hazard Identification techniques such as HazOp.

1.3 Paired Comparisons is a significant expert judgement technique. Using this technique, an individual makes a series of judgements about pairs of tasks. The results for each individual are analysed and the relative values for HEPs for the tasks derived. Use of the technique rests upon the ability to include at least two tasks with known HEPs. CORE-DATA and data from other industries may be useful.

1.4 The popularity of these techniques has reduced in recent times, probably due to the requirement to get the relevant groups of experts together. However, these techniques may be very appropriate for the maritime industry.

2 Technique for Human Error Rate Prediction (THERP)

2.1 THERP is one of the best known and most often utilized human reliability analysis techniques. At first sight the technique can be rather daunting due to the volume of information provided. This is because it is a comprehensive methodology covering task analysis, human error identification, human error modelling and human error quantification. However, it is best known for its human error quantification aspects, which includes a series of human error probability (HEP) data tables and data quantifying the effects of various performance shaping factors (PSFs). The data presented is generally of a detailed nature and so not readily transferable to the marine environment.

2.2 THERP contains a dependence model which is used to model the dependence relationship between errors. For example, the model could be used to assess the dependence between the helmsman making an error and the bridge officer noticing it. Operational experience does show that there are dependence effects between people and between tasks. Whilst this is the only human error model of its type, it has not been comprehensively validated.

2.3 A full THERP analysis can be resource-intensive due to the level of detail required to utilize the technique properly. However, the use of this technique forces the analyst to gain a detailed appreciation of the system and of the human error potential. THERP models humans as any other subsystem in the FSA modelling process. The steps are as follows:

.1 identify all the systems in the operation that are influenced and affected by human operations;

.2 compile a list and analyse all human operations that affect the operations of the system by performing a detailed task analysis;

.3 determine the probabilities of human errors through error frequency data and expert judgements and experiences; and

.4 determine the effects of human errors by integrating the human error into the PRA modelling procedure.

2.4 THERP includes a set of performance shaping factors (PSFs) that influence the human errors at the operator level. These performance factors include experience, situational stress factors, work environment, individual motivation, and the human-machine interface. The PSFs are used as a basis for estimating nominal values and value ranges for human error.

2.5 There are advantages to using THERP. First, it is a good tool for relative risk comparisons. It can be used to measure the role of human error in an FSA and to evaluate risk control options not necessarily in terms of a probability or frequency, but in terms of risk magnitude. Also, THERP can be used with the standard event-tree/fault-tree modelling approaches that are sometimes preferred by FSA practitioners. THERP is a transparent technique that provides a systematic, well-documented approach to evaluating the role of human errors in a technical system. The THERP database can be used through systematic analysis or, where available, external human error data can be inserted.

3 Human Error Assessment and Reduction Technique (HEART)

3.1 HEART is best known as a relatively simple way of arriving at human error probabilities (HEPs). The basis of the technique is a database of nine generic task descriptions and an associated human error probability. The analyst matches the generic task description to the task being assessed and then modifies the generic human error probability according to the presence and strength of the identified error producing conditions (EPCs). EPCs are conditions that increase the order of magnitude of the error frequency or probability measurements, similar in concept to PSFs in THERP. A list of EPCs is supplied as part of the technique, but it is up to the analyst to decide on the strength of effect for the task in question.

3.2 Whilst the generic data is mainly derived from the nuclear industry, HEART does appear amenable to application within other industries. It may be possible to tailor the technique to the marine environment by including new EPCs such as weather. However, it needs careful application to avoid ending up with very conservative estimates of HEPs.

4 CORE-DATA

4.1 CORE-DATA is a database of human error probabilities. Access to the database is available through the University of Birmingham in the United Kingdom. The database has been developed as a result of sponsorship by the UK Health and Safety Executive with support from the nuclear, rail, chemical, aviation and offshore industries and contains up to 300 records as of January 1999.

4.2 Each record is a comprehensive presentation of information including, e.g. a task summary, industry origin, country of origin, type of data collection used, a database quality rating, description of the operation, performance shaping factors, sample size and HEP.

4.3 As with all data from other industries, care needs to be taken when transferring the data to the maritime industry. Some of the offshore data may be the most useful.

APPENDIX 2

EXAMPLES OF HAZARDS

1 SHIPBOARD HAZARDS TO PERSONNEL

.1 asbestos inhalation;
.2 burns from caustic liquids and acids;
.3 electric shock and electrocution;
.4 falling overboard; and
.5 pilot ladder/pilot hoist operation.

2 HAZARDOUS SUBSTANCES ON BOARD SHIP

Accommodation areas:

.1 combustible furnishings;
.2 cleaning materials in stores; and
.3 oil/fat in galley equipment;

Deck areas:

.4 cargo; and
.5 paint, oils, greases, etc. in deck stores;

Machinery spaces:

.6 cabling;
.7 fuel and diesel oil for engines, boilers and incinerators;
.8 fuel, lubricating and hydraulic oil in bilges, save-alls, etc.;
.9 refrigerants; and
.10 thermal heating fluid systems.

3 POTENTIAL SOURCES OF IGNITION

General:

.1 electrical arc;
.2 friction;
.3 hot surface;
.4 incendiary spark;
.5 naked flame; and
.6 radio waves;

Accommodation areas (including bridge):

.7 electronic navigation equipment; and
.8 laundry facilities – irons, washing machines, tumble driers, etc.;

Deck areas:

.9 deck lighting;
.10 funnel exhaust emissions; and
.11 hot work sparking;

Machinery spaces:

.12 air compressor units; and
.13 generator engine exhaust manifold.

4 HAZARDS EXTERNAL TO THE SHIP

.1 storms;
.2 lightning;
.3 uncharted submerged objects; and
.4 other ships.

APPENDIX 3

HAZARD IDENTIFICATION AND RISK ANALYSIS TECHNIQUES

1 FAULT TREE ANALYSIS

1.1 A Fault Tree is a logic diagram showing the causal relationship between events which singly or in combination occur to cause the occurrence of a higher level event. It is used in Fault Tree Analysis to determine the probability of a top event, which may be a type of accident or unintended hazardous outcome. Fault Tree Analysis can take account of common cause failures in systems with redundant or standby elements. Fault Trees can include failure events or causes related to human factors.

1.2 The development of a Fault Tree is by a top-down approach, systematically considering the causes or events at levels below the top level. If two or more lower events need to occur to cause the next higher event, this is shown by a logic "and" gate. If any one of two or more lower events can cause the next higher event, this is shown by a logic "or" gate. The logic gates determine the addition or multiplication of probabilities (assuming independence) to obtain the values for the top event.

2 EVENT TREE ANALYSIS

2.1 An Event Tree is a logic diagram used to analyse the effects of an accident, a failure or an unintended event. The diagram shows the probability or frequency of the accident linked to those safeguard actions required to be taken after occurrence of the event to mitigate or prevent escalation.

2.2 The probabilities of success or failure of these actions are analysed. The success and failure paths lead to various consequences of differing severity or magnitude. Multiplying the likelihood of the accident by the probabilities of failure or success in each path gives the likelihood of each consequence.

3 FAILURE MODE AND EFFECT ANALYSIS (FMEA)

FMEA is a technique in which the system to be analysed is defined in terms of functions or hardware. Each item in the system is identified at a required level of analysis. This may be at a replaceable item level. The effects of item failure at that level and at higher levels are analysed to determine their severity on the system as a whole. Any compensating or mitigating provisions in the system are taken account of and recommendations for the reduction of the severity are determined. The analysis indicates single failure modes which may cause system failure.

4 HAZARD AND OPERABILITY STUDIES (HAZOP)

4.1 These studies are carried out to analyse the hazards in a system at progressive phases of its development from concept to operation. The aim is to eliminate or minimize potential hazards.

4.2 Teams of safety analysts and specialists in the subject system, such as designers, constructors and operators are formally constituted. The team members may change at successive phases depending on the expertise required. In examining designs they systematically consider deviations from the intended functions, looking at causes and effects. They record the findings and recommendations and follow-up actions required.

5 WHAT IF ANALYSIS TECHNIQUE

5.1 What If Analysis Technique is a hazard identification technique suited for use in a hazard identification meeting. The typical participants in the meeting may be: a facilitator leader, a recorder and a group of carefully selected experienced persons covering the topics under consideration. Usually a group of 7 to 10 persons is required.

5.2 The group first discusses in detail the system, function or operation under consideration. Drawings, technical descriptions etc. are used, and the experts may have to clarify to each other how the details of the system, function or operation work and may fail.

5.3 The next phase of the meeting is brainstorming, where the facilitator leader guides by asking questions starting with "what if?". The questions span topics like operation errors, measurement errors, equipment malfunction, maintenance, utility failure, loss of containment, emergency operation and external influences. When the ideas are exhausted, previous accident experience may be used to check for completeness.

5.4 The hazards are considered in sequence and structured into a logical sequence, in particular to allow cross-referencing between hazards.

5.5 The hazard identification report is usually developed and agreed in the meeting, and the job is done and reported when the meeting is adjourned.

5.6 The technique requires that the participants are senior personnel with detailed knowledge within their field of experience. A meeting typically takes three days. If the task requires long meetings it should be broken down into smaller sub-tasks.

5.7 SWIFT (Structured What If Technique) is one example of a What If Analysis Technique (http://www.dnv.nl/Syscert/training&consultancy.htm).

6 RISK CONTRIBUTION TREE (RCT)

6.1 RCT may be used as a mechanism for displaying diagrammatically the distribution of risk amongst different accident categories and sub-categories, as shown in figure 6 of the FSA Guidelines. Structuring the tree starts with the accident categories, which may be divided into sub-categories to the extent that available data allow and logic dictates. The preliminary fault and event trees can be developed based on the hazards identified in step 1 to demonstrate how direct causes initiate and combine to cause accidents (using fault trees), and also how accidents may progress further to result in different magnitudes of loss (using event trees). Whilst the example makes use of fault and event tree techniques, other established methods could be used if appropriate.

6.2 Quantifying the RCT is typically undertaken in three stages using available accident statistics:

.1 categories and sub-categories of accidents are quantified in terms of the frequency of accidents;

.2 the severity of accident outcomes is quantified in terms of magnitude and consequence; and

.3 the risk of the categories and sub-categories of accidents can be expressed as F-N curves (see appendix 5) or potential loss of lives (PLL) based on the frequency of accidents and the severity of the outcome of the accidents.

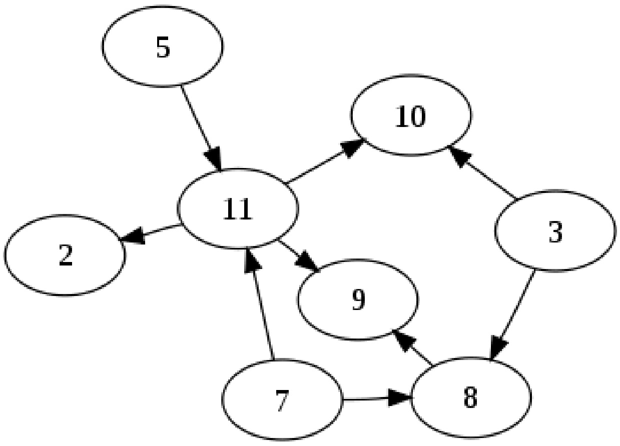
Thus, the distribution of risks across all the sub-categories of accidents is determined in risk terms, so as to display which categories contribute how much risk.

7 INFLUENCE DIAGRAMS

The purpose of the Influence Diagram approach is to model the network of influences on an event. These influences link failures at the operational level with their direct causes, and with the underlying organizational and regulatory influences. The Influence Diagram approach is derived from decision analysis and, being based on expert judgements, is particularly useful in situations for which there may be little or no empirical data available. The approach is therefore capable of identifying all the influences (and therefore underlying causal information) that help explain why a marine risk profile may show high risk levels in one aspect (or even vessel type) and low risk level in another aspect. As the Influence Diagram recognizes that the risk profile is influenced, for example by human, organizational and regulatory aspects, it allows a holistic understanding of the problem area to be displayed in a hierarchical way.

8 BAYESIAN NETWORK

Bayesian network is a probabilistic graphical model (a type of statistical model) that represents a set of random variables and their conditional dependencies via a directed acyclic graph (DAG; see diagram below). For example, a Bayesian network could represent the probabilistic relationships between diseases and symptoms. Given symptoms, the network can be used to compute the probabilities of the presence of various diseases.



9 SENSITIVITY ANALYSIS AND UNCERTAINTY ANALYSIS

Sensitivity analysis is the study of how the uncertainty in the output of a model (numerical or otherwise) can be apportioned to different sources of uncertainty in the model input. A related practice is **uncertainty analysis** which focuses rather on quantifying uncertainty in model output. Ideally, uncertainty and sensitivity analysis should be run in tandem.

Uncertainty analysis investigates the uncertainty of variables that are used in decision-making problems in which observations and models represent the knowledge base. In other words, uncertainty analysis aims to make a technical contribution to decision-making through the quantification of uncertainties in the relevant variables.

Uncertainty and sensitivity analysis investigate the robustness of a study when the study includes some form of **statistical modelling**.

APPENDIX 4

INITIAL RANKING OF ACCIDENT SCENARIOS

1 At the end of step 1, hazards are to be prioritized and scenarios ranked. Scenarios are typically the sequence of events from the initiating event up to the consequence, through the intermediate stages of the scenario development.

2 To facilitate the ranking and validation of ranking, it is generally recommended to define consequence and probability indices on a logarithmic scale. A risk index may therefore be established by adding the probability/frequency and consequence indices. By deciding to use a logarithmic scale, the Risk Index for ranking purposes of an event rated "remote" (FI=3) with severity "Significant" (SI=2) would be RI=5.

Risk = Probability x Consequence
Log (Risk) = log (Probability) + log (Consequence)

3 The following table gives an example of a logarithmic severity index, scaled for a maritime safety issue. Consideration of environmental issues or of passenger vessels may require additional or different categories.

Severity index				
SI	SEVERITY	EFFECTS ON HUMAN SAFETY	EFFECTS ON SHIP	S (Equivalent fatalities)
1	Minor	Single or minor injuries	Local equipment damage	0.01
2	Significant	Multiple or severe injuries	Non-severe ship damage	0.1
3	Severe	Single fatality or multiple severe injuries	Severe damage	1
4	Catastrophic	Multiple fatalities	Total loss	10

4 The following table gives an example of a logarithmic probability/frequency index.

Frequency index			
FI	FREQUENCY	DEFINITION	F (per ship year)
7	Frequent	Likely to occur once per month on one ship	10
5	Reasonably probable	Likely to occur once per year in a fleet of 10 ships, i.e. likely to occur a few times during the ship's life	0.1
3	Remote	Likely to occur once per year in a fleet of 1,000 ships, i.e. likely to occur in the total life of several similar ships	10^{-3}
1	Extremely remote	Likely to occur once in the lifetime (20 years) of a world fleet of 5,000 ships	10^{-5}

5 The following table gives an example of a risk matrix based on the tables above.

Risk Index (RI)					
		SEVERITY (SI)			
		1	2	3	4
FI	FREQUENCY	Minor	Significant	Severe	Catastrophic
7	Frequent	**8**	**9**	**10**	**11**
6		**7**	**8**	**9**	**10**
5	Reasonably probable	**6**	**7**	**8**	**9**
4		**5**	**6**	**7**	**8**
3	Remote	**4**	**5**	**6**	**7**
2		**3**	**4**	**5**	**6**
1	Extremely remote	**2**	**3**	**4**	**5**

6 In case of FSA on prevention of oil spill from ships, the following severity index can be used.

Severity Index		
SI	SEVERITY	DEFINITION
1	Category 1	Oil spill size < 1 tonne
2	Category 2	Oil spill size between 1-10 tonnes
3	Category 3	Oil spill size between 10-100 tonnes
4	Category 4	Oil spill size between 100-1,000 tonnes
5	Category 5	Oil spill size between 1,000-10,000 tonnes
6	Category 6	Oil spill size >10,000 tonnes

APPENDIX 5

MEASURES AND TOLERABILITY OF RISKS

1 INTRODUCTION

The following information on measures and tolerability of risks is provided for conceptual understanding and is not intended to provide prescriptive thresholds for acceptability of risks.

2 TERMINOLOGY

Individual Risk (IR): The risk of death, injury and ill health as experienced by an individual at a given location, e.g. a crew member or passenger on board the ship, or belonging to third parties that could be affected by a ship accident. Usually IR is taken to be the risk of death and is determined for the maximally exposed individual. Individual Risk is person and location specific.

$$IR_{for\ Person\ Y} = F_{of\ undesired\ Event} * P_{for\ Person\ Y} * E_{of\ Person\ Y}$$

F = frequency
P = resulting casualty probability
E = fractional exposure to that risk

Societal Risk: Average risk, in terms of fatalities, experienced by a whole group of people (e.g. crew, port employees or society at large) exposed to an accident scenario. Usually Societal Risk is taken to be the risk of death and is typically expressed as FN-diagrams or Potential Loss of Life (PLL) (refer to section 2). Societal Risk is determined for the all exposed, even if only once a year. Societal Risk is not person and location specific.

FN-Curve: A continuous graph with the ordinate representing the cumulative frequency distribution of N or more fatalities and the abscissa representing the consequence (N fatalities). The FN-curve represents the cumulative distribution of multiple fatality events and therefore useful in representing societal risk. The FN-curve is constructed by taking each hazard or accident scenario in turn and estimating the number of fatalities. With the estimated frequency of occurrence of each accident scenario the overall frequency with which a given number of fatalities may be equalled or exceeded can be calculated and plotted in the form of an FN-curve.

ALARP (As Low As Reasonably Practicable): Refers to a level of risk that is neither negligibly low nor intolerable high. ALARP is actually the attribute of a risk, for which further investment of resources for risk reduction is not justifiable. The principle of ALARP is employed for the risk assessment procedure. Risks should be As Low As Reasonably Practicable. It means that accidental events whose risks fall within this region have to be reduced unless there is a disproportionate cost to the benefits obtained.

3 PRINCIPLES OF RISK EVALUATION

Risk can be expressed in several complementary fashions. Concerning life safety, the most commonly used expressions are Individual Risk and Societal Risk. This is risk of death, injuries and ill health experienced by an individual and/or a group of people. The notion of risk combines frequency and an identified level of harm. Commonly, the level of harm is narrowed down to the loss of life and risk is an expression of frequency and number of fatalities. In other words, life safety is usually taken to refer to the risk of loss of life, and usually expressed as fatalities per year. In order to address not only fatalities, but also disabilities and injuries, the Equivalent Fatality Concept as specified below is advocated. Risk should at least be judged from two viewpoints. The first point of view is that of the individual, which is dealt with by the Individual Risk. The second point of view is that of society, considering whether a risk is acceptable for (large) group of people. This is dealt with by the Societal Risk.

3.1 The use of Individual Risk

3.1.1 This risk expression is used when the risk from an accident is to be estimated for a particular individual at a given location. Individual Risk considers not only the frequency of the accident and the consequence (here: fatality or injury), 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.

3.1.2 Example: The risk for a person to be killed or injured in a harbour area, due to a tanker explosion, is the higher the closer the person is located to the explosion location, and the more likely the person will be in that location at the time of the explosion. Therefore, the Individual Risk for a worker in the vicinity of the explosion will be higher than for an occupant in the neighbourhood of the harbour terminal.

3.1.3 The purpose of estimating the Individual Risk is to ensure that individuals, who may be affected by a ship accident, are not exposed to excessive risks.

3.2 The use of Societal Risk

3.2.1 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. Societal Risk expressions can be generated for each type of accident (e.g. collision), or a single overall Societal Risk expression can be obtained, e.g. for a ship type, by combining all accidents together (e.g. collision, grounding, fire). Societal Risk may be expressed as:

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

.2 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

3.2.2 Society in general has a strong aversion to multiple casualty accidents. There is a clear perception that a single accident that kills 1,000 people is worse than 1,000 accidents that kill a single person. Societal Risk expressed by an FN-diagram show the relationship between the frequency of an accident and the number of fatalities (see figure 1 below).

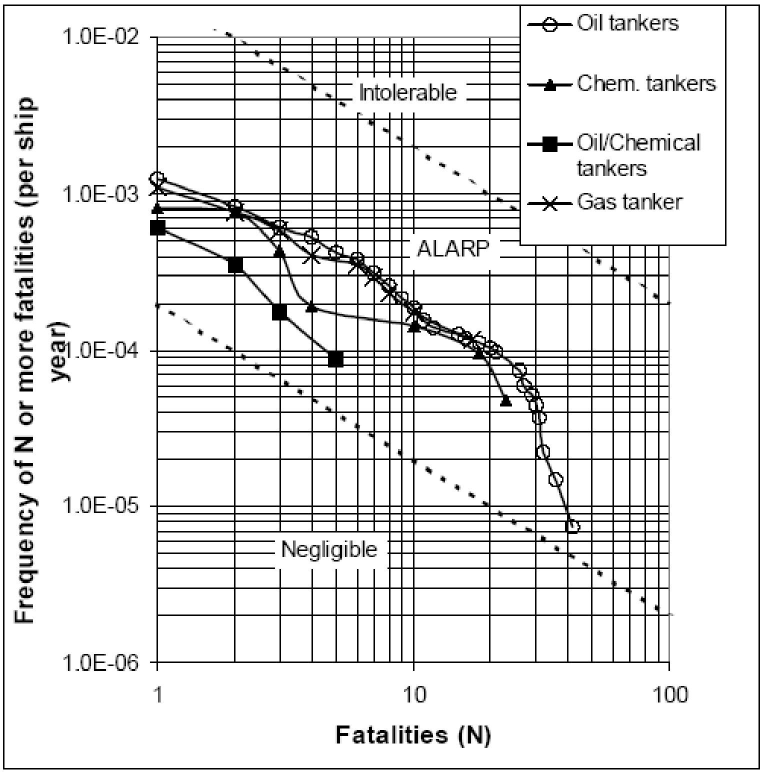


Figure 1: FN-diagram *(from MSC 72/16)*

Potential Loss of Life (PLL)

3.2.3 A simple measure of Societal Risk is the PLL which is defined as the expected value of the number of fatalities per year. PLL is a type of risk integral, being a summation of risk as expressed by the product of consequence and frequency. The integral is summed up over all potential undesired events that can occur.

3.2.4 Compared to the FN-diagram, the distinction between high frequency/low consequence accidents and low frequency/high consequence accidents is lost: all fatalities are treated as equally important, irrespective of whether they occur in high fatality or low fatality accidents. PLL is a simpler format of Societal Risk than the FN-diagram. PLL is typically measured as fatality per ship-year.

3.3 Comparing Societal Risk and Individual Risk

3.3.1 Societal Risk expressed in an FN-diagram allows a more comprehensive picture of risk than Individual Risk measures. The FN-diagram allows the assessment not only of the average number of fatalities but also of the risk of catastrophic accidents killing many people at once.

3.3.2 However, unlike Individual Risk, both FN-diagrams and PLL values give no indication of the geographical distribution of a particular risk. Societal Risk represents the risk to a (large) group of people. In this group, the risk to individuals may be quite different, depending, e.g. on the different locations of the individuals when the accident occurs. The Societal Risk value therefore represents an average risk. There is a general agreement in society that it is not sufficient to just achieve a minimal average risk. It is also necessary to reduce the risk to the most exposed individual. It is therefore adequate to look at both Societal Risk and Individual Risk to achieve a full risk picture.

3.3.3 Societal Risk is difficult to apply to the task of risk reduction, specifically because it is multidimensional.

3.4 Risk equivalence concept

3.4.1 Normally, from a given activity in industry, there tends to be a relationship between fatalities and injuries of different severities resulting from an accident. Furthermore, measures that will reduce the occurrence of fatalities also tend to reduce injuries in proportion. In the literature there exist some studies on the ratio between accidental outcomes, e.g. from Bird and German (1966). In document MSC 68/INF.6, a straightforward approach was introduced, suggesting an equivalence ratio between fatalities, major injuries and minor injuries:

.1 one (1) fatality equals ten (10) severe injuries; and

.2 one (1) severe injury equals ten (10) minor injuries.

3.4.2 The QALY and DALY concepts (refer to appendix 7) would represent more general approaches for measuring injuries and health effects, and are used by e.g. the World Health Organization (WHO).

4 ALARP PRINCIPLE

By using different forms of risk expressions, risk criteria can be created that meet the requirement of different principles. The commonly accepted principle is known as the ALARP principle. Risk criteria are used to translate a risk level into value judgement.

4.1 General

4.1.1 The purpose of FSA is to reduce the risk to a level that is tolerable. IMO has a moral responsibility to limit the risks to people life and health, to the marine environment and to property. In addition, IMO should also account for maintaining a healthy industry. Spending resources on regulations whose benefits are grossly disproportionate to their costs will put the industry in a less than competitive position.

4.1.2 This is realized in the ALARP principle, which is shown in figure 2.

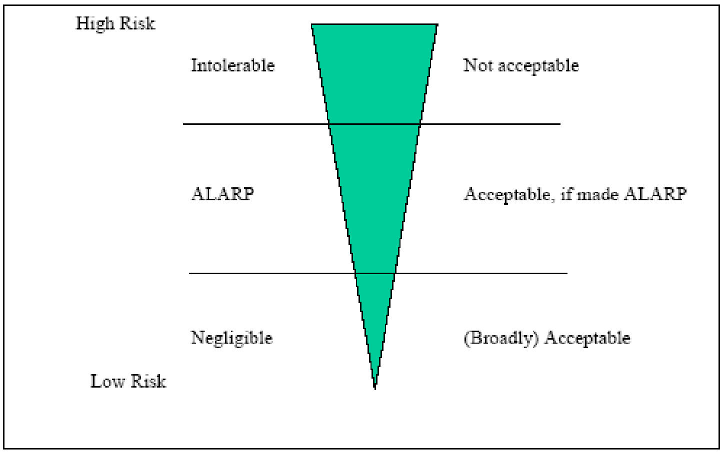


Figure 2: The ALARP principle

4.1.3 It states that there is a risk level that is intolerable above an upper bound. In this region, risk cannot be justified and must be reduced, irrespectively of costs. The principle also states that there is a risk level that is "broadly acceptable" below a lower bound. In this region risk is negligible and no risk reduction required. If the risk level is in between the two bounds, the ALARP region, risk should be reduced to meet economic responsibility: Risk is to be reduced to a level as low as is reasonably practicable. The term reasonable is interpreted to mean cost-effective. Risk reduction measures should be technically practicable and the associated costs should not be disproportionate to the benefits gained. This is examined in a cost-effectiveness analysis.

4.2 Cost-effectiveness Analysis (CEA)

With this approach the amount of risk reduction that can be justified in the ALARP region is determined. Several researchers have proven that most risks in shipping fall into this region. As such, most of risk-based decisions will require a CEA. However, it should be noted that this has not yet been verified for all ship types. There are several indices which express cost-effectiveness in relation to safety of life such as GCAF and NCAF, as described in appendix 7.

5 RECOMMENDED RISK EVALUATION CRITERIA

5.1 Individual Risk

5.1.1 Individual Risk criteria for hazardous activities are often set using risk levels that have already been accepted from other industrial activities.

5.1.2 The level of risk that will be accepted for an individual depends upon two aspects:

.1 if the risk is taken involuntarily or voluntarily; and

.2 if the individual has control over the risk or no control.

5.1.3 If a person is voluntarily exposing himself to a risk and/or has some control over it, then the risk level that is accepted is higher as if this person was exposed involuntarily to that risk or had no control over it.

5.1.4 For example: A passenger on a cruise ship or an occupant living in the vicinity of a port have little or no control over the risks they are exposed to from the ship and/or the port activity. They are involuntarily exposed to risks. A crew member on a ship, instead, has chosen his workplace on a voluntary basis, and due to skills and training has some control over the risks he/she is exposed to at the workplace.

5.1.5 An appropriate level for the risk acceptance criteria would be substantially below the total accident risks experienced in daily life, but might be similar to risks that are accepted from other involuntary sources.

5.1.6 The lower and upper bound risk acceptance criteria as listed in table 1 are provided for illustrative purposes only. The specific values selected as appropriate should be explicitly defined in FSA studies.

5.2 Societal Risk/FN-Diagram

5.2.1 When setting upper and lower bounds for societal risk acceptance, both an anchor point and a slope should be defined. The slope reveals the risk inherent attitude: risk prone, neutral or averse. It is recommended to use a slope equal of -1 on a log/log scale to reflect the risk aversion.

5.2.2 In document MSC 72/16 it was pointed out that Societal Risk acceptance criteria cannot be simply transferred from one industrial activity to another. This could lead to illogical and unpredictable results. A method was introduced where the Societal Risk acceptance criteria reflect the importance of the activity to the society (for more detail, refer to document MSC 72/16, Skjong and Eknes (2001, 2002)).

5.2.3 For a given activity, an average acceptable Potential Loss of Life (PLL) is developed by considering the economic value of the activity and its relation to the gross national product. This can be done for crew/workers, passengers and other third parties. The risk is defined to be intolerable if it exceeds the average acceptable risk by more than one order of magnitude, and it is negligible (broadly acceptable), if it is one order of magnitude below the average acceptable risk. These upper and lower bounds represent the ALARP region, which thus ranges over two orders of magnitude, which is in agreement with other published Societal Risk acceptance criteria.

5.2.4 It is recommended to apply this method to define Societal Risk acceptance criteria on different ship types and/or marine activities, as the method can contribute to transparency in using risk acceptance criteria for Societal Risk. In document MSC 72/16, Societal Risk criteria developed with this method and expressed in FN-diagrams are provided for different ship types.

5.3 Examples of risk acceptance criteria

5.3.1 The following criteria are broadly used in other industries and have been also published in HSE (2001).

Decision Parameter		Acceptance Criteria	
		Lower bound for ALARP region	Upper bound for ALARP region
		Negligible (broadly acceptable) fatality risk per year	Maximum tolerable fatality risk per year
Individual Risk	to crew member	10^{-6}	10^{-3}
	to passenger	10^{-6}	10^{-4}
	to third parties, member of public ashore	10^{-6}	10^{-4}
	target values for new ships *)	10^{-6}	Above values to be reduced by one order of magnitude
Societal Risk	to groups of above persons	To be derived by using economic parameters as per MSC 72/16	

Table 1: Quantitative risk evaluation upper and lower bounds

*) While it is recommended that the maximum tolerable criteria for Individual Risk as listed should apply to all ships, it is proposed, in accordance with MSC 72/16, that for comprehensive FSA studies for new ships a more demanding target is appropriate.

5.3.2 It is important to understand, that the above risk acceptance criteria always refer to the total risk to the individual and/or group of persons. Total risk means the sum of all risks that, e.g. a person on board a ship is exposed to. The total risk therefore would contain risks from hazards such as fire, collision, etc. There is no criterion available to determine the acceptability of specific hazards. Therefore, the above criteria can be used to assess the acceptability of the total risk on being, e.g. on a passenger ship, but not for assessing the specific risk of dying on a passenger ship due to a fire.

APPENDIX 6

ATTRIBUTES OF RISK CONTROL MEASURES

1 CATEGORY A ATTRIBUTES

1.1 *Preventive risk control* is where the risk control measure reduces the probability of the event.

1.2 *Mitigating risk control* is where the risk control measure reduces the severity of the outcome of the event or subsequent events, should they occur.

2 CATEGORY B ATTRIBUTES

2.1 *Engineering risk control* involves including safety features (either built in or added on) within a design. Such safety features are safety critical when the absence of the safety feature would result in an unacceptable level of risk.

2.2 *Inherent risk control* is where at the highest conceptual level in the design process, choices are made that restrict the level of potential risk.

2.3 *Procedural risk control* is where the operators are relied upon to control the risk by behaving in accordance with defined procedures.

3 CATEGORY C ATTRIBUTES

3.1 *Diverse risk control* is where the control is distributed in different ways across aspects of the system, whereas concentrated risk control is where the risk control is similar across aspects of the system.

3.2 *Redundant risk control* is where the risk control is robust to failure of risk control, whereas **single risk control** is where the risk control is vulnerable to failure of risk control.

3.3 *Passive risk control* is where there is no action required to deliver the risk control measure, whereas *active risk control* is where the risk control is provided by the action of safety equipment or operators.

3.4 *Independent risk control* is where the risk control measure has no influence on other elements.

3.5 *Dependent risk control* is where one risk control measure can influence another element of the risk contribution tree.

3.6 *Involved human factors* is where human action is required to control the risk but where failure of the human action will not in itself cause an accident or allow an accident sequence to progress.

3.7 *Critical human factors* is where human action is vital to control the risk either where failure of the human action will directly cause an accident or will allow an accident sequence to progress. Where a *critical human factor* attribute is assigned, the human action (or critical task) should be clearly defined in the risk control measure.

3.8 *Auditable* or *Not Auditable* reflects whether the risk control measure can be audited or not.

3.9 *Quantitative* or *Qualitative* reflects whether the risk control measure has been based on a quantitative or qualitative assessment of risk.

3.10 *Established* or *Novel* reflects whether the risk control measure is an extension to existing marine technology or operations, whereas novel is where the measure is new. Different grades are possible, for example the measure may be novel to shipping but established in other industries or it is novel to both shipping and other industries.

3.11 *Developed* or *Non-developed* reflects whether the technology underlying the risk control measure is developed both in its technical effectiveness and its basic cost. Non-developed is either where the technology is not developed but it can be reasonably expected to develop, or its basic cost can be expected to reduce in a given timescale. The purpose of considering this attribute is to attempt to anticipate development and produce forward looking measures and options.

APPENDIX 7

EXAMPLES OF CALCULATION OF INDICES FOR COST-EFFECTIVENESS

1 Indices for cost-effectiveness on safety

1.1 Introduction

The purpose of this appendix is to suggest a set of cost-effectiveness criteria, which may be used in FSA studies. The use of these cost-effectiveness criteria would enable the FSA studies to be conducted in a more consistent manner, making results and the way they were achieved better comparable and understandable. This appendix provides clarification on available criteria to assess the cost-effectiveness of risk control options so-called cost-effectiveness criteria. It is also recommended how these criteria should be applied.

1.2 *Terminology*

1.2.1 *DALY (Disability Adjusted Life Years)/QALY (Quality Adjusted Life Years)*: The basic idea of a QALY is one year of perfect health-life expectancy to be worth 1, but regards one year of less than perfect health-life expectancy as less than 1. Unlike QALY, the DALY assigns that one year of perfect health-life to be 0 and one year of less than perfect as more than 0.

1.2.2 *LQI (Life Quality Index)*: The index for expressing the social, health, environment and economic dimensions of the quality of life at working conditions. The LQI can be used to comment on key issues that affect people and contribute to the public debate about how to improve the quality of life in our communities.

1.2.3 *GCAF (Gross Cost of Averting a Fatality)*: A cost-effectiveness measure in terms of ratio of marginal (additional) cost of the risk control option to the reduction in risk to personnel in terms of the fatalities averted; i.e.

$$GCAF = \frac{\Delta Cost}{\Delta Risk}$$

1.2.4 *NCAF (Net Cost of Averting a Fatality)*: A cost-effectiveness measure in terms of ratio of marginal (additional) cost, accounting for the economic benefits of the risk control option to the reduction in risk to personnel in terms of the fatalities averted, i.e.

$$NCAF = \frac{\Delta Cost - \Delta EconomicBenefit}{\Delta Risk} = GCAF - \frac{\Delta EconomicBenefit}{\Delta Risk}$$

1.3 *NCAF and GCAF*

1.3.1 The common criteria used for estimating the cost-effectiveness of risk reduction measures are NCAF and GCAF. In principle there are several approaches to derive NCAF and GCAF criteria:

.1 Observation of the Willingness-To-Pay to avert a fatality;

.2 Observation of past decisions and the costs involved with them; and

.3 Consideration of societal indicators such as the Life Quality Index (LQI).

For further detail, reference is made to Nathwani et al., Rackwitz (2002).

1.3.2 The proposed values for NCAF and GCAF in table 2 were derived by considering societal indicators (refer to document MSC 72/16, UNDP 1990, Lind 1996). They are provided for illustrative purposes only. The specific values selected as appropriate and used in an FSA study should be explicitly defined. These criteria given in table 2 are not static, but should be updated every year according to the average risk free rate of return (approximately 5%) or by use of the formula based on LQI (Nathwani et al. (1996), Skjong and Ronold (1998, 2002), Rackwitz (2002 a,b).

	NCAF [US $]	GCAF [US $]
criterion covering risk of fatality, injuries and ill health	3 million	3 million
criterion covering only risk of fatality *)	1.5 million	1.5 million
criterion covering only risk of injuries and ill health *) **)	1.5 million	1.5 million

Table 2: Cost Effectiveness Criteria

*) NCAF and GCAF criteria are normally used covering not only fatalities from accidents, but implicitly also injuries and/or ill health from them. This is an adequate approach, because, as was mentioned above, many accidents involve both consequence categories: fatalities and injuries/ill health.

However, if accidents are analysed that involve only one of the two categories, the criteria should be adjusted to cover explicitly only the category relevant to the accident under consideration. In MSC 72/16 a proposal was made, that the NCAF and GCAF criteria are split equally for the two consequence categories.

**) refer also to QALY approach

1.3.3 It is recommended that the following approach is applied in using GCAF and NCAF criteria:

.1 GCAF or NCAF:

In principle, either of the two criteria can be used. However, it is recommended to firstly consider GCAF instead of NCAF. The reason is that NCAF also takes into account economic benefits from the RCOs under consideration. This may be misused in some cases for pushing certain RCOs, by considering more economic benefits on preferred RCOs than on other RCOs.

If the cost-effectiveness of an RCO is in the range of criterion, then NCAF may be also considered.

.2 Negative NCAF:

Recent FSA studies have come up with some risk control options (RCO) where the associated NCAF was negative. Assuming that the RCO has a positive risk reduction potential ΔR (i.e. reduces the risk), a negative NCAF means that the benefits in monetary units are higher than the costs associated with the RCO. It should be noted that a high negative NCAF with positive ΔR may result from either of the following two facts:

.1 the benefits are much higher than the costs associated with the RCO; or

.2 the RCO has a low risk reduction potential ΔR (the lower ΔR, the higher is the NCAF, refer to formula (2)).

1.3.4 Therefore, RCOs with high negative NCAFs should always be considered in connection with the associated risk reduction capability.

QALY and/or DALY

1.3.5 The QALY or DALY criterion can be used for risks that only involve injuries and/or ill health, but no fatalities. It can be derived from the GCAF criterion, by assuming that one prevented fatality implies 35 Quality Adjusted Life Years gained (refer to document MSC 72/16):

QALY = GCAF (covering injuries/ill health) / 35 = US$42,000.

2 Environmental risk evaluation criteria on prevention of oil spill from ships

2.1 Noting that the most appropriate conversion formula to use will depend on the specific scope of each FSA to be performed, a general approach to be followed is outlined in the following suggested examples.

Cost for compensating oil spills

2.2 Consolidated oil spill database based on IOPCF data; US Data; and Norwegian data.

2.3 Figure 1 shows the data of the consolidated oil spill database in terms of specific costs per tonne spilled (figure 5 of document MEPC 62/INF.24). Further information with respect to the basis of the database can be found in document MEPC 62/INF.24. It should be acknowledged that the consolidated oil spill database has limitations and possible deficiencies. These are described in document MEPC 62/INF.24 and may also involve incomplete or missing data on costs or other information.

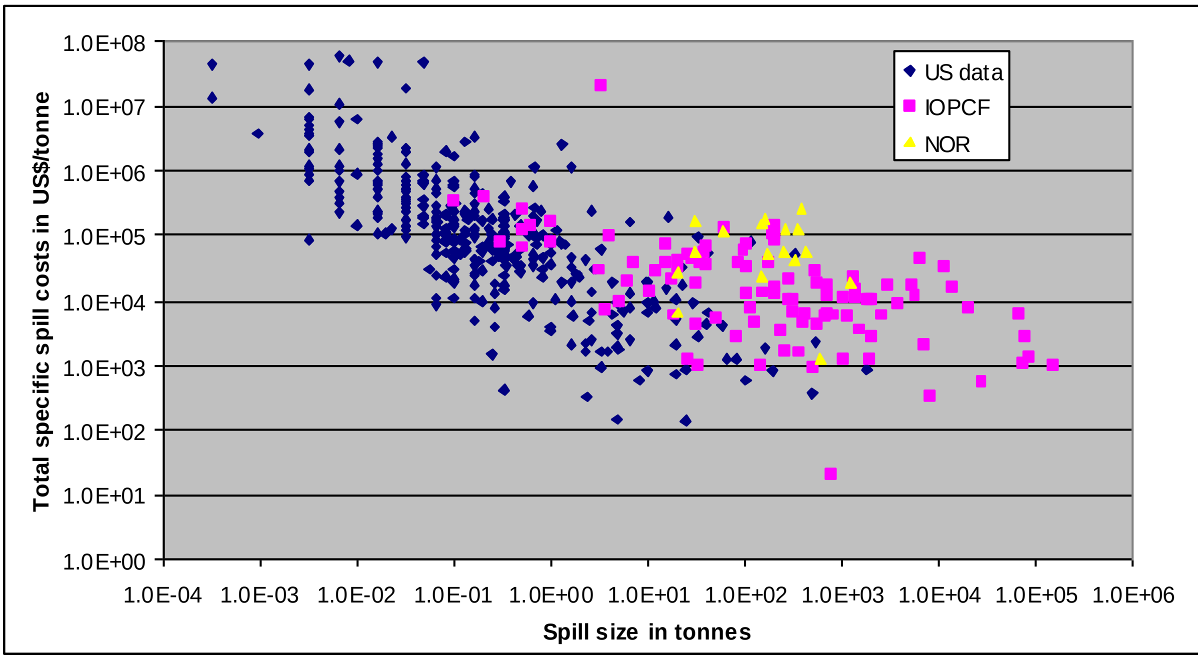


Figure 1: All specific oil spill cost data in 2009 USD (spill cost per tonne)
Source: document MEPC 62/INF.24

2.4 The submitter of the FSA can amend this database with new oil spill data, however, this amendment should be properly documented.

2.5 Some regression formulae derived from the consolidated oil spill database are summarized in table 1 in which V is spill size in tonnes.

Table 1: Regression formulae derived from the consolidated database

Dataset	f(V)=Total Spill Cost (TSC) (2009 US dollars)	Reference
All spills	$67{,}275\ V^{0.5893}$	MEPC 62/INF.24
V>0.1 tonnes	$42{,}301\ V^{0.7233}$	MEPC 62/18[1]

2.6 FSA analysts are free to use other conversion formulae, so long as these are well documented by the data. For example, if an FSA is considering only small spills, the submitter may filter the data and perform his or her own regression analysis.

2.7 It is recommended that the FSA analyst use the following formula to estimate the societal oil spill costs (SC) used in the analysis:

$$SC(V) = F_{Assurance} * F_{Uncertainty} * f(V)$$

This equation considers:

.1 Assurance factor ($F_{Assurance}$): allowing for society's willingness to pay to avert accidents;

.2 Uncertainty factor ($F_{Uncertainty}$): allowing for uncertainties in the cost information from occurred spill accidents; and

.3 Volume-dependent total cost function (*f(V)*): representing the fact that the cost per unit oil spilled decreases with the spill size in US$ per tonne oil spilled.

2.8 The values of both assurance and uncertainty factors should be well documented. In addition, if value of $F_{Assurance}$ and $F_{Uncertainty}$ other than 1.0 are used, a cost-effective analysis using $F_{Assurance}$= 1.0 and $F_{Uncertainty}$ = 1.0 should be included in the FSA results, for reference.

2.9 In order to consider the large scatter, the FSA analyst may perform a regression to determine a function *f(V)* that covers a percentile different than 50% and document it in the report.

Application in RCO evaluation

2.10 The FSA analyst should perform a cost-benefit and cost-effectiveness evaluation of the RCOs identified and provide all relevant details in the report, as outlined below.

[1] Updated regression made on the final consolidated dataset.

RCOs affecting oil spills only

2.11 In case an RCO affects oil spills only:

RCO is cost-effective if ΔC < ΔSC

ΔC = Expected cost of the RCO

ΔSC = (Expected SC **without** the RCO) – (Expected SC **with** the RCO) = Expected benefit of the RCO

RCOs affecting both safety and environment

2.12 In case of RCOs addressing both safety and environment the following formula is recommended:

NCAF = (ΔC – ΔSC) / ΔPLL

In the above,

ΔC = Expected cost of the RCO

ΔSC = (Expected SC **without** the RCO) – (Expected SC **with** the RCO) = Expected benefit of the RCO

ΔPLL = Expected reduction of fatalities due to the RCO

2.13 The criteria for NCAF are as per table 2 of appendix 7 of document MSC 83/INF.2.

2.14 In case there is an economic benefit (ΔB), ΔC should be replaced by ΔC-ΔB.

2.15 It is also emphasized that all cost and benefit components of the cost-benefit or cost-effectiveness inequality should be shown in an FSA study for better transparency.

Other indices

2.16 The user is free to develop new approaches, taking into account the objectives of the FSA.

APPENDIX 8

STANDARD FORMAT FOR REPORTING AN APPLICATION OF FSA TO IMO

1 This standard format is intended to facilitate the compilation of the results of applications according to these guidelines and the consistent presentation of those results to IMO.

2 Interested parties having carried out an FSA application should provide the most significant results in a clear and concise manner, which can also be understood by other parties not having the same experience in the application of risk assessment techniques.

3 The report of an FSA application should contain an executive summary and the following sections: definition of the problem, background information, method of work, description of the results achieved in each step and final recommendations arising from the FSA study.

4 The level of detail of the report depends on the problem under consideration. In order for users and reviewers to understand the results of FSA, the results of the FSA should be reported by:

.1 a summary report of limited length (i.e. maximum 20 pages);

.2 a full report that includes a detailed presentation and an explanation; and

.3 if necessary, background data on an Internet site which is accessible by reviewers of the Organization.

5 Those submitting the results of the FSA application should provide the other interested parties with timely and open access to relevant supporting documentation and sources of information or data which are referred to in the above-mentioned report, as reflected in paragraph 9.2.1 of the FSA Guidelines.

6 The following section presents the standard format of FSA application reports. The subjects expected to be presented in each section of the report are listed in italic characters and reference is made, in brackets, to the relevant paragraph(s) of the FSA Guidelines.

STANDARD REPORTING FORMAT

1 TITLE OF THE APPLICATION OF FSA

2 SUMMARY (maximum 1/2 page)

2.1 Executive summary: scope of the application and reference to the paragraph defining the problem assessed and its boundaries.

2.2 Actions to be taken: type of action requested (e.g. for information or review) and summary of the final recommendations listed in section 7.

2.3 Related documents: reference to any supporting documentation.

3 DEFINITION OF THE PROBLEM (maximum 1 page)
(refer to paragraphs 4.1 and 4.2 of these guidelines)

3.1 Definition of the problem to be assessed in relation to the proposal under consideration by the decision-makers.

3.2 Reference to the regulation(s) affected by the proposal to be reviewed or developed (in an annex).

3.3 Definition of the generic model (e.g. functions, features, characteristics or attributes which are relevant to the problem under consideration, common to all ships of the type affected by the proposal).

4 BACKGROUND INFORMATION (maximum 3 pages)
(refer to paragraph 3.2 of these guidelines)

4.1 Lessons learned from recently introduced measures to address similar problems.

4.2 Casualty statistics concerning the problem under consideration (e.g. ship types or accident category) including data analysis (i.e. time dependence, ship size influence, variability assessment, hypothesis testing, etc.).

4.3 Any other sources of data and relevant limitations.

5 METHOD OF WORK (maximum 3 pages)
(refer to paragraph 3.1.1.2 of these guidelines)

5.1 Composition and expertise of those having performed each step of the FSA process by providing e.g. name and expertise of the experts involved in the application and name and contact point (email address, telephone number and mailing address) of the coordinator of the FSA.

5.2 Description of how the assessment has been conducted in terms of organization of working groups and, method of decision-making in the group(s) that performed each step of the FSA process.

5.3 Start and finish date of the assessment.

6 DESCRIPTION OF THE RESULTS ACHIEVED IN EACH STEP (max. 10 pages)

For each step, describe:

.1 method and techniques used to carry out the assessment;

.2 assumptions, limitations or uncertainties and the basis for them; and

.3 outcomes of each step of the FSA methodology, including:

STEP 1 – HAZARD IDENTIFICATION:
(refer to paragraph 5.3 of these guidelines)

- prioritized list of hazards and description of their associated scenarios
- identified significant accident scenarios including causes and initiating events in line with the scope of the FSA

STEP 2 – RISK ANALYSIS:
(refer to paragraph 6.3 of these guidelines)

- types of risk (e.g. individual, societal, environmental, business)
- presentation of the distribution of risks depending on the problem under consideration
- identified significant risks
- principal influences that affect the risks
- sources of accident and reliability statistics

STEP 3 – RISK CONTROL OPTIONS:
(refer to paragraph 7.3 of these guidelines)

- what hazards are covered by current regulations
- identified risk control options
- assessment of the control options as a function of their effectiveness against risk reduction

STEP 4 – COST-BENEFIT ASSESSMENT:
(refer to paragraph 8.3 of these guidelines)

- identified types of cost and benefits involved for each risk control option
- cost-benefit assessment for the entities which are influenced by each option
- identification of the cost-effectiveness expressed in terms of cost per unit risk reduction

STEP 5 – RECOMMENDATIONS FOR DECISION-MAKING:
(refer to paragraph 9.3 of these guidelines)

- objective comparison of alternative options
- discussion on how recommendations could be implemented by decision-makers

7 FINAL RECOMMENDATIONS FOR DECISION-MAKING (maximum 2 1/2 pages)

List of final recommendations, ranked and justified in an auditable and traceable manner
(refer to paragraph 9.3 of these guidelines)

ANNEXES (as necessary)

.1 explanation of the background of each expert (e.g. a short curriculum vitae) and the basis of selection of the experts;

.2 list of references;

.3 sources of data;

.4 accident statistics;

.5 technical support material; and

.6 any further information.

APPENDIX 9

DEGREE OF AGREEMENT BETWEEN EXPERTS CONCORDANCE MATRIX

1 Experts are sometimes used to rank risks associated with accident scenarios, or to rank the frequency or severity of hazards. One example is the ranking that takes place at the end of FSA Step 1 – Hazard Identification. This is a subjective ranking, where each expert may develop a ranked list of accident scenarios, starting with the most severe. To enhance the transparency in the result, the resulting ranking should be accompanied by a concordance coefficient, indicating the level of agreement between the experts.

Calculation of concordance coefficient

2 Assume that a number of experts (J experts in total) have been tasked to rank a number of accident scenarios (I scenarios), using the natural numbers (1, 2, 3, .. , I). Expert "j" has thereby assigned rank x_{ij} to scenario "I". The concordance coefficient "W" may then be calculated by the following formula:

$$W = \frac{12 \sum_{i=1}^{i=I} \left[\sum_{j=1}^{j=J} x_{ij} - \frac{1}{2} J(I+1) \right]^2}{J^2 \left(I^3 - I \right)}$$

3 The coefficient W varies from 0 to 1. W=0 indicates that there is no agreement between the experts as to how the scenarios are ranked. W=1 means that all experts rank scenarios equally by the given attribute.

Examples

4 The following three tables are examples. In each example there are 6 experts (J=6) that are ranking 10 scenarios (I=10). In order to show the role of the concordance coefficient, the final combination by $\sum x_{ij}$ constructed by the importance of hazards 1- 10 for all three groups. From tables 1 to 3 it is quite evident how various degrees of concordance have been formed.

5 Assessment of significance of the concordance coefficient is determined by parameter Z:

$$Z = \frac{1}{2} \ln \frac{(J-1)W}{1-W}$$

which has the Fischer distribution with degrees of freedom $\nu_1 = I - 1 - \frac{2}{J}$ and $\nu_2 = (J-1)\nu_1$. If I > 7 Pearson's criteria χ^2 may be used. The value of $J(I-1)W$ has a χ^2-distribution with $\nu = I - 1$ degrees of freedom.

Table 1: Group of experts with high degree of agreement

Experts \ Hazards	1*	2	3	4	5	6	7	8	9	10
1	1	3	4	2	5	6	8	10	7	9
2	2	3	1	5	4	6	7	8	9	10
3	1	2	3	4	5	6	7	8	9	10
4	2	1	4	3	6	5	7	8	10	9
5	2	3	1	4	5	6	8	10	9	7
6	1	2	4	3	5	7	6	8	9	10
$\sum x_{ij}$	9	14	17	21	30	36	43	52	53	55

* Numbers correspond to the initial list of hazards.

Calculations based on Table 1 result in W = 0,909; $\chi^2 = J(I-1)W = 47{,}5$; confidence level of probability $\alpha = 0{,}999$.

Table 2 Group of experts with medium degree of agreement

Experts \ Hazards	1	2	3	4	5	6	7	8	9	10
1	1	6	8	4	2	3	5	7	9	10
2	2	3	1	5	6	4	7	8	10	9
3	3	4	1	2	5	8	9	10	6	7
4	4	5	6	1	8	2	3	10	7	9
5	4	3	1	9	2	5	7	10	6	8
6	5	1	7	4	3	9	8	2	10	6
$\sum x_{ij}$	19	23	24	25	26	31	39	47	48	49

Calculations based on the ranking in Table 2 result in W = 0,413; $\chi^2 = 25{,}4$; $\alpha = 0{,}995$, where α is the confidence level of probability.

Table 3 Group of experts with low degree of agreement

Experts \ Hazards	1	2	3	4	5	6	7	8	9	10
1	5	9	3	8	2	1	7	10	6	4
2	1	5	7	4	8	9	3	6	2	10
3	6	2	8	3	9	10	4	1	5	7
4	1	4	3	2	7	5	9	6	10	8
5	6	1	3	5	2	8	4	9	7	10
6	3	7	5	8	4	2	10	6	9	1
$\sum x_{ij}$	22	28	29	30	32	35	37	38	39	40

Calculations based on the ranking in Table 3 result in W = 0,102; $\chi^2 = 5{,}4$; $\alpha = 0{,}20$.

6 The level of agreement is characterized in table 4:

Table 4: Concordance coefficients		
W	> 0.7	Good agreement
W	0.5 – 0.7	Medium agreement
W	< 0.5	Poor agreement

Other use

7 The method described can be used in all cases where a group of experts are asked to rank object according to one attribute using the natural numbers [1,I].

8 Generalizations of the method may be used when experts assign values to parameters, when pair comparison methods are used, etc. David (1969), Kendall (1970). An FSA application is published by Paliy et al. (2000).

References for further reading

1 David, H.A. *The method of Paired Comparisons*. Griffin and Co, London, 1969.

2 Kendall, M. *Rank Correlation Methods*. Griffin and Co, London, 1970.

3 Paliy, O., E. Litonov, V.I. Evenko. *Formal Safety Assessment for Marine Drilling Platforms*. Proceedings Ice Tech' 2000, Saint Petersburg, 2000.

APPENDIX 10

GUIDANCE FOR PRACTICAL APPLICATION AND REVIEW PROCESS OF FSA

Introduction

1 The guidance provides information on the following subjects:

.1 project management issues to be considered for an FSA study;

.2 application of FSA by a Member State or an organization having a consultative status with the IMO (hereinafter called Member), when proposing amendments to maritime safety and pollution prevention instruments, to support or analyse the implications of such proposals;

.3 application of FSA by a Committee or instructed subsidiary body, to provide a balanced view of a framework of regulations, so as to identify priorities and areas of concern, and to analyse the benefits and implications of proposed changes;

.4 consideration of the expertise for the team carrying out an FSA study and qualifications for those experts; and

.5 review of an FSA study.

2 Recommendations resulting from an FSA study should aim to be used by decision makers at all levels and in a variety of contexts at the IMO, without a requirement of specialist expertise. For this purpose, an FSA study should be open and transparent for review by all interested Member States and non-governmental organizations which have not participated in the conduct of the FSA study.

3 FSA studies submitted to the Organization in accordance with the *Guidelines for formal safety assessment (FSA), for use in IMO rule-making process* for consideration, when introducing or amending IMO instruments should be considered as one source but not the only source of valuable information to support IMO decision-making.

Practice/Conduct of FSA Study

Project management

4 Any activity that uses resources to transform inputs to outputs can be considered a process, and this definition also fits FSA. Quality management in FSA can be applied by identifying each FSA step as a sub-process involving a number of interrelated activities, and by establishing means to facilitate, monitor and control these activities to achieve the desired objectives.

5 In principle, critical issues, controls and controlling measurements to monitor the quality of the process should be defined for each FSA step. Moreover, several issues should be identified up front, before the study initiation and periodically reviewed during the study:

.1 basic reasons to undertake the study;

.2 responsibilities and skills of the team in the various stages of the study;

.3 clear authority chart;

.4 extent of the coverage of the study (in particular, how many of the FSA steps are required, which tools are expected to be used);

.5 a project plan including the time scale of the study;

.6 potentially critical areas and key measures of quality assurance; and

.7 risk evaluation criteria.

Application of FSA by a Member

6 A Member State or an organization having a consultative status with IMO, or a pool of Members, may decide to carry out an FSA and submit its results for consideration by a Committee or instructed subsidiary body. The scope of the FSA definition of the problem and its boundaries should be decided by the Member(s) conducting the study, in the context of the submitted proposal. The costs involved in carrying out the study should be covered by the Member(s) conducting the study, who will also coordinate and keep responsibility for the work of subcontractors, if any.

7 The Member(s) carrying out the FSA study should make its/their best efforts to ensure that the report is presented in accordance with the Standard Format for Reporting FSA Applications, given in appendix 8 of the FSA Guidelines. It is important that the FSA report includes the names and credentials of the experts who have carried out or have been involved in the FSA.

Application of FSA by a Committee or an instructed sub-committee

8 The Committee may decide to carry out an FSA study following:

.1 a proposal by a Member;

.2 a proposal from a subsidiary body; or

.3 discussion in the Committee of an agenda item.

9 There are different options which may be followed by the Committee for undertaking the FSA study. In some circumstances, for instance when a proposal has far reaching implications and requires a balanced view between all relevant issues, the Committee may decide that the FSA study should be carried out by an instructed sub-committee, as described in paragraphs 15 to 24 below.

10 Further options for undertaking an FSA study may also be appropriate, one of which could be to invite a Member, or a pool of Members, to carry out the FSA study and report its results for consideration by the Committee. The Member(s) accepting this proposal could proceed according to the steps given in paragraphs 4 to 9 above.

11 In cases where the Committee decides that the study should be carried out by instructed sub-committee(s), the FSA study may be conducted in accordance with the flow chart shown in figure 1, as described below.

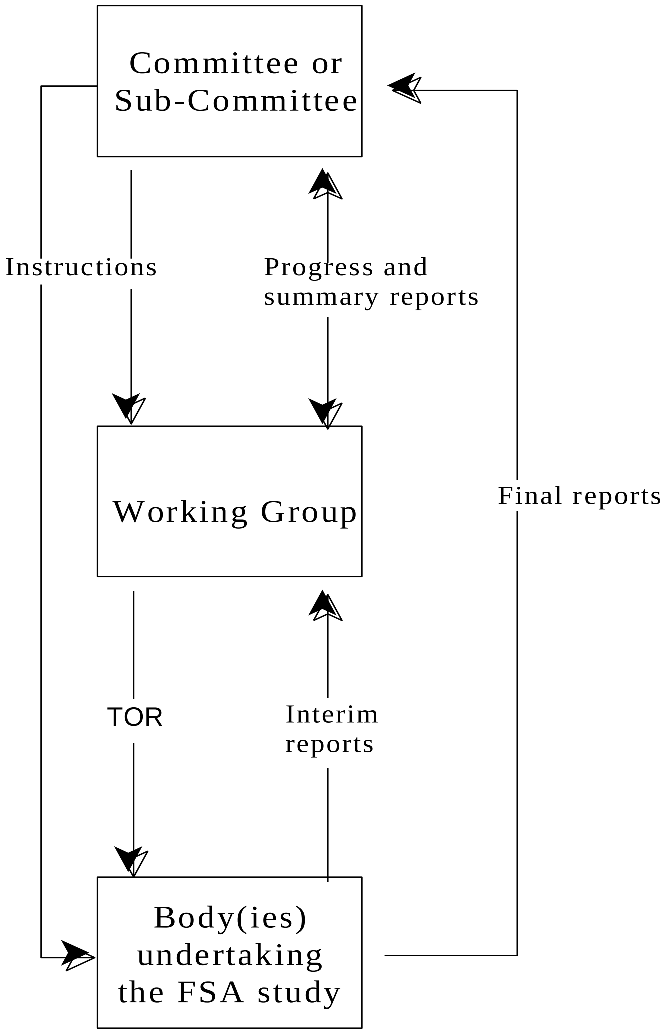


Figure 1

12 The Committee may decide to establish a working group, instructed to:

.1 develop the terms of reference for undertaking FSA;

.2 propose a list of required competencies;

.3 develop and execute a project management plan;

.4 coordinate the conduct of FSA;

.5 validate FSA, when necessary; and

.6 report the results of FSA to the Committee, for information and approval.

13 The terms of reference of FSA may include, inter alia:

.1 the definition of the problem under consideration and its boundaries (chapter 4 of these guidelines);

.2 characterization of the problem under consideration, for example in terms or features, characteristics and attributes which are relevant to the problem concerned (section 4.2 of the guidelines);

.3 the organization and tasks proposed for carrying out the five steps of the FSA process, including instructions to the relevant subsidiary bodies; and

.4 the list of competencies required for carrying out each step of FSA.

14 The Committee should examine the draft terms of reference developed by the working group, including in particular the necessary competencies, for approval. On the basis of the approved terms of reference, the Committee will:

.1 instruct the sub-committee(s) to undertake FSA (for instance a sub-committee or several sub-committees);

.2 endorse the list of competencies for carrying out each step of FSA; and

.3 invite Members willing to participate in the conduct of the FSA study to provide persons with the required competencies.

15 Members interested in participating in FSA should provide the Committee with a list of persons proposed to participate in the sub-committees instructed to carry out the FSA study, together with details of their relevant competencies. The working group should determine that such a list, when completed, covers the competencies deemed necessary for carrying out each step of the FSA study, and report to the Committee to decide as appropriate.

16 Each instructed subsidiary body should carry out the parts of the FSA study assigned to them. Any progress reports that the Committee may require, and, on completion of the FSA study, the final report should be submitted to the Committee. This final report should be in accordance with the Standard Reporting Format, given in annex 2 of the FSA Guidelines.

17 Interim reports may be submitted to the working group for the purposes of providing inputs to other parts of the process and enabling the working group to facilitate and monitor progress according to the project plan. The working group should review these reports and inform the Committee whether the FSA study proceeds in accordance with the approved project management plan. The working group should also propose necessary corrective actions, if any.

18 In addition to the final report submitted to the Committee by the sub-committees undertaking the FSA study, the working group should, at the completion of the FSA study, present to the Committee a summary report, which may include, inter alia:

.1 an evaluation that the methodology applied is in accordance with the interim guidelines;

.2 any proposals for improvement of the interim guidelines;

.3 deviations, if any, from the terms of reference approved by the Committee, and reasons therefor; and

.4 a list of recommendations resulting from the FSA study for a decision by the Committee.

19 The Committee should receive the recommendations made by the working group and decide as appropriate.

Participation of experts in an FSA study

20 The participation of experts in the various fields is an essential part for the success of an FSA application. The team carrying out the FSA study should be selected in accordance with the area of interest of the study and related problems. A number of other experts should be involved to gather expert views and judgements throughout the five steps of the FSA process.

21 The team carrying out an FSA study should cover the fields of expertise necessary to progress within the five steps of the FSA process. The composition of the team depends on the type of problem and level of detail of the assessment. For instance, the team might include:

.1 experts in risk assessment techniques;

.2 experts in statistical data gathering and analysing;

.3 experts involved in casualty investigations;

.4 experts in the human element;

.5 experts in the applicable rules and regulations;

.6 experts from the technical, operational and organizational field, (e.g. designers, builders and operators);

.7 experts in consequence assessment (e.g. SAR, salvage and environment protection); and

.8 experts in cost-benefit assessment.

22 The team carrying out an FSA study may involve other experts in order to provide additional expert views, technical evaluations and/or judgements. All the experts involved in FSA study should have, as far as possible, a basic knowledge and understanding of the FSA methodology, as set out in the FSA Guidelines.

23 The experts to be involved should cover the widest possible range of knowledge, qualifications and competence relevant to the problem under consideration, including, for instance:

.1 organizational and managerial aspects, e.g. pertinent to shipping companies;

.2 technical aspects, e.g. design, construction, operation and maintenance;

.3 legal, finance and insurance matters; and

.4 matters of concern to flag Administrations and port State controls.

24 The names and expertise of the members of the team carrying out an FSA study and other experts involved should be included in an annex to the report containing the results of the study.

25 Other experts in various fields may be involved when reviewing and discussing the results of the FSA study.

Review of FSA study

Review process

26 The Committee or an instructed subsidiary body should consider the submission of an FSA study and decide, on a case-by-case basis, the most appropriate course of action. When the subject is sufficiently clear, the Committee can form an opinion about the FSA study and its relevant proposals, and decide accordingly. In other circumstances, the Committee may decide that a review is necessary to validate the FSA study and its findings.

27 The review process should be carried out within the Organization, by a group of experts established by the Committee for that purpose following the flow chart shown in figure 2 below.

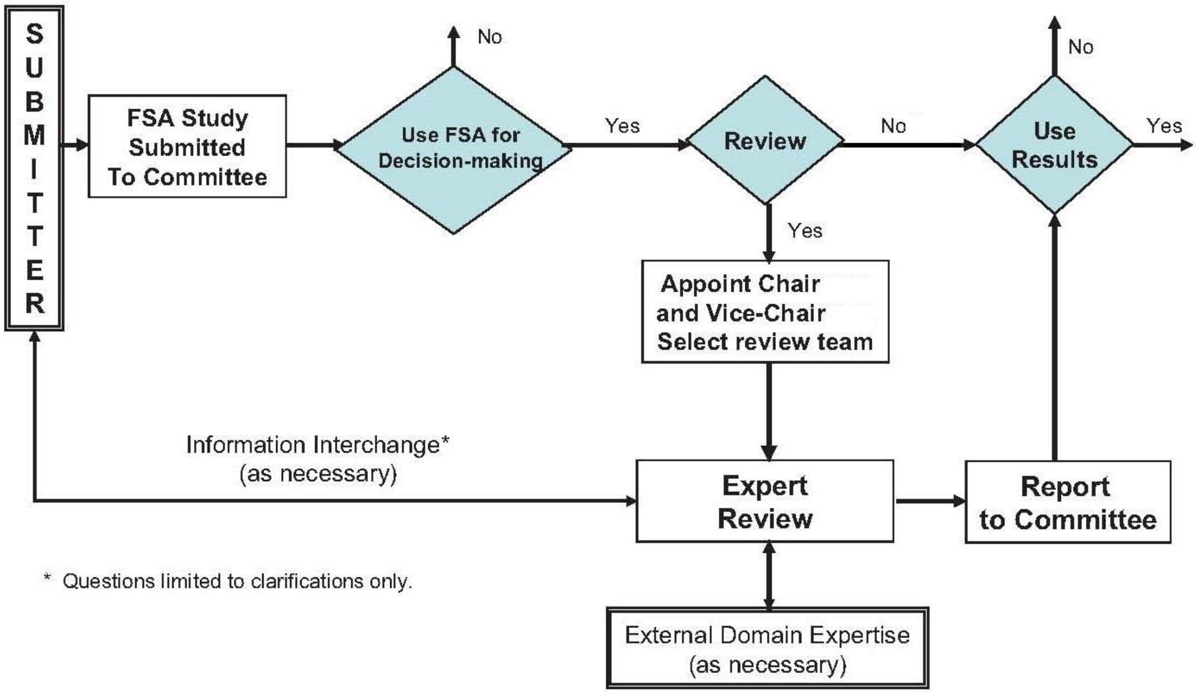


Figure 2

Flow chart for FSA review process

Terms of reference of the Experts Group

28 The terms of reference of such a review should be established by the Committee, based on the matter under consideration. The terms of reference should be to review the FSA studies submitted, in particular to:

.1 check:

.1 the adequacy of scope of the FSA; and definition of the problem;

.2 the validity of the input data (transparency, comprehensiveness, availability, etc.);

.3 the adequacy of expertise of participants in the FSA; identified hazards and their ranking; and the reasonableness of assumptions; and

.4 the adequacy of accident scenarios, risk models and calculated risks; identified RCMs and RCOs; selection of RCOs for Cost-Benefit Analysis (CBA); and CBA results;

.2 check methodologies used and relevance of methods and tools for:

.1 decision in the group(s) in the FSA;

.2 HAZID;

.3 Calculation of risk;

.4 Cost-Benefit Analysis (CBA); and

.5 Sensitivity and uncertainty analysis;

.3 if any deficiency was identified in the items above, consider whether they affect the results;

.4 consider whether the FSA was conducted in accordance with the guidelines;

.5 check whether the recommendations in the FSA ask to take any immediate action or propose any changes to IMO instruments;

.6 consider whether the results and the recommendations in the FSA are credible and advise the decision makers (e.g. Committees of the Organization) accordingly; and

.7 consider whether it is necessary to improve the FSA Guidelines, and, if so, the proposal for the improvement.

Establishment of, and report from, the Experts Group

29 When the Committee decides to establish a group of experts for a specific project, it should determine the number of meetings necessary to meet the target completion date.

30 The Members, having carried out the FSA study, should provide timely and open access to relevant supporting documents, and any reasonable opportunity to take into consideration the comments received.

31 The results of the review by the group of experts should be presented to the Committee or instructed subsidiary body, as appropriate. The group of experts should, as a goal, try to reach consensus on its conclusions for the review of the FSA study, but where there are strong conflicting views, these should be indicated in the report.

Structure of the Experts Group

32 Participation in a group of experts will be voluntary and is open to all Member States and international organizations.

33 A Chairman and a Vice-Chairman should be selected by the Committee when it decides an FSA study should be reviewed by a group of experts.

34 When nominating experts, Member States and international organizations should nominate experts who have suitable qualifications in the field of formal safety assessment, as described in paragraph 37, and inform the Organization of particulars of the expert (e.g. name, expertise and contact details) with a short CV.

35 Participants in the group of experts should:

.1 have not been involved in the FSA study to be reviewed; and

.2 be capable of acting scientifically independent (i.e. acting in an individual capacity).

36 The review work should be conducted concisely in order to give timely conclusion(s) to the Committee(s) and, in order to do so, the review work can be conducted by holding meetings of the group (without interpretation) as well as by correspondence.

Qualifications of the experts

37 Members participating in a group of experts should, as a minimum, have knowledge/training in the application of the FSA Guidelines, and should have, at least, one of the following qualifications:

.1 risk assessment experience;

.2 a maritime background; or

.3 relevant knowledge or any unique concerns related to the FSA (e.g. human element).

Report of the Experts Group

38 Experts Groups' reports should only include the names of the experts but not of the nominating Member States or organizations.

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Appendix 4 – Annex 1 to the MCA MGN 654 Methodology for Assessing the Marine Navigational Safety, etc. requested at question NS.2.46

Maritime &
Coastguard
Agency

Methodology for Assessing Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREI)

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Published: April 2021

Version History	Date	Government Department
1	December 2005	Department for Trade and Industry
2	September 2013	Department for Energy and Climate Change
3	April 2021	Maritime and Coastguard Agency, Department for Transport

Acknowledgements

In December 2005 the Department of Trade & Industry (DTI), in co-operation with the Department for Transport (DfT) and the Maritime & Coastguard Agency (MCA), produced a document entitled "*Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms".* In September 2013 the Department of Energy and Climate Change (DECC) in co-operation with the MCA, updated this edition to include data gained through operational knowledge since 2005, with Marine Guidance Notes (MGN) produced by the MCA and to enable the risk assessment of all OREI types, including the associated emergency response issues. The title was amended to *Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations".*

This version was produced by MCA in co-operation with those individuals and organisations who contributed useful feedback during the consultation period through the Nautical and Offshore Renewable Energy Liaison (NOREL) group. It is not intended to be published in hard copy, but available online, along with a suite of technical support documents. A revised MGN will direct users to the on-line guidance documentation.

Note: *New guidance and MGNs together with mandatory legislation may be promulgated at any time and developers should consult the MCA website at regular intervals for such revisions or innovations.*

Contents

FIGURES

TABLES

GLOSSARY

AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
BEIS	Department for Business, Energy and Industrial Strategy
BMT	British Maritime Technology
CBA	Cost Benefit Analysis
CEFAS	Centre for Environment, Fisheries and aquaculture Science
CGOC	Coastguard Operations Centre
COLREG	International Regulations for the Prevention of Collisions at Sea 1972, as amended
CPA	Coast protection Act 1949
CURR	Cost per Unit Reduction of Risk
DECC	Department for Energy and Climate Change
DEFRA	Department for Environment, Food & Rural Affairs
DfT	Department for Transport
DTI	Department of Trade and Industry
ER	Emergency Response
ERCoP	Emergency Response Cooperation Plan
ETA	Event Tree Analysis
EU	European Union
FEPA	Food and Environmental Protection Act 1985
FMEA	Failure Modes and Effects Analysis
FSA	Formal Safety Assessment
FTA	Fault Tree Analysis
HAZOP	Hazard and Operability Studies
SFAIRP	So Far As Is Reasonably Practicable
HSE	Health and Safety Executive
IMO	International Maritime Organization
LOHI	Loss of Hull Integrity
MCA	Maritime and Coastguard Agency
MGN	Marine Guidance Note
MSN	Merchant Shipping Notice

OREI	Offshore Renewable Energy Installation
RCM	Risk Control Measure
RCO	Risk Control Option
RNLI	Royal National Lifeboat Institution
R2P2	HSE Document Reducing Risks, Protecting People
SAR	Search and Rescue
SFAIRP	So Far As Is Reasonably Practicable
VTS	Vessel Traffic Service

EXECUTIVE SUMMARY

This revised document has been produced by the Maritime and Coastguard Agency (MCA) with the co-operation of key stakeholders as a methodology for assessing the marine navigational safety & emergency response risks of offshore renewable energy installations. With the exception of the MCA technical guidance, it conforms closely to the original version of December 2005 and subsequent amendment in September 2013. This version was incorporated into MGN 654 as Annex 1. Developers who have produced Navigational Risk Assessments prior to the publication of this document should simply note the new guidance available and refer to it as and when appropriate.

Its purpose is to be used as guidance for developers in preparing their navigation risk and emergency response assessments and includes a suggested template in which they may produce their submission. It is centred around risk controls and the feedback from risk controls into risk assessment. It requires a submission that shows that suitable and appropriate risk controls are, or will be, in place for the assessed risk to be judged as broadly acceptable or tolerable. Although the specifics of this guidance are not mandatory, its use in carrying out marine navigational safety and emergency response risk assessments is strongly recommended. The key features of the Methodology recommend that developers:

1. Produce a submission that is proportionate to the scale of the development and the magnitude of the risks.
2. Produce a submission based on assessing risk by Formal Safety Assessment (FSA) using numerical modelling and/or other techniques and tools of assessment acceptable to Government and capable of producing results that are also acceptable to Government.
3. Estimate the "Base Case" level of risk based on existing densities and types of traffic and the existing marine environment.
4. Predict the "Future Case" level of risk based on the predicted growth in future densities and types of traffic and reasonably foreseeable future changes in the marine environment.
5. Produce a "Hazard Log" listing the hazards caused or changed by the introduction of the OREI, the risk associated with the hazard, the controls put in place and the tolerability of the residual risk.
6. Define the risk controls that will be put in place and create a Risk Control Log.
7. Predict the "Base Case with OREI" level of risk based on existing densities and types of traffic, the existing marine environment and with the OREI in place.
8. Predict the "Future Case with OREI" based on future traffic densities and types, the future marine environment and with the OREI in place.
9. Process this information into a submission including a claim that the risks associated with the OREI are Tolerable on the basis of "As Low As Reasonably Practicable" (ALARP) declarations.

It advises that Government will base their decision on assessing:

1. Whether the tools and techniques used in the assessments are acceptable.
2. Whether the claim in the submission shows that the OREI will meet the sought-after level of marine navigational safety and emergency response.
3. Whether there is sufficient information with the submission to have confidence in the claim.
4. Whether there is sufficient information with the submission to have confidence that appropriate risks controls are, or will be, in place.

1. INTRODUCTION

1.1 Development of the Methodology

The project to develop a methodology for assessing the marine navigational safety risks of offshore wind farms and other types of OREI was originally, in 2005, carried out by the Department of Trade and Industry (DTI) in conjunction with British Maritime Technology (BMT) Renewables Ltd. It has evolved with the close co-operation of developers, the Government, its agencies, and other stakeholders. Extensive consultation and research were carried out to ensure that the methodology is robust, verified, auditable and accountable in a local, national and international context. These features have been confirmed in the intervening years and were expanded in 2013 to cover emergency response issues and the document was revised in consultation with key stakeholders.

1.2 Risk Control

The Methodology is focused on risk controls and in preparing a submission which shows that sufficient risk controls are in place for the assessed risk to be judged as “tolerable”.

The primary duty in law (Health and Safety at Work Act, 1974) is to reduce risk so far as is reasonably practicable (SFAIRP). For most purposes, this is synonymous with it being reduced to as low as reasonably practicable (ALARP) used in the IMO’s Formal Safety Assessment (FSA) guidance, upon which this risk methodology is based. The mere fact that a risk falls into a ‘tolerable’ or ‘broadly acceptable’ band in a Risk Matrix (see Annex C), or is below some numerical limit, does not prove that it has been reduced SFAIRP or to ALARP. Further reduction may still be reasonably practicable, however small the risk.

1.3 Structure

This document is comprised of two parts:

- A recommended Methodology (described in the main text);
- General guidance & suggested techniques (described in the Annexes);

Methodology

Developers are invited to carry out marine navigational safety and emergency response risk assessments in accordance with the spirit of the methodology and the MCA’s Marine Guidance Note (MGN) 654 *Safety of Navigation: Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response* and to submit the results in accordance with the standard format for a submission.

In carrying out these assessments, developers should address the two phases of the OREI’s life concerning construction, and operation and maintenance.
(Note: The assessment of risks during the decommissioning stage are addressed separately through the decommissioning programme.)

Guidance

Guidance to developers in applying the methodology is provided, as annexes illustrating various methods. Although the specific aspects of this guidance are not mandatory, it is strongly recommended that developers carry out risk assessments in the spirit of the detail indicated.

1.4 Key Terminology

The key terminology used in this document is:

Table 1 - Key Terminology

Acceptable Techniques	Techniques that are acceptable to Government in assessing the marine navigational safety and emergency response risks of offshore wind farms and other OREI types.
Acceptable Results	Results from applying the acceptable techniques that are themselves acceptable to Government. ***Note:*** *An "Acceptable Result" is a result where the risk has been accurately assessed. It does not necessarily mean that the risk is acceptable.*
Accident	An unintended event involving fatality or injury, property loss or damage or environmental damage.
Accident Category	A designation of accident reported according to their nature.
Area Traffic Assessment	The part of general navigation risk assessment that assesses the wider sea area, its marine environment, traffic and the OREI development to enable the prediction of the risk of collision, contact, grounding and stranding.
Consequence	The outcome of an accident.
FN Curve	The cumulative frequency (F) of an accident versus the number (N) of fatalities.
Formal Safety Assessment	A rational and systematic process for assessing the risk associated with an activity and for evaluating the costs and benefits of options for reducing these risks. FSA is recommended by the IMO in its rule-making process.
Frequency	The number of occurrences per unit time (e.g. per year).
General Navigation Safety Risk Assessment	The part of the navigation risk assessment relating to collision, contact, grounding and stranding of vessels. Generally, this assessment will be centred on a Hazard Log and other assessment techniques and appropriate tools, which may include numerical modelling and simulation.

Guidance	Guidance on techniques and tools that may be used in applying the Methodology.
Hazard	A potential to threaten human life, health, property of the environment.
Individual Risk	A direct measure of the frequency of injury and fatalities for individuals at a given location e.g. crew members, passengers and third parties.
Initiating Event	The first in a sequence of events leading to a hazardous situation or accident.
Marine Navigational Safety and Emergency Response Risk Assessment	The body of information produced that is used as the basis of the marine navigational safety and emergency response risk assessment carried out for inclusion in the developer's ES comprising: • Formal Safety Assessment (FSA) supported by: • Navigation risk assessment comprising: o General Navigation Safety Risk Assessment and o Other Navigation Safety Risk Assessment • General details of Search and Rescue implications
Methodology	The recommended process, as described in this document, for undertaking and presenting a marine navigational safety and emergency response risk assessment to Government as part of the developer's EIA Report.
Other Navigation Safety Risk Assessment	The part of the navigation risk assessment relating to the wider range of marine safety risks but excluding initial collision, contact, grounding and stranding. This assessment may be centred on a Hazard Log.
Risk	The combination of the frequency of occurrence and the severity of the consequence.
Risk Control Measure	A means of controlling a single element of risk. Usually expressed as either: a. embedded – standard or good practice measures already utilised or in place, or b. additional – in addition to embedded controls for reducing risk to ALARP
Risk Control Option	A grouping of risk control measures into a practical regulatory option.

Societal Risk	An indirect measure of the magnitude of the event taking into account public aversion to large accidents. It is average risk experienced by a group of people exposed to an accident scenario.
Specific Traffic Assessment	The part of the general navigation risk assessment that may be used, where required, to assess in detail the risk of more specific navigation issues and/or the proposed risk controls.

2. USE AND COVERAGE OF THE METHODOLOGY

2.1 Use by Developers

This Methodology has been produced to assist developers in preparing their marine navigation safety and emergency response risk assessments for all types of OREI, and to identify the type and level of information that should be provided by the OREI developer in an application. It includes a template developers may wish to follow in preparing their submission.

Developers are recommended to carry out marine navigation safety and emergency response risk assessments in accordance with the IMO's Formal Safety Assessment methodology and to submit the results in accordance with the standard format for a submission. This is shown in Section 7.

Although this methodology was originally intended for use by OREI developers, the principles can be applied to other developments below Mean High Water Spring, for example, individual structures (e.g. meteorological masts), cables (e.g. telecommunications, interconnectors), aquaculture (e.g. seaweed farms), other energy generating facilities (e.g. biomass, waste, nuclear) and more.

Note: *With respect to operations carried out on wind turbines and other OREI structures, developers are directed towards the various Health & Safety Executive (HSE) guidance and requirements, including Construction, Design and Management (CDM) regulations*[1]*.*

2.2 Coverage of the Methodology – Physical Areas

The key risk areas to be covered by the methodology are:

- Risks associated with a development
- Cumulative risks associated with the development and the other OREI developments in the strategic OREI area
- In-combination effects on the risk of the development with other economic developments over the operational life of the OREI.

2.3 Cumulative Impacts

Consideration of cumulative and in combination effects need to be undertaken, adopting a zonal approach for large developments, which will require a detailed consideration of the 'worst case' scenario. The National Policy Statement for Renewable Energy Infrastructure (EN1) outlines the Government approach to cumulative impacts[2].

2.4 Relationship with the EIA Report

The Navigational Risk Assessment (NRA), produced by applying this Methodology, informs the Shipping and Navigation chapter of the EIA Report required for a development consent decision. The EIA Report should confirm which NRA recommendations are proposed with justification for acceptance or rejection of each. It is recommended to use the same or similar terminology in the

[1] For initial advice see : http://www.hse.gov.uk/risk/fivesteps.htm

[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf

EIA Report and NRA to ensure there is a clear understanding on the proposals at the application stage.

The marine navigational safety and emergency response risk aspects of the Navigational Risk Assessment are largely based on the Maritime and Coastguard Agency's Marine Guidance Note 654 (M+F), or subsequent updates. This MGN provides guidance on the technical navigation and Search and Rescue (SAR) issues needed to be considered for all stages of development, not just pre-consent to which this methodology applies.

3. SCOPE AND DEPTH OF ASSESSMENT

3.1 Proportionality

The scope and depth of the developer's assessment, together with the tools and techniques necessary to carry this out, should be proportionate to the scale of the development and magnitude of the risks. Developers are advised, prior to developing a submission to:

- Inform the MCA of their proposals and seek guidance
- Carry out a preliminary hazard analysis
- Define an appropriate programme of work
- Define the tools and techniques to be used
- Be prepared to change scope, depth, tools and techniques resulting from assessed risk as the full assessment progresses.

The MCA will consider each assessment on a case by case basis and will be prepared in principle to accept a change in scope, depth, tools and techniques resulting from the assessed risk as the full assessment progresses.

3.2 Examples of Proportionality

High Risk or Large-Scale Development

A development in an area where the potential risks are high, or a large-scale development e.g. those that qualify for an EIA, would probably require a submission based on a:

- Comprehensive Hazard Log
- Detailed and quantified Navigation Risk Assessment
- Preliminary search and rescue assessment or overview to agreed MCA requirements
- Preliminary emergency response assessment or overview to agreed MCA requirements
- Comprehensive Risk control log.

Low Risk or Small-Scale Development

A development in an area where the potential risks are lower, or a small-scale development, might only require a submission based on a:

- Hazard list
- Navigation Risk Assessment based on qualitative techniques such as "expert judgement"
- Search and Rescue overview, to agreed MCA requirements
- Emergency response overview, to agreed MCA requirements
- Risk Control List.

3.3 Preliminary Search and Rescue Operations Assessment or Overview

The OREI may present risks to marine safety that generate the need for search and rescue operations or may hinder search and rescue operations not connected to the development itself.

Therefore, the preliminary assessment should firstly consider all those features of the proposal which could present problems for the emergency services.

These considerations will include, but not be limited to, the detection, location and rescue of casualties[3] and safe operation of rescue assets within and near to the OREI by: other vessels, MCA Coastguard Operations Centres (CGOCs), MCA SAR helicopters and RNLI lifeboats or other rescue assets. They will subsequently feed into the details of the proposed turbine compliance with respect of an Emergency Response Cooperation Plan (ERCoP) addressing individual turbine marking, lighting, rotor and nacelle control, emergency refuge and communications links. These should link to the developer's own contingency plans and safety management system, developed in conjunction with the Health & Safety Executive (HSE) in relation to its personnel working on turbines or operating within and close to the OREI. It is recommended that any marine safety aspects of these be discussed and agreed with MCA. In particular, note should be taken of any recommendations made by the Nautical & Offshore Renewable Energy Liaison (NOREL) group with respect to helicopter operations within and around OREI, and to the requirements of the Civil Aviation Authority (CAA).

Due to the differences in designs and layouts, the physiological demands and safety risks of OREI structures, the rescue of personnel from OREI structures is not part of the training or mission of search and rescue helicopter or lifeboat personnel. To ensure rapid and effective rescue of injured or ill persons from within OREIs, it is recommended that developers and operators create in-field Technical Rescue teams or capabilities. Such teams could be comprised of technicians or other employees who have received relevant training and qualification in technical rescue and immediate medical aid techniques and procedures. These teams would form the primary response to extract an injured or ill person from within an OREI and deliver them to an accessible area for onward evacuation by SAR unit. This would most likely be from a helicopter winching area or vessel.

Emergency trials and exercises have taken place at a variety of UK windfarms since an initial one at North Hoyle in 2005, including 'Guardex', a major multi-agency exercise at London Array in 2012. HM Coastguard SAR helicopters have also conducted a series of exercises at Hornsea 1, where crews were able to simulate bad weather flying prior to the windfarm being fully constructed. These have all proved invaluable to evaluate SOPs and ensure operations within and in the vicinity of OREIs is fully understood and refined.

Since surface vessels will, in some circumstances, often be the most appropriate means of rescue from within wind farms or close to other OREI, the assessment should give details of the nearest RNLI, or other lifeboat service, stations near to the site.

Such a full assessment may, if deemed appropriate by MCA, include:

- Resource planning assessment
- Response planning assessment

The MCA will inform developers of their specific requirements in this respect.

[3] Casualty is a generic term used by the Coastguard to describe persons, vessels or aircraft in distress or danger at sea.

3.4 Preliminary Assessment or Overview of the Required Emergency Response to the spills of Hazardous and Polluting Substances

Developers should become familiar with the Government's "National Contingency Plan for Marine Pollution from Shipping and Offshore Installations" (NCP)[4]. Such pollution, which includes oil and a variety of hazardous substances, may result from incidents occurring within or close to an OREI.

The preliminary assessment should determine the likelihood of any such incident occurring, such assessment to be based on the general navigation risk assessment and the types of vessel expected to be found in the vicinity. The potential consequences of such an incident, with respect to seafarers, the environment, and the shore population should be considered.

Any circumstance created by the OREI development which may adversely affect counter pollution operations undertaken by the appropriate authorities should be specified. These circumstances should include counter pollution operations relating to incidents not caused by the development itself, but into whose area the resulting pollution may drift.

3.5 Requirements for more detailed Emergency Response Assessments

Depending on the above assessment MCA may require a more detailed emergency response assessment to be undertaken later as a condition of a granted consent. However, where the frequency or the consequences of such incidents gives rise for even greater concern, a full assessment may be required before consent is granted. Developers of specified OREIs may be required to develop individual Marine Pollution Contingency Plans (MPCP) broadly following the structures set out in the NCP.

[4] Details of changes to the NCP, and other information on its content can be obtained from the MCA's Counter Pollution Branch.

4. MARINE NAVIGATIONAL SAFETY GOAL

4.1 Proposed Navigation Safety Principles

Due to the lack of specified goals for navigational safety in national or international waters, it is prudent to consider the overarching principle of reducing risk to that which is “as low as reasonably practicable” (ALARP) and that relevant good practice risk controls are in place.

This overarching principle is based on the UK Health and Safety Executive (HSE) document “Reducing Risks Protecting People”, which is a guide to the HSE’s decision-making process[5]. The document is aimed at explaining the decision-making process of the HSE[6] and therefore contains much useful information on risk-based decision making.

4.2 Implications of the Proposed Navigational Approach

The implication of the proposed navigational safety approach is that safety will have to be managed through the lifetime of an OREI. Through life safety management will include:

- Keeping up to date the marine navigational safety and emergency response risk assessment
- Updating other risk assessments
- Updating risk mitigations and controls (including the provision of assets)
- Having a safety policy
- Having a commitment to comply with latest MGN guidance.
- Meeting the requirements for lighting and marking in accordance with IALA O-139
- Running an effective ERCoP
- Keeping current a safety and operations plan
- Having an emergency plan
- Maintaining a safety culture
- Having a process for “Through Life Review”.

As much of this will involve work after the consent period is granted, at the consent application stage the developer’s navigational safety and emergency response risk assessment must make a commitment to:

- Marine navigation risk assessment
- Enact the risk mitigations and controls (including the provision of assets) listed in the application
- Undertake any required post consent search and rescue and emergency response assessments.
- Define a safety policy
- Follow the RenewableUK Guidelines for Health and Safety in the wind energy and other OREI industries[7]
- Introduce a safety management system
- Install, operate and practice the Emergency Response Cooperation Plan (ERCOP)
- Operate in accordance with a safety and operations plan

[5] Reducing Risks Protecting People (RRPP or R2P2), ISBN 0 7176 2151 0, available as a download from www.hse.gov.uk/risk/theory/r2p2.htm

[6] RRPP page vi

[7] See “Health & Safety” at www.renewableuk.com

- Set up and periodically exercise an emergency plan
- Take positive action to create a safety culture including Board level responsibilities and Measurement with feedback of the level of compliance
- Undertake periodic risk reviews and implement the findings to keep the risk levels within the goals for the navigation safety aspects of the OREI as part of their overall approach to safety.

5. OVERVIEW OF THE METHODOLOGY

5.1 Key Features of the Methodology to achieve the Marine Navigational Safety Objectives

The key features of the 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 tolerable, and preparing a submission that includes a claim, based on a reasoned argument, for a positive consent decision.

To produce a submission based on Formal Safety Assessment:	
1	**Define a Scope & Depth of the submission proportionate to the scale of the development & the magnitude of the risks**
2	**Estimate the "base case" level of risk**
3	**Predict the "future case" level of risk**
4	**Create a hazard log**
5	**Define risk controls and create a risk control log**
6	**Predict "base case with OREI" level of risk**
7	**Predict "future case with OREI" level of risk**
8	**Submission**

Figure 1- Key Features of the Methodology

5.2 Appropriate Risk Assessment Techniques

There are a wide range of risk assessment techniques available and the selection of the techniques should be:

- Proportionate to the scale of the development and the magnitude of the risk
- Acceptable to Government.

Techniques and tools appropriate to aspects of specific developments include:

- No action
- Expert judgement
- Qualitative assessment
- Quantitative calculations
- Simulations
- Trials
- Analysis of the real-world situation.

Various approaches to risk assessment, using the above techniques and tools, can be utilised and the techniques selected will need to be justified in the submission (see Annex D2).

5.3 Integrity of Risk Assessment

It is important that risk assessment should be of high integrity and not just a quoted risk number. Risk assessment should be used to:

- Show that the activities (i.e. navigation, search and rescue and emergency response) will remain feasible during construction and operation of the development.
- Produce an intelligent comparative value of the change in risk associated with the activity caused by the development
- Assess the sensitivity of the risk to changes
- Identify, evaluate and decide on appropriate risk controls.

In addition, the discipline of risk assessment is to be used to identify issues that need to be considered in the:

- Hazard log
- Selection of Risk Control Options.

5.4 Progressive Development of the Submission

It is recommended that the submission is developed in stages as the scope and depth of each stage is dependent on the findings of the previous stage. The suggested stages are:

Stage 1: Obtain MCA approval for approach to be taken

- Preliminary Hazard Analysis
- Define an appropriate Programme of Work

- Specify the tools and techniques to be used

Stage 2: Traffic Survey (see MGN 654 Section 4.6)

- Understanding the Base Case densities and types of traffic
- Understanding the future densities and types of traffic

Stage 3: Navigation risk assessment

- Area traffic assessment
- Specific traffic assessment (if appropriate)

Stage 4: Formal Safety Assessment comprising

- Hazard identification
- Risk assessment
- Hazard log
- Risk control log
- Cost-Benefit Analysis, if appropriate.

Stage 5: Other Assessments

- Appropriate search and rescue assessment or overview
- Appropriate emergency response assessment or overview

Stage 6: Final Assessments and Submission Preparation.

6. MECHANISM FOR ASSESSING TOLERABILITY OF MARINE NAVIGATIONAL SAFETY AND EMERGENCY RESPONSE RISK

6.1 Tolerability of Individual Risks

Developers should aim to achieve agreement with stakeholders that risks in the hazard log are reduced to a level that is as low as reasonably practicable (ALARP). Failure to reach agreement may result in delays or objections from stakeholders within the licensing and consenting process.

Risk

For each entry in the hazard log the risk shall be assessed against a risk matrix. Annex C provides examples of risk scoring from the IMO and HSE. Other risk scoring systems may be used by developers.

- There shall be no unacceptable risks
(***Note***: *The rating of risk may, with suitable justification, be determined by those undertaking the assessment. "Unacceptable" risks are normally those with a score of 6 or 7, in the HSE example*)

- All risks assessed as Tolerable with 'x' (e.g. scores 3 to 5, *in the HSE example*) shall be subject to an assessment of rule compliance and proposed risk controls. Further risk control options must be considered to the point where further risk control is grossly disproportionate (i.e. the ALARP principle) and an ALARP justification and declaration made.

Evidence

For each entry in the hazard log the sources of evidence shall be listed e.g. expert judgement, quantitative calculations.

Risk Controls

For each entry in the hazard log the risk controls shall be listed.

6.2 Tolerability of Societal Concerns

It is unlikely that reducing all risks in the hazard log to a level that is ALARP will be sufficient to give confidence that societal concerns are broadly acceptable. This is because many of the risks are interrelated in both cause and consequence and also the affected stakeholders may have different perspectives of perceived risks. Therefore, as a minimum, an overall assessment of societal risk will need to be made as:

- An aggregate of all entries in the risk register; and for
- Major risks such as collision, contact, grounding and stranding

The level of risk can, if appropriate, be determined in the form of an FN curve[8] and:

Base Case

- With the current traffic, existing marine environment without the OREI
- Is assumed to be tolerable

Base Case with OREI

- With the current traffic, existing marine environment and with the OREI
- The change against the base case needs to be assessed and judged against ALARP criteria

Future Case

- With the future traffic, future marine environment without the OREI
- Is assumed to be tolerable

Future Case with OREI

- With the future traffic, future marine environment and with the OREI
- The change against the future case needs to be assessed and judged against ALARP criteria

These calculations and their results shall both be based on techniques that are acceptable to Government.

Note: *These values of change and their tolerability are likely to be dependent on a number of variables used in the assessment of an OREI. These will include the size of the water space, its bathymetry and hence the sea room available for manoeuvring, and the variations in the marine operations taking place in the water space. The larger the space the lower the ratio of the OREI to base case risk.*

[8] See Annex C4 – Measuring the level of risk

7. STANDARD FORMAT OF A SUBMISSION

7.1 Contents of a marine navigational safety and emergency response risk assessment Submission

Developers are invited to submit their assessments in the following format:

Table 2 - Contents of a marine navigational safety and emergency response risk assessment submission

Sect.	Contents	Commentary on the Contents	Supporting information
1	**Summary**		
2	**Risk Claim supported by a Reasoned Argument and Evidence**	This should be written in such a way so that, if read separately from the rest of the document, the reader can understand: • If the developer is claiming that the OREI will achieve the sought for level of marine navigational safety • the reasoning and evidence on which that claim is made It should include: a. Navigational Safety Claim b. Supporting Reasoned Argument c. Overview of the Evidence obtained Detailed description of the tools and techniques used, describing in detail, and demonstrating where necessary, the tools and techniques used and their rationale. This will be necessary for gaining "acceptance" of tools and techniques by Government	
3	**Description of the Marine Environment**	This description should include the: a. Current marine environment b. Future marine environment	**Annex B3**
4	**Description of the OREI Development and how it changes the Marine Environment**	This description should include: a. The proposed OREI b. Any options c. The future environment	**Annex B3**

Sect.	Contents	Commentary on the Contents	Supporting information
5	**Analysis of the Marine Traffic**	This analysis should include: a. Current traffic densities and types b. Predicted future traffic densities and types c. The effect of the OREI on current traffic densities and types d. The effect of the OREI on future traffic densities and types	**Annexes** **B1** **B2**
6	**Status of the Hazard Log**	This should include: a. Summary of Tolerable, ALARP and Intolerable Risks b. Graphical representation of all risks on a matrix	**Annexes** **C3** **C4** **C5**
7	**Navigation Risk Assessment**	The risk assessment should include: a. Base Case b. Future Case c. Base Case with OREI d. Future Case with OREI e. Future Options f. A summary of the other navigation safety risks from the hazard log and the risk controls put in place to manage them	**Annex** **D1**
8	**Search and Rescue Overview and Assessment**	Assessment dependent on level agreed with the MCA. In high risk developments this may include, prior to or post consent: • Resource Planning • Prevention Strategy • Response Plan Assessment	**Section** **3.3**
9	**Emergency Response Overview and Assessment**	Assessment dependent on level agreed with the MCA.	**Sections** **3.4** **3.5**
10	**Status of Risk Control Log**	An overview of the risk controls in the Risk Control Log	**Annex** **E1**

Sect.	Contents	Commentary on the Contents	Supporting information
11	**Major Hazards Summary**	A summary of the major hazards, how they have been assessed, how they will be controlled and what trials have been undertaken to develop the assessment or controls. Likely "Major Hazards" to be summarised are: • Collision and contact with other vessels and with OREI structures • Grounding • Contact with cables and snagging • Interference with communications, radar, etc.	**Annexes** **F1** **F2**
12	**Statement of Limitations**		**Annex E2**
13	**Through Life Safety Management**	An indication of, or a commitment to, the planned through life safety management including: • Updating risk assessments • Filling gaps in assessment • Safety Policy • Safety Management System • Safety and Operations Plan • Emergency Plan • Through Life Review • Emergency Response Cooperation Plan[9]	

7.2 Explanatory Annexes

Explanatory annexes may be included if appropriate to expand on the information given in the submission:

[9] Marine Guidance Note 654 (M+F) *"Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response Issues."* Maritime and Coastguard Agency, August 2021. Available from the MCA website.

Table 3 - Annexes to a marine navigational safety and emergency response risk assessment submission

	Annex	Commentary of the Annex
A	**Background Information**	
B	**Setting the Scene**	This should include: a. Base Case densities and types of traffic b. Predicted Future Level of Traffic c. The Marine Environment – development of a Specific Technical and Operational Analysis
C	**Hazard Identification and Risk Assessment**	This should include: a. Development of Specific Influences on the Level of Risk b. Hazard log Worksheets or Database
D	**Appropriate Assessment Techniques and Tools**	This should include: a. Navigation risk assessment b. Appropriate search & rescue overview & assessment c. Appropriate emergency response overview & assessment d. Selection of techniques that are acceptable to Government e. Demonstration that results from the techniques are acceptable to Government
E	**Deciding on the Risk Controls**	This should include: a. Risk Control Log Worksheets or Database

7.3 Electronic Distribution

The submission and its annexes must be capable of electronic circulation e.g. PDF, similar open standard files types from file download sites, over email, etc. or by other means in agreement with MCA e.g. digital submissions.

8. INDICATIVE PROCESS FOLLOWED BY GOVERNMENT DEPARTMENTS AND AGENCIES IN ASSESSING A DEVELOPER'S SUBMISSION

8.1 Introduction

This section gives an indication of the process that will be followed by Government in assessing submissions.

8.2 Principle of the Process

The principle behind the process followed by government departments is that they will seek the following in a developer's submission:

- A supported claim that if the planned risk controls are implemented and maintained the proposed OREI will achieve the sought for level of marine navigational safety
- Sufficient information for government departments, their agencies and other stakeholders to have confidence in the claim
- A declaration that the risk controls will be implemented.

8.3 Assessment of Information Supplied in the Submission

Government departments will assess if the submission includes information showing that:

1. The marine navigational safety requirements have been correctly identified based on Formal Safety Assessment
2. The submission makes a claim against the safety requirements that:
   a. The rules have been complied with
   b. As a minimum standard or relevant good practice, risk controls will be put in place
   c. The risks are broadly acceptable; or
      i. Tolerable with modifications; or
      ii. Tolerable with additional controls; or
      iii. Tolerable with monitoring
   d. That further risk control is grossly disproportionate
3. The claim is backed up by a reasoned argument
4. The reasoned argument is built on the use of evidence and appropriate risk assessment tools and techniques
5. The evidence is quality checked
6. Techniques selected are acceptable to Government
7. The results from applying the techniques are acceptable to Government, such as calibration against known data.
8. MGN checklist has been completed

8.4 Assessment of the Limitations of the Information Supplied in the submission

Government departments will assess if the submission includes information showing that:

- The nature, assumptions and limitations of the submission are set out and understood
- The "absence of evidence of risk" is not taken as "evidence of absence of risk".

9. INDICATIVE PROCESS FOLLOWED BY GOVERNMENT DEPARTMENTS IN RESPONDING TO A DEVELOPER'S SUBMISSION

9.1 Background to the Response Process

In defining the response process the broadly stated principles of good regulation, published by the Better Regulation Executive will be applied. These require:

- The targeting of action: focussing on the most serious risks or where the hazards need greater controls
- Consistency: adopting a similar approach in similar circumstances to achieve similar ends
- Proportionality: requiring action that is commensurate to the risks
- Transparency: being open on how decisions were arrived at and what their implications are
- Accountability: making clear, for all to see, who are accountable when things go wrong.

9.2 How the Response Process links to the Consent Application Process

The submission forms part of the developer's EIA Report based on an Environmental Impact Assessment, which is needed to support an application for the consents and licenses necessary for an offshore development In England and Wales through the Planning Inspectorate (The Infrastructure Planning Regulations 2009 Section 36, Electricity Act 1989, Section 56 Planning Act 2008). In Scotland the same NRA approach is adopted, and applications are made to Marine Scotland, whilst in Northern Ireland applications are made to the Department of Agriculture, Environment and Rural Affairs (DAERA). In reviewing the NRA, a number of bodies will be consulted including:

- Other Government departments including the MCA, DfT and the Ministry of Defence.
- A range of organisations such as the General Lighthouse Authority, Chamber of Shipping, Royal Yachting Association, ports and harbour authorities (if relevant), fishing associations, the British Marine Aggregates Producers Association, shipping companies and Maritime Administrations of neighbouring states (if relevant).

The relevant organisations are invited to advise on the potential marine navigational safety and emergency response risk impacts of the:

- Development itself
- Development in-combination with other planned developments
- Effect of these on other future developments.

9.3 Ultimate Responsibility for consent

The aim is to involve stakeholders at all stages of development with the aim of achieving consensus. However, Government departments (namely The Planning Inspectorate, BEIS, Marine Scotland, Natural Resources Wales, Marine Management Organisation, Department of Agriculture, Environment and Rural Affairs or DfT/MCA) must make recommendations to Ministers where consensus is not possible, for example because different stakeholders hold opposing views based on deep-rooted beliefs.

10. GUIDANCE TO DEVELOPERS IN APPLYING THE METHODOLOGY

The guidance is given in the following Annexes:

ANNEX A: BACKGROUND INFORMATION

- A1 Reference Sources - Lessons Learned

ANNEX B: SETTING THE SCENE

- B1 Understanding the base case traffic densities and types
- B2 Predicting future densities and types of traffic
- B3 Describing the marine environment

ANNEX C: HAZARD IDENTIFICATION AND RISK ASSESSMENT

- C1 Hazard identification in the marine environment
- C2 Risk assessment in the marine environment
- C3 Influences on the level of risk
- C4 Tolerability of risk
- C5 Risk Matrix

ANNEX D: APPROPRIATE ASSESSMENT TECHNIQUES & TOOLS

- D1 Overview of appropriate assessment techniques
- D2 The selection of techniques that are acceptable to Government
- D3 Demonstration that the results from the techniques are acceptable to Government
- D4 Navigation risk assessment – area traffic assessment techniques
- D5 Navigation risk assessment – specific traffic assessment technique

ANNEX E: DECIDING ON THE RISK CONTROLS

- E1 Creating a risk control log
- E2 Marine stakeholders and stakeholder organisations

ANNEX F: EXAMPLE CHECKLISTS

- F1 Example hazard identification checklist
- F2 Example risk control checklist

ANNEX G:

- G1 Categories, Terms and References

ANNEX A Background Information

A1 Overview of Formal Safety Assessment

Developers are expected to base their submissions on a Formal Safety Assessment[10] and addressing the navigation issues arising from the Marine Guidance Note *Safety of Navigation: Offshore Renewable Energy Installations (OREI) – Guidance on UK Navigational Practice, Safety and Emergency Response*.

The IMO methodology was developed for use in the IMO rule making process for ships involved in international trade but since its development it has proved successful in more general marine applications, including the navigation risk assessment of ports. Formal Safety Assessment is a five-step process aimed at producing decision-making recommendations:

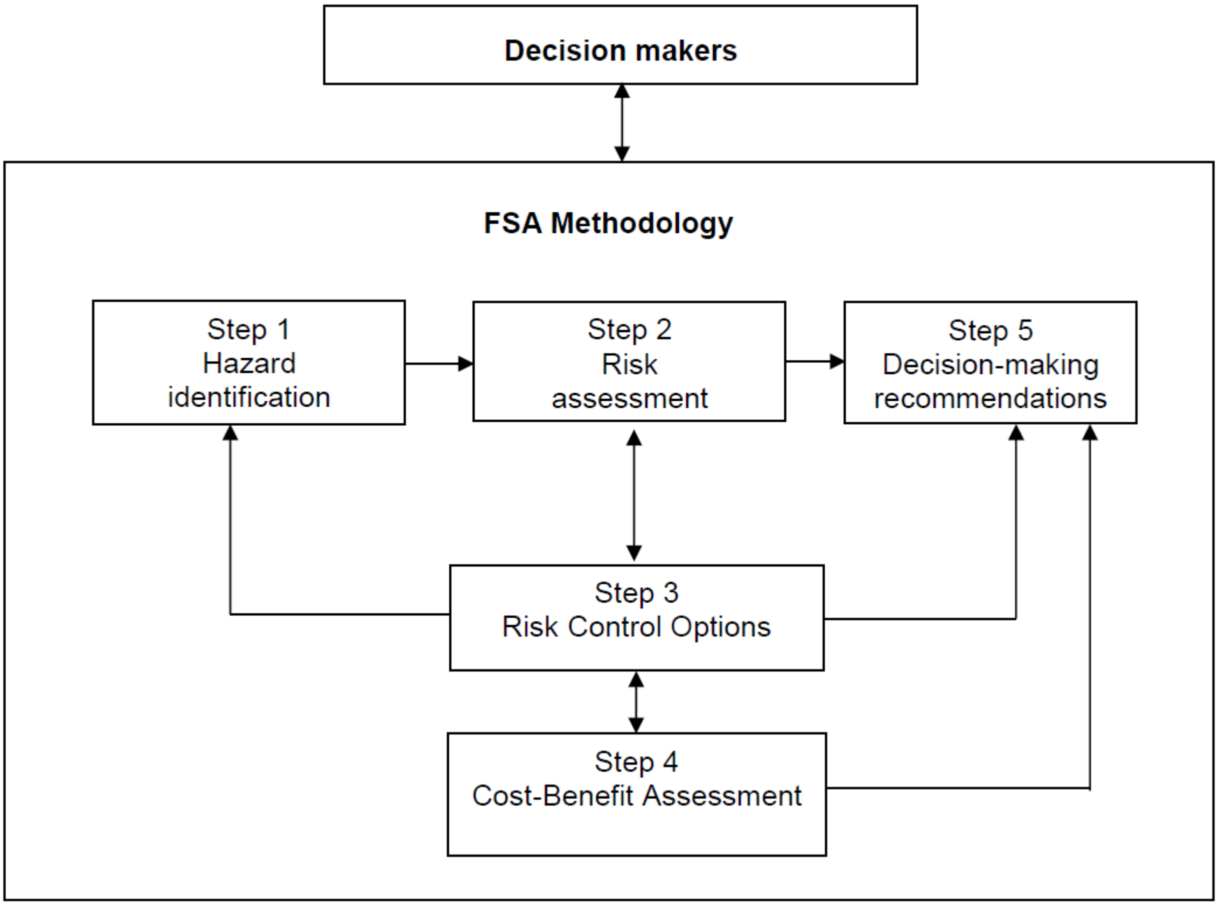


Figure 2 Flow Chart of the FSA Methodology

[10] See International Maritime Organization guidelines for FSA for use in the IMO-rule making process (MSC-MEPC.2/Circ.12/Rev.2)

A2 Reference Sources - Lessons Learned

Prior to and during the development of this methodology (January to August 2005, updated 2013 and 2021) a number of desktop and laboratory investigations and, where feasible, field trials in early UK wind farm developments, were carried out. Some of these trials, reports and other documents with Lessons Learned are listed below.

Table 4 - Some Trials Reports and other Lessons Learned

Ref	Title	Date
1	**Assessing the Navigational Impact of Offshore Wind Farm Proposed for UK Sites – Guidance for Developers** Maritime and Coastguard Agency Project MSA 10/6/200, May 2002	2002
2	**Wind Energy and Aviation Issues - Interim Guidance** Wind Energy, Defence & Civil Aviation Interests Working Group ETSU W/14/00626/REP	2002
3	**UK Atlas of Recreational Boating** A compilation of the cruising routes, general sailing & racing areas used by recreational sailing craft around the UK coast. The Royal Yachting Association	2008
4	**Results of the electromagnetic investigations and assessments of marine radar, communications and positioning systems undertaken at the North Hoyle wind farm by QinetiQ and the Maritime and Coastguard Agency** QINETIQ/03/00297/1.1 MCA MNA 53/10/366	2004
5	**Guidelines for Health & Safety in the Wind Energy Industry** British Wind Energy Association	2005
6	**Offshore Wind Farm Helicopter Search and Rescue - Trials Undertaken at the North Hoyle Wind Farm** Report of helicopter SAR trials undertaken with Royal Air Force Valley ‘C’ Flight 22 Squadron on March 22nd 2005 Maritime and Coastguard Agency Project MSA 10/6/239, May 2005	2005
7	**Interference to radar imagery from offshore wind farms** A Report compiled by the Port of London Authority based on experience of the Kentish Flats Wind Farm Development 2nd NOREL WP4	2005

8	**Investigation of Technical and Operational Effects on Marine Radar close to Kentish Flats Offshore Wind Farm** [11] Investigation of Technical and Operational Effects on Marine Radar close to Kentish Flats Offshore Wind Farm – Report by the BWEA (British Wind Energy Association) April 2007	2007
9	**MCA report following aviation trials and exercises in relation to offshore windfarms** A summary of findings, lessons learned and corroboration of published MCA guidance following helicopter SAR exercises, trials and discussions undertaken between 2015 and 2019. Maritime and Coastguard Agency, January 2019	2019
10	**MCA report following aviation trials at Hornsea Project 1 windfarm** A report on helicopter SAR trials undertaken within a large wind farm to test the various systems on the aircraft Maritime and Coastguard Agency, November 2019	2019
11	**Regulatory Expectations for Emergency Response Arrangements for the Offshore Renewable Energy Industry** A document setting out the principles to be adopted to ensure compliance with relevant legislation. Health and Safety Executive and Maritime and Coastguard Agency, August 2019	2019

Note: *Various trials and research projects are continuously being undertaken with respect to all offshore renewable energy installations. These include work on wind turbine effects on marine and military radars, the resolving of incompatibilities between marine navigation and aviation lighting, etc. Developers are advised to contact the Maritime & Coastguard Agency's Navigation Safety Branch if they have any queries relating to navigational safety or emergency response issues.*

[11] Investigation of Technical and Operational Effects on Marine Radar close to Kentish Flats Offshore Wind Farm. BWEA (British Wind Energy Association) April 2007 report. This is available from www.dft.gov.uk/mca/kentish_flats_radar.pdf

ANNEX B Setting the Scene

B1 Understanding the Base Case Traffic Densities and Types

This section should be read in conjunction with MGN 654 Section 4.

The risk assessment needs to be based on a sound knowledge of the traffic densities and types. This is one of the key inputs to assessing proportionality.

Survey Area

The boundary of the Survey Area should be constituted at a position so that further extension of the boundary would not appreciably impact the results of the assessment, i.e. boundary effects are minimised. A general guideline could be applied that the area of direct interest adjacent to the OREI or OREI groups, should lie within the centre 1/4 to 1/3 of the Survey Area. However, it is the responsibility of the analyst to demonstrate that the Survey Area is appropriate.

B.1.1 Traffic Data Requirements

Marine navigation safety issues within and close to offshore OREI exist in many situations, and particularly where there is a combination of high traffic levels, different vessel operations and constrained water spaces, cumulative impacts and weather routing being key considerations. These aspects are inter-related with respect to offshore OREI. The risk is also dependent upon the type, size and nature of the vessels and their operations within the survey area. As such the classification of the traffic density, types, operations, sizes, drafts, speeds and routes, is key to the accurate representation of the present safety regime, and future impacts.

MCA traffic survey requirements contained in MGN 654 Section 4.6 should be followed.

B.1.2 Extracting Information from the Data

The results of the traffic survey should provide traffic information for the traffic as a whole and for each class of vessel with the data available. AIS data alone will not capture all vessel sizes therefore data from appropriate additional sources such as radar should be collected. The type of data required may vary with the type of modelling or other appropriate technique used in the risk assessment but may include such parameters as, for example:

- the centrelines and excursion limits of representative routes and operations through and within the Study Area
- the average traffic volume of vessels passing along key routes
- key seasonal variations in traffic activity.

B.1.3 Design Traffic Densities and Types

A key issue following collection and collation of data is the accurate representation of “Design Traffic Densities and Types” in the risk assessment. This raises the issue over whether average, peak or some intermediate values should be used as the base case and of the traffic limits appropriate to the assessment. In some cases, it might be appropriate to identify an average of the daily traffic densities and types for these routes or operations and for the survey area as a whole.

Routes and operational areas associated with and used by leisure craft, fishing vessels, aggregate dredging and other marine activities, should be identified. The seasonal variation of such traffic should be closely examined, and the data used to assess the specific risks relevant to these vessel types together with their interaction with larger vessels which might be navigating on through routes.

Developers should be aware that the traffic survey and assessment requirements cover all vessel and craft types and sizes. Many smaller vessels will not be equipped with the Automatic Identification System (AIS) and therefore will not be detected using that system alone. Similarly, if radar surveys are made from shore locations, account should be taken of the operational range of such radars based on antenna height and target vessel size. Where small vessels cannot be detected visually or by either of these two methods, alternative arrangements should be made to fairly assess traffic types, routes and operations within the whole of the area under survey. Consultation with organisations representing such vessels or craft may be useful in establishing how data can be obtained and establishing confidence level information on detection of non-AIS vessels and craft.

Additionally, it should be noted that there are differences in the levels of training, equipment & manoeuvrability amongst the various vessel categories – for which see Table 10, section B.3.7.

B1.4 Human Element

For risk assessments where the scale of development and/or the magnitude of the risk has led to a risk assessment supported by simulation modelling then the typical behaviour of vessels in complying with the “Collision Regulations” should be extracted from available data and included in the assessment algorithms. Where appropriate the algorithms should include the results of Rule violations, mistakes, lapses or slips, these categories being transparent and variable amongst the simulation algorithms.

This should not be taken to indicate that the Maritime and Coastguard Agency sanctions any departure from the Collision Regulations or “special rules”. No such “special rules” will apply to areas around OREI unless they lie within sea areas controlled by appropriate authorities, e.g. port authorities, who would promulgate any necessary differences from the Collision Regulations. It is unlikely that such “special rules” would impinge on any UK offshore wind farm proposals.

B2 Predicting Future Densities and Types of Traffic

The methodology requires "Future Case" levels of Risk with and without the OREI to be assessed. Therefore, a prediction needs to be made of the future densities and types of traffic.

B.2.1 Traffic Forecasting

A forecast of future traffic activity at 10-year intervals over the expected life of the OREI should be made, dependent on:

- macro drivers (national/regional marine growth predictions) and local conditions (reasonably foreseeable developments, i.e. port & marine growth plans, etc)
- changes in vessel size anticipated over the forecast period. For example, if a local container port is set to improve its throughput by 50% in the next 20 years, but the vessels serving this facility will grow at a similar rate the traffic volumes will stay the same, although the vessel size, displacement and draft will increase.
- future change in all marine activities, such as fishing, recreational craft, offshore exploitation, other OREIs etc.

B.2.2 Techniques of Traffic Forecasting

A number of techniques may be used to forecast future traffic volume, routes and vessel types. Developers' proposals for appropriate techniques for predicting future densities and types of traffic should be discussed with MCA at the commencement of the risk assessment.

Vessel types, routes and operational areas

Various techniques may be used in assessing prime considerations such as whether the growth of traffic densities, or of vessel types, size, draft, etc., and construction of other OREIs, might lead to the non-viability of major traffic routes or operations due to the OREI location.

Local knowledge, together with that of international trade, fishing operations and all other activities potentially affecting the sea area will be vitally important in traffic forecasting. Together with sample assessments using stepped traffic growths of 20%, 40%, etc., such knowledge may be used to determine whether or not non-viability of major traffic routes is a credible possibility. It should be remembered that traffic within a particular area may reduce as well as increase due to a variety of controlling circumstances.

B.2.3 Stochastic Forecasting

In addition to the stepped change techniques mentioned above, some techniques may use a stochastic, or probabilistic, approach. This method, which may be appropriate for some development sites, reviews prior historic traffic trends for the previous ten years or more and identifies the variability of relevant factors. The forecast model then creates various viable future scenarios.

Stochastic forecast techniques review prior historic growth trends (preferably for a time span of the previous 10 years or more) from a specific end point against the key economic/transport drivers and identify the variability of these factors. This variability is then introduced into the forecast model to create a range of viable future scenarios. Those carrying out stochastic forecasting should bear in mind the limitations of traffic data obtained from the Automatic Identification System (AIS).[12]

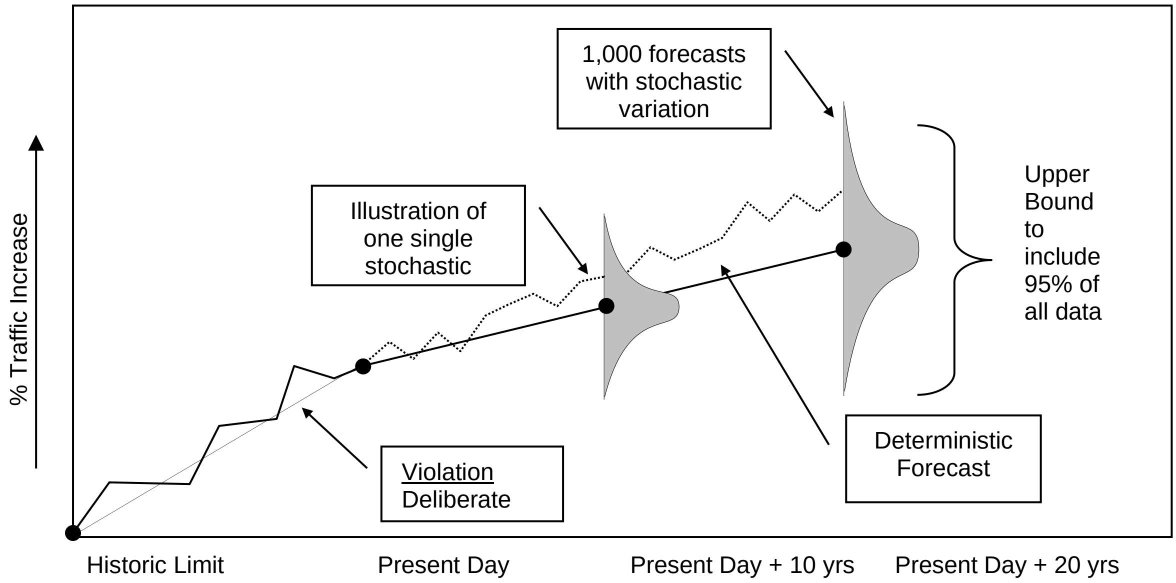


Figure 3 – A Method of Statistical Forecasting

If statistical forecasting is used, the adoption of a Design Traffic Level at the 95% confidence level is suggested, i.e. that only 5% of the future growth scenarios develop traffic above that predicted. This exercise may be conducted for each class and the traffic levels combined.

[12] See IMO requirements in: http://www.imo.org/Safety/mainframe.asp?topic_id=754

B3 Describing the Marine Environment

Developers should use the following analysis as a starting point for a site specific technical and operational analysis including any extra site-specific information and excluding (with a justification) information that is not applicable.

This section should be read in conjunction with MGN 654 Section 4.

B.3.1 Description of a Technical and Operational Analysis

The developer's analysis will be expected to cover navigational risks which will include appropriate search and rescue and emergency response overviews and how these will be assessed and managed over all phases of the OREI development.

The developer's analysis will be expected to include a systematic identification of:

1. Potential accidents resulting from navigation activities
2. Navigation activities affected by their proposed offshore OREI
3. OREI structures that could affect navigation activities
4. OREI development phases that could affect navigation activities
5. Other structures and features that could affect navigation activities
6. Vessel types involved in navigation activities
7. Conditions affecting navigation activities
8. Human actions related to navigation activities for use in hazard identification.

Note: *In this context "Navigation" includes the marine operations undertaken by vessels of all types and sizes. Examples of such operations include fishing, aggregate dredging, recreational activities, etc. Where military vessel activity takes place on a regular basis in a particular area, such activity should be taken into account.*

The following sections describe a generic technical and operational analysis. In producing a site-specific analysis, developers should use this as a guide and add or remove site specific items, as appropriate and with justifications.

Note*: The tables are labelled H1, H2, etc. as the main use of the technical and operational analysis is in the identification of hazards.*

B.3.2 Potential Accidents resulting from Navigation Activities – Examples

Table 5 - Potential Accidents resulting from Navigation Activities

H1	Accident Category
	All
1	General Navigation Safety Risks
	a. Collision
	b. Allision/Contact
	c. Grounding and Stranding
2	Other Navigation Safety Risks
	a. Foundering

H1	Accident Category
	b. Capsizing
	c. Fire
	d. Explosion
	e. Loss of Hull Integrity
	f. Flooding
	g. Machinery Related Accidents
	h. Payload Related Accidents
	i. Hazardous Substance Accidents
	j. Accidents to Personnel
	k. Accidents to the General Public and Shore Populations
	l. Electrocution
3	Aviation Safety Risks[13]
	a. Aviation Accidents
4	Other Safety Risks
	a. High Probability Events
	b. High Severity Outcomes
	c. Low Confidence / High Uncertainty Events
	Note: *Although not "accident categories" themselves the following search and rescue and emergency response activities may result from one or more of the above incident categories*
5	Search and Rescue (see Annex F Table 28 Example Hazard Identification)
	a. Overall
	b. External to Internal
	c. Internal to Internal
	d. Internal to External
	e. External to External
	f. Worst Case
6	Emergency Response
	a. Overall
	b. External to Internal
	c. Internal to Internal
	d. Internal to External
	e. External to External
	f. Worst Case

[13] Aviation Safety Risks are included in potential accidents list as a reminder that marine navigation and aviation risks interact, for example required marine lights vs. aviation lights and potential effects on search and rescue or dispersant spraying.

B.3.3 Navigation Activities affected by an OREI – Examples

Table 6 - Navigation Activities affected by an OREI

H2	Navigation Activity
1	*All*
2	Navigation on Passage
	Navigating or operating near, around or through an OREI
	Navigating or operating within an OREI
	International traffic
	National traffic
	Coastal traffic
	Short sea shipping traffic
	Fishing vessels
	Recreational craft
	All other traffic listed in section H6 below
3	Fishing operations
	Single vessels
	Paired vessels & others fishing in close proximity
	Static e.g. pots, long lines
	Mobile e.g. trawling
	Drift Nets
4	Recreational activities
	Sail and power day sailing, cruising and racing
	Personal watercraft use (e.g. Jet Skiing, Canoeing, Kayaking, Paddleboards)
	Windsurfing
	Kite surfing and kite boarding
	Leisure or sport diving
5	Anchoring
	Routine Anchoring
	Emergency Anchoring
6	Other Marine Operations close to or within an OREI
	Aggregate Dredging, Dredging or Spoil Dumping
	Commercial Diving
	Construction Operations
	Servicing Operations
	Decommissioning Operations
	Oil and Gas Operations
	Salvage Operations
	Cable Laying
	Pipeline Installation
	Boarding and Landing of Pilots
7	Special Events
	Regattas and Competitions

B.3.4 OREI Structures that could affect Navigation Activities – Examples

Table 7 – OREI Structures that could affect Navigation Activities

H3	Structures
1	Wind Turbines (floating or fixed)
	a. Foundation type or mooring arrangements)
	b. Transition Piece
	c. Tower
	d. Nacelle
	e. Blades
	f. Platforms and superstructure fittings
2	Floating and fixed wave energy devices
	a. Seabed mounted
	b. Floating – horizontal or vertical
	c. Foundation type
3	Floating and fixed tidal energy devices
	a. Seabed mounted
	b. Suspended mid-water
	c. Floating - horizontal or vertical
	d. Foundation type
	e. Blades – exposed or enclosed
4	Offshore Installations
	a. Substation
	b. Accommodation
5	Cable
	a. Export cable
	b. Inter-array cabling
	c. Electrical hub
6	Subsea Installations, including anti-scour material
7	Moorings
	a. Foundations
	b. Lines

B.3.5 OREI Development Phases that could affect Navigation Activities – Examples

Table 8 - OREI Development Phases that could affect Navigation Activities

H4	Development Phase
1	*All*
2	Pre-construction

H4	Development Phase
3	Construction
4	Operation
5	Maintenance
6	Decommissioning

B.3.6 Other Structures and Features that could affect Navigation Activities – Examples

Table 9 - Other Structures and Features that could affect Navigation Activities

H5	Other Structures and Features
1	Wrecks
2	Oil & Gas Installations (Existing and projected)
3	Other OREI (Existing and projected)
4	Other Exclusion or Safety Zones
5	Fishing Grounds
6	Dredging and Dumping Areas
7	Diving Areas

B.3.7 Vessel Types involved in Navigation Activities – Examples

Table 10 - Vessel Types involved in Navigation Activities

H6	Types of Vessel
1	*All*
2a	Cargo Vessels
	a. General Cargo
	b. Specialised Carriers
	c. Bulk Carriers
	d. Bulk/Oil Carriers
	e. Chemical Tankers
	f. Container Vessels
	g. Cruise Vessels
	h. Liquefied Gas Carriers
	i. Oil Tankers
2b	Passenger Vessels
	a. Passenger
	b. Passenger Ferries
2c	High Speed Craft (HSCs)
	a. High speed ferries

H6	Types of Vessel
	b. Other high speed recreational and commercial craft
3	Fishing Vessels
	a. Fish Processing
	b. Fishing Vessels (Various types and operations)
4	Recreational Vessels
	a. Sailing dinghies and yachts
	b. Motorboats
	c. Small Personal Watercraft
	d. Rowing boats
	e. Sports Fishing
	f. Windsurfer
	g. Kite Boards
	h. Tall Ships
	i. Recreational Submarines and dive support craft
5	Anchored Vessels
	a. All
6	Other Operational Vessels
	a. Barges
	b. Dredgers
	c. Dry Cargo Barge
	d. Offshore Production and Support
	e. Salvage
	f. Tank Barges
	g. Tugs and Tows
7	Military Vessels
	a. Surface warships
	b. Submarines
	c. Royal Fleet Auxiliaries
8	Other Vessels
	a. Seaplanes
	b. Wing-In-Ground Craft (WIG)
	c. Hovercraft

B.3.8 Conditions affecting Navigation Activities – Examples

Table 11 - Conditions affecting Navigation Activities

H7	Conditions
1	*All*
1	Weather
	a. Restricted visibility (Fog, mist, haze, precipitation)
	b. Wind strength and direction
	c. Sea state
	d. Icing
	e. Light conditions
2	Tides and local currents
	a. Local currents
	b. Tidal streams and heights
3	Time of Day
	a. Night
	b. Dawn
	c. Day
	d. Dusk
3	Circumstances
	a. Planning access to shelter
	b. Vessel constrained by her draft
	c. Vessel engaged in fishing
	d. Vessel not under command
	e. Vessel restricted in her ability to manoeuvre
	f. Scheduled/Shuttling vessels
4	Electronics
	a. Vessels underway with no AIS (i.e. non SOLAS craft) or with AIS switched off
	b. Interference to marine radar, navigation and communications
5	Other
	a. Overfalls and other local conditions

ANNEX C HAZARD IDENTIFICATION AND RISK ASSESSMENT

C1 Hazard Identification in the Marine Environment

Marine accidents tend to be the result of a chain of events rather than a single cause and often involve human error, either in the cause of the accident or in the response to it.

The Hazard Log construction and population would largely depend on the geospatial and other complexities of a particular OREI with regard to the navigational risks and any consequential emergency responses. It should include a suitable set of incident scenarios with potential causes and outcomes, to formulate objective evidence which is empirically reproducible where possible.

The Hazard Log should, therefore, contain constructs which could:

- produce quantitively and qualitatively verifiable hazard scenarios; and
- provide data detailed enough for the next step of evaluation of risk factors.

C.1.1 Causal Chains

The IMO FSA encourages the use of causal chains in risk assessment as it recognises that many risks will be the result of complex chains of events, with a diversity of causes and a range of consequences.

The causal chain used here is:

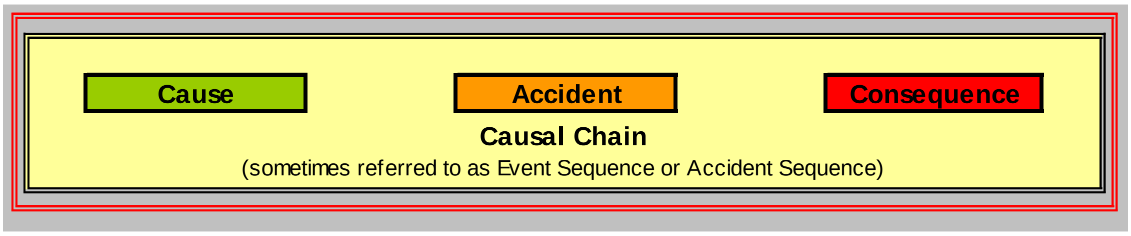


Figure 4 - Overview of Causal Chains

C.1.2 Human Element

FSA stresses the importance of the human element. It states “The human element is one of the most contributory aspects to the causation and avoidance of accidents. Human element issues should be systematically treated within the FSA framework”. The following diagram lists the principle causes of “Human Error”, here defined as examples of the active cause of an unsafe act recognising that some acts are intentional while others are not.

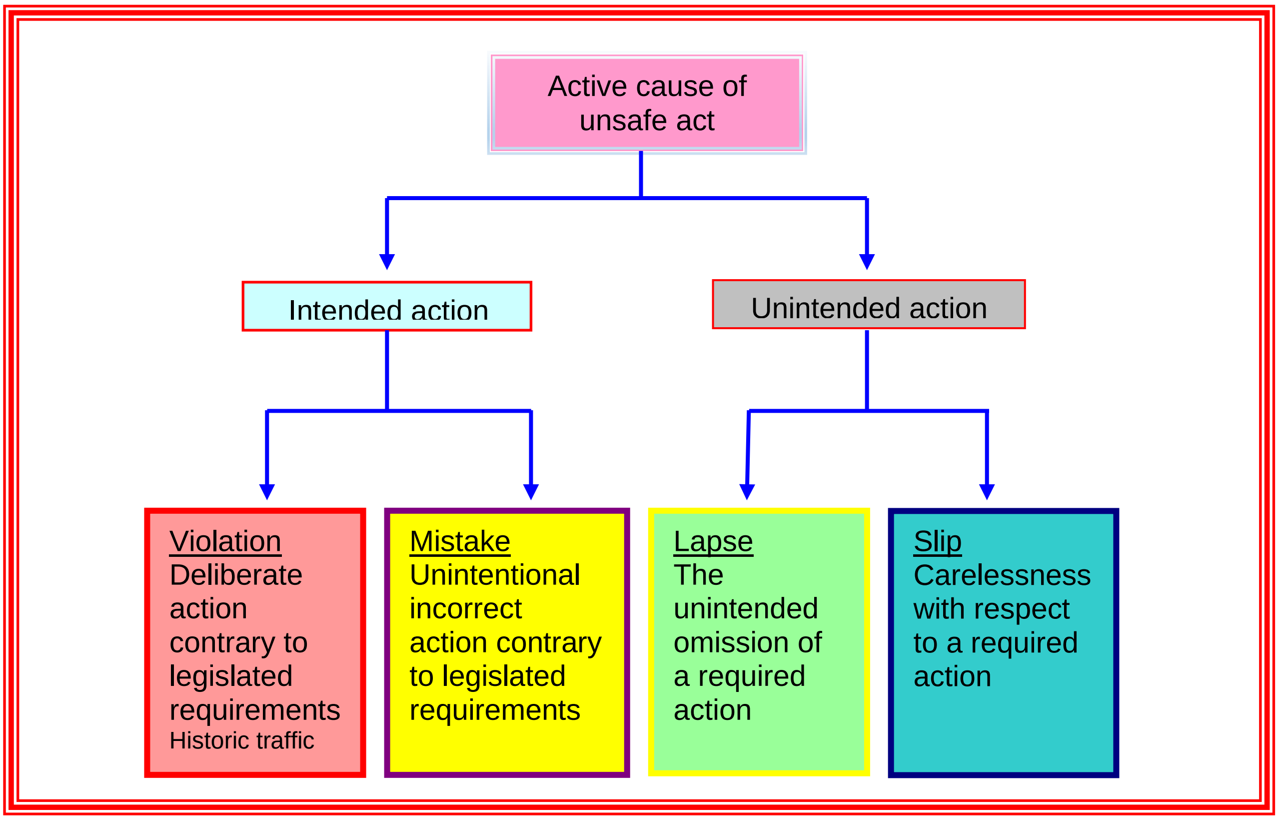


Figure 5 - Overview of the Human Element

C.1.3 Compliance with the Collision Regulations[14]

The Hazard Identification should clearly identify and investigate where the OREI may make it more likely that vessels will deviate from the International Regulations for the Prevention of Collisions at Sea 1972, as amended (IRPCS, known as COLREG), either as an intended or unintended action.

This may include any effects which the OREI might make on the lights and shapes to be carried by vessels (e.g. interference to the visibility of navigation lights), on navigation marks ashore and at sea and to the light and sound signals made by vessels and navigational aids in particular circumstances.

C.1.4 Effect of Non-Compliance with the Collision Regulations

Vessels do not always follow the COLREG. The Hazard Identification should include any reasonably foreseeable compliance with them.

Annex F Table 27 provides a list of example hazard identification.

[14] Merchant Shipping Notice MSN 1781 Amendment 2 (M+F) The Merchant Shipping (Distress Signals and Prevention of Collisions) Regulations 1996

C2 Risk Assessment in the Marine Environment

FSA uses the classic definition of risk as a combination of probability and consequence.

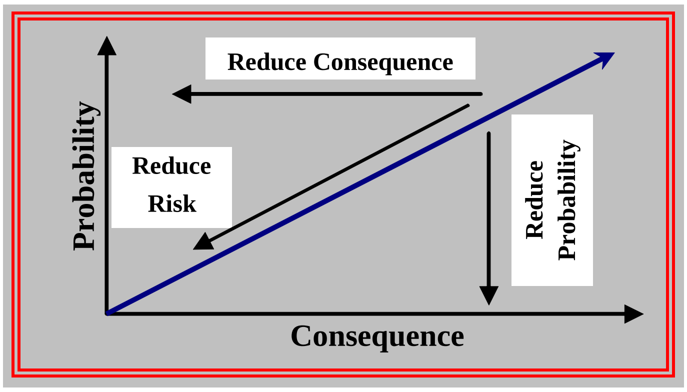


Figure 6 Classic Definition of Risk

Hazard Identification therefore requires an assessment to be made of the:

- probability of the cause
- magnitude of the consequence.

FSA also encourages the consideration of the influences on the causal chain of an accident as well as any direct causes and consequences. This is done because in many marine accident sequences these influences not only affect the probability of the cause but also the magnitude of the consequence in the same accident sequence.

Weather is a typical factor that affects both cause and consequence. It is often a major factor, as are human error and remoteness.

C3 Influences on the Level of Risk

Developers are invited to use the following analysis as a starting point for a site-specific Influence Analysis including any extra site-specific influences and excluding (with a justification) influences that are not applicable.

C.3.1 Influence Analysis

The following sections describe a generic identification of the influences on the level of risk. In producing a site-specific analysis, developers should use this as a guide:

- adding site specific influences
- removing (with justifications) influences that are not applicable

Note: *The tables are labelled R1, R2, etc. as the main use of the Influence Analysis is on the assessment or risk.*

C.3.2 Risk Factors – Examples

Table 12 - Risk Factors – Examples

R1	Risk Factors
1	**Site**
	a. Location of OREI.
	b. Type of OREI
	c. Alignment of OREI.
	d. Layout of OREI. (e.g. grid, scattered or other layouts)
	e. Proximity of other OREI
2	**Traffic**
	a. Traffic routes, density, type and operations.
	b. Potential growth or decline in traffic.
	c. Seasonal variation in traffic.
	d. Special traffic, e.g. dangerous goods, etc.
3	**Interrelations Between Vessels**
	a. Blocking of escape routes or bad weather refuges
	b. Bunching
	c. Increase in “crossing” encounters
	d. Increase in “end-on” encounters
	e. Increase in “overtaking” encounters
	f. Increase in traffic volumes
	g. Loss of recreational cruising routes
	h. Pinching
	i. Reduction in sea room for manoeuvring
	j. Reduction in water depth for manoeuvring
	k. Blocking of routes to safe havens and inshore anchorages
	l. Redirection of recreational craft and fishing vessels into routes used by other vessels, particularly larger and faster vessels.

R1	Risk Factors
4	Navigator Behaviour
	a. Lengthened navigation routes for leisure craft increase navigator fatigue (and hence error) and increase the criticality of weather windows.
	b. Enhanced navigational complexity and need for navigational awareness increase fatigue (and hence error)
5	Other single vessel factors
	a. Collision with OREI structures
	b. Fouling or contact with cables
	c. Grounding

C.3.3 Influences on Causes – Examples

Table 13 - Influences on Causes – Examples

R2	Influence on Causes
1	Vessel Traffic Management
	1. Availability of Vessel Traffic Services (VTS).
	2. Availability of Pilot services.
2	Aids to Navigation
	3. Compliance with requirements for Aids to Navigation (site and vessel)
	4. Failure (or non-availability) of Aids to Navigation & other systems
	5. Site specific effects on aids to navigation e.g. masking by background lights, masking by structures and the effects of rotating blades, control responsibility for foghorns, etc.)
	6. AIS (Automatic Identification System) failure or not required to fit.
	7. Marking on charts of OREI structures and associated navigation aids
3	Bathymetry
	1. Accuracy of and changes to bathymetry (e.g. navigable channels, shifting sandbanks, anti-scour material, seabed mobility, etc.)
4	Interference
	1. Interference with vessel-based communications.
	2. Interference with shore-based communications.
	3. Interference with vessel-based navigation. (e.g. GPS, radar, compasses etc.).
	4. Interference to ship-based radar e.g. shadowing and blind sectors and false echoes.
	5. Interference with shore-based navigation. (e.g. VTS services, MRCC services, etc.)
	6. Interference to shore based radar e.g. shadowing and blind sectors and false echoes.
	7. Similar interference to helicopter and fixed wing aircraft radar used in SAR and emergency response.

R2	Influence on Causes
	8. Electromagnetic interference from turbine generators, transformers, other structures or cables.
	9. Acoustic interference to sonar, diver communications, echo sounders, fish finders and acoustic release systems.
	10. Helicopter radar contact in a wind farm or other OREI interpreted as a vessel contact.
5	**Future Technical Change**
	1. Application of radar absorbing material to towers and blades, etc.

C.3.4 Traffic Densities and types – Examples

Table 14 - Traffic Levels – Examples

R3	Traffic Levels
1	Hindcast – ½ consent period (e.g. 10 years)
2	Current
3	Forecast – ½ consent period (e.g. 10 years)
4	Forecast – full consent period (e.g. 25 years)

C.3.5 Circumstances – Examples

Table 15 – Circumstances – Examples

R4	Circumstance
1	**Intentional Navigation**
	a. Intentionally navigating within a wind farm or other OREI site en route or to carry out activities.
2	**Accidental Navigation**
	a. Unintentionally navigating within a wind farm or other OREI site or being forced to do so to avoid collision with another vessel, carried by the tide, etc.
3	**Emergency Navigation**
	a. Wind farm or other OREI site blocking passage to port of refuge, safe haven, inshore anchorage or inshore routes.
	b. Wind farm or other OREI site restricting anchoring.
4	**Forced Navigation**
	a. Wind farm or other OREI site forcing passage in more dangerous waters.
	b. Wind farm or other OREI site forcing passage in more congested water.

C.3.6 Influences on Consequences – Examples

Table 16 - Influences on Consequences – Examples

R5	Influence on Consequence
1	**OREI Design**
	a. Strength and robustness of turbines or other OREI structure.
	b. Collapse mode of impacted turbines or other OREI structure after contact/allision
	c. Design of turbines or other OREI structure to minimise entrapment of vessels, craft or persons in the water
2	**Vessels**
	a. Vessel size.
	b. Vessel cargo. (e.g. polluting cargoes, hazardous cargoes, etc.)
3	**Search and Rescue**
	a. Adequacy of Search and Rescue provision (e.g. equipment, equipment location, communication, etc.).
	b. Availability of Search and Rescue resources (e.g. currently in commercial use, multiple SAR operations, etc).
	c. Ability to deploy Search and Rescue resources (e.g. helicopter operations affected by blade rotation, aircraft operations affected by search height restrictions, etc.).
4	**Emergency Response**
	a. Adequacy of Emergency Response provision (e.g. tugs, oil spill equipment, communications, etc.).
	b. Availability of Emergency Response resources (e.g. currently in commercial use, multiple ER operations, etc).
	c. Ability to deploy Emergency Response resources (e.g. state of contingency planning).

C4 Tolerability of Risk

Determining whether the predicted level of risk from an OREI development is tolerable or not is, in the first instance, a matter of asking the following questions:

a. is the risk below any unacceptable limit that has been established?
b. if so, has it also been reduced to as low as reasonably practicable (ALARP)?

The risk is only tolerable if the answer to both these questions can be demonstrated to be 'Yes'.

Brief guidance on addressing these two questions is given below.

Question (a): is the risk below any unacceptable limit?

The HSE has suggested that, as a very broad indication, an individual risk of death of 1 in 1000 per annum should *"…represent the dividing line between what could be just tolerable for any substantial category of workers for any large part of a working life, and what is unacceptable for any but fairly exceptional groups"*. For members of the public who have a risk imposed on them in the wider interest of society *"this limit is judged to be an order of magnitude lower –1 in 10,000 per annum"*.

It is very important to note that these limits were originally proposed in the context of considering the tolerability of risks from onshore hazardous installations, such as nuclear or chemical plant. For such installations, it is relatively clear that the groups of people most exposed, who need to be considered as the limiting case, are workers at the site and/ or people living or spending a large proportion of their time in the vicinity. For an OREI development, identifying the most exposed groups is not easy. People on board passing vessels not associated with the OREI will in general only be exposed for a small proportion of time. Even those most involved with the development, e.g. service technicians using offshore accommodation between visits to OREI(s), may only be exposed to navigational risks for relatively short periods. This might suggest that the HSE's suggested limits could be relaxed. But such groups are already exposed to other risks at other times. For example, wind farm technicians are also exposed to risks from work at height, electricity and many other hazards. The navigational risk associated with OREIs cannot be allowed to 'use up' the entire risk 'budget'. Developers should therefore give very careful consideration to the question of who is exposed to risk and hence what limits may be appropriate.

It is also essential to note that the HSE's limits were intended to be applied to the total risk to a worker as a result of their occupation, or to a member of the public from a hazardous installation which poses a risk to them. As in the paragraph above, navigational risk is itself only one component of the risk to people, and the HSE limits cannot not be applied to it, or indeed to any further subdivision into components of the navigational risk, such as those vessel-vessel collision, vessel-OREI collisions, grounding, fouling of cables and so on. The IMO (Ref. MSC-MEPC.2/Circ.12/Rev.2) recognises this, stating: *"… risk acceptance criteria always refer to the total risk to the individual and/or group of persons. Total risk means the sum of all risks that e.g. a person on board a ship is exposed to. The total risk therefore would contain risks from hazards such as fire, collision, etc. There is no criterion available to determine the acceptability of specific hazards….".* In the context of risk assessment for an OREI, total risk means the sum of all risks arising from the presence of the OREI.

The HSE is careful to note that any quantitative 'unacceptable' limits must be used with great caution. The concepts used in establishing them are complex, and the quantitative predictions that might be compared against them are fraught with uncertainty. It may not be helpful to attempt to define quantitative limits, and developers should consider whether there are other ways to define what is unacceptable. The HSE guidance document *Reducing Risks Protecting People* (R2P2) notes that what is unacceptable *"…is often spelled out or implied in legislation, ACOPs, guidance, etc or reflected in what constitutes good practice"* such that there is no need to set an explicit quantitative boundary. Developers should therefore carefully justify any unacceptable limits they propose.

Question (b): has the risk been reduced to as low as reasonably practicable (ALARP)?

A primary duty on employers with regarding to health and safety in UK law (under the Health and Safety at Work etc Act, 1974) is to reduce risk 'so far as is reasonably practicable' (SFAIRP). For most purposes, this is synonymous with its being reduced ALARP. Establishing what is reasonably practicable involves considering whether further risk control measures are called for. This must be considered in terms of:

- whether the cost of further measures would be grossly disproportionate to the value of the benefit obtained and
- whether relevant good practice has been followed.

Further guidance on the concepts of gross disproportion and relevant good practice can be found in R2P2 and elsewhere on the HSE website. It is important to note that good practice is relevant to the situation; what is good practice for a wind farm may not be good practice for a tidal array, and what is good practice for commercial shipping may not be relevant to recreational vessels and/or personal watercraft. For OREIs that are novel in type or scale there may be no established good practice.

Wider considerations

These two questions are 'pure safety' ones. In question (a), risk is considered in relation to what has been tolerated in other contexts and in question (b), it is weighed against the cost of reducing it further. Other considerations are likely to be taken into account in the final claim or decision about whether or not, taking account of risk, a development should be consented. Risk will be weighed together with other effects, positive and negative, of the proposed development. Nevertheless, the two questions provide a useful framework for looking at risk 'in its own terms'.

C5 Risk Matrix

There is no generally accepted standard for a risk matrix therefore developers will be expected to define the following as appropriate to the OREI development:

- likelihood/frequency of incident scenarios
- severity/consequence of incident scenarios
- risk matrix
- tolerability matrix scores

The below IMO examples are based on ship-board scenarios and will require intelligent application for navigational risk posed by Offshore Renewable Energy Installations. It is suggested the assessment is based on a matrix that developers believe is appropriate for the needs of their development.

C.5.1 IMO Example of Likelihood/Frequency Index

Frequency Index			
Frequency	7	Frequent	Once per month on one ship
	5	Reasonably Probable	Once a year in a fleet of 10 ships
	3	Remote	Once a year in a fleet of 1000 ships
	1	Extremely Remote	Once in 20 years of a fleet of 5000 ships

C.5.2 IMO Example of Severity/Consequence Index

(Note: this example does not consider severity/consequence to property)

Severity Index			
Severity	4	Catastrophic	Multiple fatalities
	3	Severe	Single fatality of multiple severe injuries
	2	Significant	Multiple of severe injuries
	1	Minor	Single of minor injuries

C.5.3 IMO Example of Risk Matrix

Risk Matrix					
	FREQUENCY	SEVERITY			
		1	2	3	4

		Minor	Significant	Severe	Catastrophic
4	Frequent	**8**	**9**	**10**	**11**
		7	**8**	**9**	**10**
3	Reasonably Probable	**6**	**7**	**8**	**9**
		5	**6**	**7**	**8**
2	Remote	**4**	**5**	**6**	**7**
		3	**4**	**5**	**6**
1	Extremely Remote	**2**	**3**	**4**	**5**

C.5.4 HSE Example of Tolerability Matrix[15]

Risk Matrix Score	Tolerability	Explanation
7	Unacceptable	Risk must be mitigated with design modification and/or engineering control to a Risk Class of 5 or lower before consent
6	Unacceptable	Risk must be mitigated with design modification and/or engineering control to a Risk Class of 5 or lower before consent
5	Tolerable with Modifications	Risk should be mitigated with design modification, engineering and/or administrative control to a Risk Class of 4 or below before construction
4	Tolerable with Additional Controls	Risk should be mitigated with design modification, engineering and/or administrative control to a Risk Class 3 or below before operation
3	Tolerable with Monitoring	Risk must be mitigated with engineering and/or administrative controls. Must verify that procedures and controls cited are in place and periodically checked
2	Broadly Acceptable	Technical review is required to confirm the risk assessment is reasonable. No further action is required.
1	Broadly Acceptable	Technical review is required to confirm the risk assessment is reasonable. No further action is required

[15] HSE R2P2 document.

ANNEX D APPROPRIATE ASSESSMENT TECHNIQUES & TOOLS

D1 Overview of Appropriate Risk Assessment

D.1.1 Introduction

In their assessments and submissions developers will be expected to undertake appropriate assessment in support of their navigation risk assessment. This can be extended to cover some aspects of search and rescue (SAR) and emergency response.

This Annex gives an overview of:

- the purpose of the appropriate assessment in a developer's assessment and submission;
- the types of appropriate assessment, for example modelling, sought for in a developer's assessment and submission;
- the hierarchy of appropriate assessment techniques appropriate to a developer's assessment and submission;
- the concept of a scenario to control the scope and depth of the appropriate assessment.

The Annex then includes:

- Guidance on Navigation Risk Assessment
- Area Traffic Assessment
- Specific Traffic Assessment

Note: *Guidance on appropriate search and rescue overview and appropriate emergency response overview can be found in Sections 3.3, 3.4 and 3.5.*

D.1.2 Purpose of an Appropriate Assessment Technique in Risk Assessment

The purpose of the appropriate assessment is to:

- Prove Feasibility
  Demonstrate that the navigation activities (or search and rescue and emergency response activities) are feasible, with the wind farm or other OREI structures in place, during the phase of development, for the vessel types and with the conditions

- Quantify Risk
  Produce a quantitative or qualitative value, acceptable to Government, of the change in risk caused by the development to the base risk associated with the activity and how this risk varies across vessel types

- Assess Sensitivity
  Determine the sensitivity of the risk to the conditions and the risk factors

- Decide on risk controls
  Identify, evaluate and decide on appropriate risk controls to reduce risk to ALARP.

D.1.3 Purpose of the Appropriate Assessment in Hazard Log Closure

In addition, the discipline of the appropriate assessment technique is to be used to identify issues that need to be considered:

- to close the hazard log
- to develop the risk control log.

D.1.4 Types of appropriate assessment

Depending on proportionality judgement leading to the scope and depth of the submission the following types of other appropriate assessment, for example numerical modelling, may be needed:

- In support of navigation risk assessment
- Area traffic assessment
- Specific traffic assessment
- For search and rescue and emergency responses assessments see Sections 3.3, 3.4 & 3.5.

D.1.5 Concept of the Scenario to Control the Scope and Depth of the appropriate assessment

The various hazard identifications will generate a large number of situations that require further investigation.

The concept of the scenario is to set up a model (or assessment), that while it is not necessarily an exact representation an exact situation being assessed is sufficiently:

- widely defined to cover a range of situations in a single scenario
- applicable to generate reasonable estimations of feasibility, risk, sensitivity and the effect of controls.

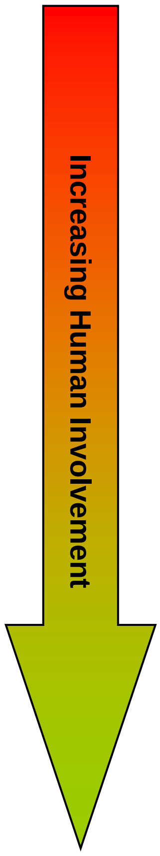
D.1.6 Hierarchy of the appropriate assessment in support of Navigation Risk Assessment

The concept of the methodology is of a hierarchy of appropriate assessment, including numerical modelling, which starts at the area level and the results used to define, if necessary, more specific issues to be investigated.

For example, the process followed to support the navigation risk assessment of a particular proposal might be:

Table 17 - A Possible Hierarchy of Assessment and Trials in support of Navigation Risk Assessment

1a	Area Traffic Assessment of the Strategic Area
	leading to:
1b	Area Traffic Assessment of the OREI Area
	leading to, where necessary:
2a	Specific Traffic Assessment in and around the OREI Area
	leading to (where necessary and appropriate to the development proposal):
2b	Specific Traffic Simulation in and around the OREI Area
	leading to (where necessary and appropriate to the development proposal):
3	Specific Traffic Bridge Control Simulation in and around the OREI Area for training and research purposes
	leading to (where necessary and appropriate to the development proposal):
4	Site Specific Trials



Definition 1 – Area Traffic Assessment

Area Traffic Assessment assesses the marine environment, the traffic and the OREI development to predict the risk of collision, contact, grounding and stranding now and in the future. If appropriate it may need to be statistical in nature, in any case based on assessing the vessel traffic and the behaviour of vessels with relation to steering rules, speed changes, the route they wish to follow, etc., and the multiple interrelationships with a large number of vessels, of different types, navigating in the same environment over a long time and involved in a variety of operations which will each interact.

Definition 2 - Specific Traffic Assessment

Specific Traffic Assessment might be used to assess in detail the risk of more specific navigation issues, and proposed risk controls, that could require a higher quality assessment and representation of:

- the manoeuvring capabilities of the vessels, including such parameters as their stopping distances and turning circles
- changes which may result in the mariners' domain size as manoeuvring sea room reduces
- details of the bathymetry.

It may also be of value to use a Navigation Simulator to train appropriate mariners in the navigation and operation of their vessels within and close to wind farms or other OREIs. Research could also be carried out, by driving the ship in real time, in conjunction with other instructor/assessor-controlled target vessels in encounter situations, to assess the feasibility and level of risk. This might include the risk of grounding or collision or contact with other vessels and structures within the OREI area or in nearby restricted water navigable channels. Such training or research should also include the ability for mariners to navigate in all circumstances using simulated radar and ARPA displays, as appropriate to their vessel types, integrated with the vessel control simulator and other simulated navigation and communication systems.

Simulators used to assess navigational risk in and near to offshore wind farms or other OREI must be capable of simulating all the navigational effects and phenomena relevant to, or peculiar to those specific OREI structures. These include, for example, the effects of such structures on vessel and shore-based radar systems.

Any simulators used should comply with Section A- I/12 ("*Standards governing the use of simulators")* of the International Convention on Standards of Training, Certification and Watchkeeping, 1978 as amended in 1995 and 2010 ("STCW Convention", IMO).

***Note**: The Instructors and Assessors operating the simulator/s should be qualified and experienced as specified in Section A-I/12 Part 2 subsection 9 of that Convention ("Qualifications of instructors and assessors").*

For non-critical assessments MCA may grant permission for systems and personnel not reaching these standards and qualifications to operate acceptable proprietary systems in mutually agreed scenarios. Such permission should be sought from MCA by developers before the assessment takes place.

Some of the parameters worked out in this way may then be used in the definition of "rules" in the Area Traffic Modelling/Assessment.

Definition 3 - Specific Traffic Full Bridge Control Simulation

For critical risks or significant investment decisions on risk control options it may be necessary to extend the assessment to simulation using full bridge simulators. A number of UK marine training and research establishments, together with some universities, have such systems.

Definition 4 – Site Specific Assessment

Any numerical modelling, navigation simulator systems or other assessment techniques used in the risk assessment of a specific development will, singly or in combination with other tools and techniques, be required to fully:

a. include bathymetric and other site features data for the area using an Electronic Navigational Chart (ENC) base map or as determined by a site-specific survey. In particular, depth contours and navigation channels relevant to various vessel types, sizes and operations should be taken into account with respect to the potential for colliding with other vessels or OREI structures and for grounding due to the limitations of water space or whilst avoiding a collision.

b. model or assess the effects of tide and tidal streams in the OREI area, plus any local currents so as to determine their effects on normal manoeuvring and operations and on vessels not under command, SAR, pollution control, etc. Where tidal streams may be significantly affected by an OREI, such as tidal turbines, the effects should be modelled or assessed, covering the OREI itself and, as necessary, the surrounding area;
c. model or assess the effects on navigation and marine operations of various weather conditions such as wind, sea state and visibility;
d. use the survey traffic data supplied by the developers and other sources from a combination of radar surveys, Automatic Identification System (AIS) data, observational and historical records;
e. model or assess typical fishing and recreational activities within and close to the OREI area, as in (d) above and their interaction with other vessel types navigating near and within that area. Such requisite background data to be supplied from the developers and other sources;
f. model or assess each vessel type with suitable draughts, dynamics and domains or equivalent parameters;
g. establish a baseline of marine activity without an OREI;
h. examine the effects of the OREI on this marine activity and traffic if no re-routeing is recommended;
i. model or assess the chain of navigational events as vessels pass within or close to the OREI (i.e. where an alteration of course or speed made in an encounter with a turbine or other vessel produces a further encounter or encounters, including the avoidance of grounding in confined channels and shallow water effects);
j. model or assess the effect of the OREI on the necessary compliance of various vessel types to all of the International Regulations for the Prevention of Collisions at Sea 1972, as amended, (The Collision Regulations or "COLREG") (e.g. power to sail, sail to fishing vessel, overtaking vessels, etc.) and to any local rules if the site lies within the area of an appropriate local authority;
k. examine the cumulative effects of all wind farms and other OREI, aggregate dredging, other offshore installations etc., within the proximity of the given site, given the traffic data by developers;
l. recommend optimum routes based on the foregoing assessments if these are seen to be required;
m. determine, on request, the increased passage distances produced by re-routeing of specific vessels;
n. allow for power and steering failures within and close to the OREI together with suitable researched allowances for human error and the effects of metocean conditions. Note that incidents such as capsizing may be part of normal operations for recreational craft that may result in them being unable to manoeuvre to avoid OREI structures;
o. Include the effects of the OREI on the detection of other vessels within or on the far side of it, such effects to include visual blind areas and radar effects such as shadow and blind sectors, spurious echoes and other effects, etc., using the typical beam widths, pulse lengths and powers of the vessel type radars involved;
p. model all vessel types' compliance with Collision Regulations Rule 19 in relation to sub para (o) above;
q. apply such effects to relevant port and Vessel Traffic Services (VTS) radar sites;
r. If required by MCA, investigate the effects of the OREI on helicopter SAR and fixed wing aircraft dispersal operations, etc., particularly any radar or thermal imaging effects;
s. examine the hazards and the consequences of major incidents within or close to the OREI including wreck, collision involving large passenger vessels, etc.;
t. include data and an overview of the consequences and control of oil and other pollutant spills;

u. recommend minimum separation distances of the specific wind farm or other OREI boundaries from established navigational routes, from port approaches, from routeing schemes, from existing recreational areas, from other OREI and from other offshore operations (see the MCA website for initial guidance);
v. make navigational risk recommendations with respect to the construction and operation phases of the development;
w. include an overview of potential search and rescue activities and difficulties within and close to the OREI

Note: *In the post-construction phase there is a requirement for OREI operators to monitor & review the impact which their activities are having on navigation and its safety. Where practical, feedback should also be obtained from commercial Masters, fishing vessel skippers, work boat crews and recreational sailors who regularly operate in and around different wind farm sites to get realistic information on their experiences in different conditions.*

D2 Selection of Techniques that are Acceptable to Government

The purpose of this annex is to give guidance on how to select modelling tools or other assessment techniques that are, or will be, acceptable to Government.

This Annex describes:

- the process of selection of assessment techniques
- how to obtain MCA approval including:
  - the self-declaration process
  - the extent of the process
  - the activities required
  - the information required
- the method of describing in the submission the techniques and tools used.

D.2.1 Process of Selection of Assessment Techniques and tools

The Assessment Techniques and tools used shall have been submitted to the MCA for approval including a self-declaration.

Whichever technique or tool is selected, the user is strongly recommended to consult with the MCA prior to its use in a specific assessment.

D.2.2 Approved OREI Tools and Assessment Techniques

“Approved OREI Tools and Assessment Techniques” are those which are granted approval by the MCA for use with OREI, and which will subsequently join the list of those having previously obtained such approval.

D.2.3 How to Obtain MCA Approval for Tools and Assessment Techniques

The process of gaining MCA approval may consist simply of a self-declaration of the Verification[16] of the Tools and Assessment Methods.

Extent of Self Declaration

The extent of this process will depend on the development status of each tool and assessment method. This status is categorised as:

- approved maritime tools and assessment techniques designed or modified specifically for assessing navigational risk within and near to OREI (Type D1)
- Widely and publicly used maritime tools and assessment techniques (Type D2)
- Specialist maritime tools and assessment techniques (Type D3)

[16] Verification: Confirmation through the provision of objective evidence, such as examination by or demonstration to the verifier, that specified requirements have been fulfilled. In software development, verification is the process of evaluating the (software) products of a given phase, or segment of work, to ensure correctness and consistency with respect to the products and standards provided as input to that stage. (ISO 9000:2000 TickIT guide 5.5 Revised 2007)

- Non marine tools and assessment techniques (Type D4)
- New tools and assessment techniques (Type D5).

List of Approved Maritime Tools and Assessment Methods (Type D1) are either:

Tools and assessment techniques designed or modified specifically for assessing navigational risk within and near to OREI approved by the MCA for use with the maritime environment.

or

Tools and assessment techniques designed or modified specifically for assessing navigational risk within and near to OREI and approved by third party bodies acceptable to MCA for use with the maritime environment.

Widely and publicly used maritime modelling tools and assessment techniques (Type D2) are either:

Maritime modelling tools or assessment techniques that are commercially available, quality controlled, with a proven track record and a large user base, but not necessarily with reference to offshore OREIs or other offshore structures.

or

Maritime modelling tools or assessment techniques that are not commercially available but are quality controlled, have a proven track record and have been used on a large number of applications or projects, but not necessarily with reference to offshore OREIs or other offshore structures.

Specialist maritime modelling tools and assessment techniques (Type D3) are:

Maritime modelling tools and assessment techniques that have been built up by a single user (or small group) and have been used on other specialist projects.

Non-maritime modelling tools and assessment techniques (Type D4) are:

Modelling Tools and Assessment Techniques that are commercially available and quality controlled but are capable of being used in a new way or domain.

or

Modelling Tools and Assessment Techniques that are not commercially available but are quality controlled but are capable of being used in a new way.

New modelling tools and assessment techniques (Type D5)

The development of new modelling tools and assessment techniques is to be encouraged, however, by their nature they will require more evidence of verification.

D.2.4 Specific Activities to Obtain Approval of Tools and Techniques

Depending on the status of the tools and techniques the activities to obtain approval shall include reasoned arguments and evidence for some, or all of, the following stages:

- statement of tool applicability
- clarification of conceptual model
- documented model/commented code
- demonstration of abilities
- peer/expert review
- comparison with real-world experience.

Statement of Tool Applicability

Explain how the tool is applied to the specific OREI assessment task. State how assumptions inherent in the tool affect the application to the OREI task.

Clarification of Conceptual Model

Document the conceptual model. This documentation should include:

- Objective(s)
- System structure/configuration
- Detailed description of the tool, and, if using numerical techniques, its algorithms.
- Logical rules & flow charts
- Input data sources.

Documented Model / Commented Code

Provide evidence that computer modelling tool code is sufficiently documented to enable another competent person to see how it corresponds to the conceptual model.

Demonstration of Abilities

If required, demonstrate to Government departments and agencies the capabilities of the modelling tool or other assessment technique.

Peer / Expert review

Provide evidence that the modelling tools or other assessment techniques have been peer reviewed by government approved person or persons.

Comparison with Real-World Experience

Provide evidence that the modelling tools or other assessment techniques have been compared to real-world experience in similar applications.

D.2.5 Specific Information Required to Obtain Approval of Modelling Tools or other Assessment Techniques

The scope of information that should be included with the Self Declaration:

Table 18 – Self Declaration Information

	Stage	Demonstration	Statement of Tool Applicability	Clarification of Conceptual Model	Documented Model / Commented Code	Peer / Expert Review	Comparison with Real World
D1	Maritime Modelling Tools and Techniques Approved for Application to OREI	✓	✓	-	-	-	-
D2	Widely and Publicly Used Maritime Modelling Tools and Assessment Techniques	✓	✓			✓	
D3	Specialist Maritime Modelling Tools and Assessment Techniques	✓	✓	✓	✓	✓	✓
D4	Non-Marine Modelling Tools and Assessment Techniques	✓	✓	✓	✓	✓	✓
D5	New Modelling Tools and Assessment Techniques	✓	✓	✓	✓	✓	✓

Depth of Information

The Depth of Information required is dependent on:

- the level of risk the tool or technique is assessing
- the level of control (if any) the tool or technique has on the Risk.
- Level of risk and control is likely to range

From:

Highest

- Navigation tools used in real time navigation monitoring and management (also, if appropriate, SAR Tools used in real time search planning)

High

- Specific navigation situation tools used to evaluate high risk conditions and advise on important controls (also, if appropriate, SAR tools used in advance search planning)

To:

Medium

- Specific navigation tools used to evaluate medium risk conditions
- Marine traffic assessment tools used to assess marine risk

Low

- Marine traffic assessment tools used to assess the economic impact of changed shipping routes.

It is up to the tool user to assess the level of risk and the level of control and provide an appropriate depth of information. IEC61508 [17] may be used as a guide.

D.2.6 Specific Information Required when Describing the Tools and Assessment Techniques Used

The description of the modelling tools and other assessment techniques used (or proposed to be used) should include:

- the modelling tool name including the version number of the software
- the application that the tool or assessment technique is supporting e.g. supporting marine traffic assessment, specific navigation situation assessment, SAR resource planning, SAR response planning, oil spill assessment, tidal resource and streams
- which OREI or OREI area
- description of the modelling tool concept
- a description of prior use of the tool in OREI, marine and other applications
- any pre or post processing software
- the hardware the modelling tool will be run on
- the approval status including reference to 3rd party certificates
- the self-declaration status

D.2.7 Specific Information Required when Describing the Assessment Methods Used

The following is an example of an assessment method description form.

Table 19 - Example of Technique or Tool Description

Assessment Method	Description
Name of Method	
Use of Method	
Method Type (D1 to D5)	
Concept of Method	
Prior Use of Method	
Pre or post Processing	
Other relevant information	

[17] International Standard IEC 61508 "Functional safety of electrical / electronic / programmable electronic safety-related systems (E/E/PES)" International Electrotechnical Commission

D3 Demonstration that the Results from the Techniques are Acceptable to Government

The purpose of this annex is to give guidance on how to demonstrate that the result from applying the selected techniques are, or will be, acceptable to Government.

This Annex describes:

- the process for self-declaration of validated [18] results
- self-declaration activities
- sources of real-world information.

D.3.1 Process for Self-declaration of Validated Results

The submission shall include a self-declaration that the results have been validated.

For each validation activity on the results, a declaration should be made that present the results and findings, together with a clear statement. An example format of a validation statement is given below. One statement can be made to cover a multiple set of results.

Table 20 - Example Format for a Validation Statement

Heading	Description
Validation activity	
Results produced by (staff member)	
Results produced on (date)	
Pre or post Processing	
Simulation parameter settings (if relevant)	
Comparison data (where relevant) description & source	
Validation Conclusion	

D.3.2 Self Declaration - Activities

For all results presented, the documentation of results validation shall include reasoned arguments and evidence for the following:

- tuning of parameters
- consistency checks
- behavioural reasonableness
- sensitivity analyses

[18] Validation: Confirmation or ratification through the provision of objective evidence that the requirements for a specific intended use or application have been fulfilled. (ISO 9000:2000 TickIT guide) Revised 2007

- comparison with real-world experience.

Tuning of Parameters

The submission should provide evidence that the modelling or other form of assessment has been carried out appropriately. Different methods have different parameters so the tuning required will differ. However, three key components, applicable in most models, are:

- choice of mathematical routines; choice of appropriate integration algorithms & statistical estimators
- convergence; increasing the resolution in a control dimension until changes of results are within satisfactory magnitude;
- mathematical formulae fitted to data should have some measure of goodness-of-fit calculated.

Consistency Checks

The submission should provide evidence that at key points (typically at the end), values of all parameters should be output & demonstrated that they are correct/consistent with the input. This checks that no inadvertent changes happened in the coding or running.

Similarly, variable distributions used should be checked.

Behavioural Reasonableness

The submission should provide evidence that the assessment has been exercised under a range of conditions and demonstrate that the results were reasonable.

- this is mainly a qualitative exercise, but it should be checked that variables stay within their bounds. For example, key values of variables such as vessel speed, as simulated, should be compared with the input data;
- the conditions simulated should include some extreme events; more severe than the events to be simulated for real. Reasonable behaviour under extreme conditions gives good confidence in the results for less severe conditions.

Sensitivity Analyses

The submission should provide evidence that the key input parameters have been varied by small amounts to determine the sensitivity of the results to changes in these inputs, and that the sensitivity has been examined for reasonableness.

- this sensitivity analysis is especially important for input parameters where there is uncertainty around the correct value to use.

Comparison with Real-World Experience

The submission should provide evidence that results have been compared with real-word experience.

- real-world experience may be in the form of data from controlled experiments (e.g. trial manoeuvring of a ship) or data from natural experiments (e.g. statistics on marine accidents)

- wherever real world experience is presented, it shall include estimates of uncertainty (data validity)
- care should be taken in calibrating to fit results to real-world experience: While calibration improves the comparison with a specific case, it reduces the generality
- state all calibrations applied to the model during validation.
- validation against real-world experience must be specific to the situation modelled.

If comparison with real-world experience is not possible, the developer shall justify why this is so.

- This model-to-model validation is not as thorough as model-to-real-world validation (both models may be wrong) but may be acceptable. The greater the difference in the two types of models compared, the greater the confidence in the result if they agree. A good example would be comparison between a computer simulation & a physical (test tank) model.

D.3.3 Sources of Real-World Information

Marine Accident Investigation Branch (MAIB)

The Marine Accident Investigation Branch (MAIB) issue statistical reports on marine accidents (freely available via the web page, below) and can also provide, on request, statistics broken down to date, location, vessel type & accident type. Some data will be freely available. Contact: http://www.maib.gov.uk/

MAIB data covers all accidents required to be reported under "The Merchant Shipping (accident reporting & Investigation) regulations 2005", available at: http://www.maib.gov.uk/resources/index.cfm. This is, broadly, all UK commercial vessels plus all foreign vessels in UK waters taking passengers to or from UK ports. This is thus useful but not exhaustive. Furthermore, incidents recorded in the MAIB database should all be included within HM Coastguard data. However, MAIB perform detailed investigative work on causes of accidents, which may be useful for understanding accident patterns or specific events. For example, the number of marine accidents reported to MAIB per year has varied quite widely.

Royal National Lifeboat Institution (RNLI)

The RNLI statistician keeps records of all their lifeboat launches, including incident date, incident type & type of vessels involved. This will not be exhaustive (RNLI are not called out to all incidents) but does show detailed information on the range of incidents in an area.
Contact: http://www.rnli.org.uk

IHS FAIRPLAY

IHS-Fairplay can provide, commercially, information on all global marine accidents involving vessels of 100 GRT & over, including vessel type, accident type & location.
Contact: http://www.fairplay.co.uk/

Port and Harbour Authorities

Port and Harbour Authorities keep records of vessel traffic within their limits and can be a source of information for the local area.

D4 Navigation Risk Assessment – Area Traffic Assessment Techniques

D.4.1 Use of Area Traffic Assessment Techniques

Area Traffic Assessment will be required when there is uncertainty over the effect of the OREI on the ability of vessels to navigate and operate in the waters adjacent to and through the wind farm or other OREI area without suffering an increase in risk. Such risk will include amongst others the risks of contact, collision, grounding and stranding.

Fundamental Requirements of Area Traffic Assessment

The fundamental requirements of Area Traffic Assessment include:

- that it assesses all traffic in both the strategic OREI area (if appropriate for the particular development) and the OREI area itself
- that it assesses the movement of vessels through the water in a way that is representative of vessel navigation and activity
- that it assesses the real-world behaviour of the vessels to the Collision Regulations including:
  - the effect of reduced visibility on compliance with the Collision Regulations coupled with the expected effects on vessel and shore-based radars
  - a representative rate of human error in applying the Collision Regulations
  - a representative rate of deliberate non-compliance with the Collision Regulations
- that it assesses the effect of manoeuvring in restricted waterways (defined from bathymetric data developed from Electronic Navigation Charts or from site specific surveys) including action by vessels to avoid shallow water
- that it is used to calculate:
  - as a minimum the frequency and density of interaction between vessels, vessels and shallow water, and vessels and OREI structures, to gain statistically significant information to assess the effect of the fundamental Risk Control Options of location, alignment, size and layout
  - the probability of collision, contact, and grounding
  - for specific vessel types the risk and tolerability of the risk.

D.4.2 How to select the Situations Requiring Area Traffic Assessment

Source of the Situations

The situations requiring assessment will come from:

- the need to evaluate the general effect of the OREI on the marine traffic and the navigational risks associated with a development
- the cumulative navigation risks associated with the development and the other OREI developments and other types of marine activity in the Strategic OREI Area
- the in-combination effects on the navigation risk of the development with other economic developments over the operational life of the OREI
- the need to evaluate the specific impact of the OREI due to the presence of specific marine traffic activity that may be present, or is planned, in close proximity to the OREI
- the hazard log
- the risk control log.

Study Area

It is anticipated that at least two study areas will be required.

- Study area 1 should be representative of an appropriate sea area which could be the full strategic area and used for evaluating cumulative and in-combination effects.
- Study area 2 should be representative of the OREI area and used to evaluate potential effects such as the introduction of separation schemes, safety zones, etc., near to and within the OREI.

Guidance on the size of the OREI study area is provided in Annex B1 – "Understanding the Base Case Densities and Types of Traffic". Having developed an appropriate area, it is then necessary to identify the significance of key meteorological and oceanographic parameters, and the nature and distribution of marine traffic passing within the study area.

D.4.3 How to Define Scenarios for Assessment

The assessment should include, as a minimum, the following scenarios which have been proposed to assess the cumulative impact but ensure the key drivers of increased marine traffic levels and navigation constraints can be isolated and identified.

Table 21 - Scenarios Requiring Area Traffic Assessment

Item	Scenario	Objective
1	Present day Base Case	Provide assessment of present risk level for validation with historic data
2	Future Case based on: • Traffic types and densities mid-way through the consent period (e.g. 10 yrs) • Traffic types and densities at end of the consent period (e.g. 20 yrs)	Future assessment of study area risks with no OREI present
3	Base Case with OREI	Provide analysis of OREI(s) impacts only, unrelated to traffic increases or reductions
4	Future Case with OREI based on: • Traffic types and densities mid-way through the consent period (e.g. 10 yrs) • Traffic types and densities at end of the consent period (e.g. 25 yrs)	

D.4.4 Requirements for Assessing a Scenario

Each of the Scenarios should be assessed to determine:

- Feasibility
- Risk

- Sensitivity
- Controls.

Feasibility

The feasibility of shipping operations through a particular water space or channel, adjacent or close to OREI developments is best developed with respect to the meteorological and oceanographic data collated above, and guidance on vessel navigation requirements.

Some aspects of the feasibility and desirability of navigation within channels might also be identified with reference to graphic outputs developed by simulation models which have the capability to place the instructor/assessor within an area traffic simulation. These tools may be used to assist in reviewing the relative sea room, and the navigation interactions within the Study Area.

Risk

The risk associated with navigation within or close to wind farms and other OREI should be related to frequency and consequence. The analysis results should inform the key changes in risk of collision, contact and grounding/stranding as a result of the OREI development, with consequences being fed into SAR and counter pollution assessment. The assessment output should be tailored to identify:

- the quantitative risk level;
- if the “Future Case with OREI” scenario develops broadly acceptable risk when judged against the present traffic environment, the “Future Case” (no OREI(s)), or are:
    - tolerable with modifications
    - tolerable with additional controls
    - tolerable with monitoring
- that further risk control is grossly disproportionate.

The output must provide specific data on collision potential between all vessel types routes and operations within the Study Area. The output should be in a format that the following key questions can be posed and answered:

- where are the areas of increased risk?
- what is the magnitude of collision, contact, grounding and other hazard increases?
- which vessel type’s routes and operations are most impacted, and where do these incidents occur?
- is the marine traffic assessment covering all the elements of navigation and other marine activities associated with key incidents, or should these scenarios be specifically addressed - perhaps within navigation simulations - to better encompass meteorological, oceanographic, navigation and human response factors?
- what SAR and counter pollution overview data may be generated from the key incidents?

The selection and identification of key incidents will be site specific, however the following threshold is recommended:

All locations where vessel types and/or routes see an increase in risk of over 50% should be reviewed independently to identify further potential impacts from meteorological and oceanographic factors, or the applicability of mitigation measures.

Sensitivity

Each of the principal scenarios defined above may be subject to sensitivity tests to examine the impact of key drivers. The sensitivities to be examined should be determined from the Influence Analysis. See Annex C3 Guidance on the Influences on the Level of Risk.

These include, but are not limited to:

- ***Adjacent wind farms and other OREI*** - These scenarios may require one or more analysis for each future year to address the impact of adjacent OREI developments.
- ***Variation in Traffic Mix*** – Key assumptions may have been made on port/terminal/marina developments and other types of marine activity that generate traffic within the Study Area. It may be appropriate to conduct sensitivity tests on the presence or absence of this associated traffic to evaluate its impact on the risk profile.
- ***Variation in Traffic Routeing Assumptions*** – Variations may be made in the routeing of traffic adjacent to and within wind farm(s) and other OREI to review the risk control measures available, and/or the sensitivity of risk to changes in these issues. This may include the minimum separation/exclusion from the OREI.
- ***Variation in Tidal Level*** and Streams – Channel widths and available sea room may be significantly impacted by changes in tidal level. Navigation and various marine operations may also be affected by tidal stream rates and directions. If these are key issues for the Study Area their impact should be addressed within sensitivity testing.
- ***Variation in Assessment Parameters*** – Should the techniques and tools adopted be particularly sensitive to variations in their parameters these features should be sensitivity tested. Examples include the perception distances adopted within the simulation, and the assessment of vessel "domains".
- ***Weather routeing, bad weather impacts on short sea services*** – Impacts on short sea crossings, scope to allow weather routing, seeking minimising violent ship movement and vessel stress.
- ***Visibility and Vessel or Structure Detection*** – The principal scenarios may have been performed with base assumptions on the change in risk as functions of such limitations as loss of visibility or radar detection due to the presence of an OREI, or lack of AIS data. Vessel interaction is particularly considered to increase as two vessels (who might be considered as completely blind to each other's presence) approach on either side of, close to, or within a wind farm. The layout of the wind farm will contribute to changes in this base profile. Key assumptions associated with this issue, and those associated with other OREI types, may be tested in a series of sensitivity analyses.

Area traffic simulations are frequently subject to variation in output between representative days due to random generation of traffic within the model. If a simulation approach is selected, then the models should be run for sufficient time to create stable average results. Where comparison between scenarios is required these should be made on the basis of stable scenario results.

Effectiveness of Controls

Where feasible the quantitative impact of modifications, controls, and monitoring should be identified. These may, but not necessarily, include:

- realignment of development boundaries and/or turbine/platform or other structure configurations
- possible safety zones
- recommended minimum separation distances of the specific OREI boundaries, and
- established navigational routes

- mandatory routeing schemes

D.4.5 Analysis and Presentation of Results

Presentation of results should be clear and concise and in a form that can be understood by both experts and non-experts alike. This could take the form of graphical presentation supported by text and numerical data. Where large datasets are used and required for presentation these are best referenced in an annex from the main text. The presentation should include:

- the assessment technique used e.g. background, validation, references and methodology
- data inputs
- the results
- any assumptions and deviations to mainstream methodology used in the calculations
- conclusions on the impact of the assessment results with regards to OREI development.

The output should inform the operator and reviewer of the quantitative and/or qualitative changes in marine risk as a result of the OREI, and future activity. This should be set against the marine environment that has been mapped for the Study Area. The assessment should, as a minimum:

- predict the vessel to vessel and vessel to structure encounters and grounding potential
- predict the contact/collision/grounding frequency distribution
- link to vessel types to predict contact and collision risk
- assist in the evaluation of the effectiveness of controls.

D.4.6 Critical Parameters within the Assessment

The following are identified as critical parameters within area traffic assessment.

Critical Parameters Table

Table 22 – Area Traffic Assessment – Critical Parameters

Critical Parameter	Explanation
Traffic Distribution	Positioning and width of vessel routes and operations
Traffic Density & Type	Total densities and types of traffic in the assessment and potential for vessel interaction.
OREI Location	Positioning and size of OREI, also orientation with respect to traffic streams and other vessel operations
Route Relocation	Assumptions adopted in impacting the original traffic distribution
Visibility	Assumptions adopted with respect to visibility through and close to the OREI and other means of vessel detection and tracking

D.4.7 Limitations of Assessment Techniques

All assessment techniques will have limitations, the extent to which these affect the results will be depend upon the scenario, the data used, and, in the case of simulation, the algorithms used. It will be necessary to discuss the limitations of the specific assessment techniques to be used with the Maritime and Coastguard Agency or, in the case of developments within port limits, other competent navigation authority, before assessment work is completed.

From illustrative risk assessments the following were identified as potential limitations of area traffic assessment techniques.

Limitations Table

Table 23 - Area Traffic Assessment - Limitations of Assessment

Limitation	Explanation
Validation on Vessel Class-by-Class basis	The quality of validation is a key issue, and where data exists the validation should be performed on a vessel by vessel basis.
Perception Issues	Validation supports the adoption of the domain and Collision Regulations assumptions adopted in the Baseline case. However severe compression of routes and increases in traffic may bring about situations beyond the scope of the original validation requiring it to be reassessed.
Near, Mid & Far Field perception	At present many assessment techniques conduct near field collision / grounding avoidance and middle and far field route following. The boundaries between local and far field navigation may be less distinct and assessment techniques with greater control and autonomy to "goal seek" will improve the veracity of the assessment.
2D model	Many area traffic assessment techniques are 2D models. Greater consideration of risk issues and perception of navigation challenges be developed if the user was able to enter the model and review the simulation from the model ship's perspective.

Key limitations should be presented within any submission, and the significance of the limitations identified.

D.4.8 Verification of Modelling Tools or Appropriate Assessment Techniques Used

General Guidance

General guidance is given in Annex D2, Guidance on the Selection of Techniques that is Acceptable to Government.

Specific Guidance

For assessment based on modelling verification of the modelling tools used for the scenarios should include:

- Copies of the electronic model run files
- Paper copies (where possible) of the data used
- Paper copies of the results as graphics and text
- Functional description of the model
- Technical description of the model.

It is strongly advised that quality assurance procedures accompany the operation and management of the modelling process.

D.4.9 Guidance on how to Validate the Assessment Results

General Guidance

General guidance is given in Annex D3, Guidance on the Demonstration that the Results from the Techniques are Acceptable to Government.

Specific Guidance

Validation of the results can be achieved with the acquisition of reference data with known results – an intrinsic role of the Baseline scenario.

D.4.10 Performance Standards Sought for in the Modelling Tool or Assessment Technique Performance Standards Table

The following table is an indication of the performance standard required from assessment techniques and tools used.

Table 24 - Area Traffic Assessment – Performance Standards

Ref	Performance Standard	Comment	Importance H/M/L
1	**MGN Requirements**		
1.1	Simulation	Computer simulation techniques are suggested to be used, where appropriate, with respect to the displacement of traffic and, in particular, the creation of “choke points” in areas of high traffic density.	H
2	**Meteorological and Oceanographic Parameters**		
2.1	Bathymetry	Critical parameter for boundaries of safe navigation, and route development.	H
2.2	Visibility (radar blind and shadow sectors around Wind Farms and other OREI)	Key impact on vessel interaction adjacent to and within OREI**.**	H
2.3	Tides and Tidal steams	Key to understanding the effects of wave and tidal energy devices on navigation	H
3	**Navigation Activities Traffic**		
3.1	Route Geometry (where relevant)	Key driver for simulation	H
3.2	Traffic distribution across routes (where relevant)	Significant impact from traffic spread across routes.	H
3.3	Variation of Vessel Types	Key driver for derivation of risk and water space impacts.	H

Ref	Performance Standard	Comment	Importance H/M/L
3.4	24 Hour traffic Variation	Significant impact, particularly for scheduled traffic, fishing and tidal dependency.	H
3.5	Speed profile	Major driver of dwell time and risk.	H
3.6	Vessel Length	Consistent with vessel type represented.	H
3.7	Vessel Length Variation	Consistent with vessel type represented and survey data.	H
3.7	Vessel domains	Consistent with vessel type represented.	H
3.9	Vessel draughts	Consistent with vessel type represented and loaded state.	H
4	**Navigation Activities – Simulation Rules for the Movement of Vessels**		
4.1	Vessel types	Capable of modelling all the vessel types expected in and close to the OREI.	H
4.2	Vessels dynamics – vessel to vessel and vessel to structure manoeuvring	Consistent with vessel type represented	M
4.3	Vessels dynamics – turning, manoeuvring	Significant dependent upon available sea room, etc.	L
4.4	Vessel acceleration / deceleration	Low order if consistent validation applied.	L
5	**Navigation Activities – Simulation Rules for the Behaviour of Mariners**		
5.1	Collision Regulations	Vessel responses in accordance with all Collision Regulations including those relating to reduced visibility.	H
5.2	Collision Regulations – Human Error	Vessel responses not in accordance with Collision Regulations.	H
5.3	Collision Regulations - Violation	Vessel responses in violation of the Collision Regulations.	H
6	**Navigation Activities – Simulation Rules for Manoeuvring in restricted waterways**		
6.1	Vessel recognition	Recognition of turbines, shallow water and other obstructions.	H
6.2	Vessel type	Different rules for vessels of different types.	H
6.3	Tides and Tidal Streams	In accordance with predictions in the area, as modified by the OREI (where applicable).	M
7	**Scenario Flexibility**		
7.1	Traffic growth or reduction scenarios	Account needed of GDP growth, port developments, fishing and other activities.	H

Ref	Performance Standard	Comment	Importance H/M/L
7.2	Multiple simulations	Models with "typical" daily activity and statistical traffic variation require multiple runs for stable result reporting.	H
7.3	Multiple OREI	Critical ability for cumulative impact assessments.	H
7.4	Vessel Routeing Options & Control measures, i.e. safety zone	Development of alternate route structures.	H
8	**Results Assessment**		
8.1	Visualisation	Ability to place the instructor / assessor within the simulation.	H
8.2	Display – Route and Activity Structures	Ability to show the Route and Activity Structures on a GIS map or ENC chart.	H
8.3	Display – Route and Activity Details	Ability to show the details for each route and activity (e.g. speed, hourly rate, course variations, etc.).	H
8.4	Display – Risk Map	Ability to display Risk as coloured areas on a GIS map or ENC chart.	H
8.5	Display – Historical incidents	Ability to overlay historical incident on the Risk map.	H
8.6	Encounter Frequency	Ability to calculate and display encounter frequencies.	H
8.7	Collision probability	Derived from validated encounter frequency	H
8.8	Contact probability	Derived from validated encounter frequency.	H
8.9	Grounding probability	Derived from validated encounter frequency.	H
8.10	Vessel Types and Routes Analysis	Ability to break down risk, encounters and probabilities into vessel types and routes.	H
8.11	Vessel Specific Risk Controls	Focus and identify key classes featuring increased risk to focus detailed assessment & risk control.	H

D.4.11 Illustrative Example of an Area Traffic Modelling Process

Starting Point

The starting point for the marine traffic assessment process is:

- obtain Traffic Survey Data traffic in the OREI area from the up to date traffic survey (MGN requirement) as well as the traffic in the wider strategic OREI area
- define the Baseline meteorological and oceanographic conditions.

Baseline meteorological and oceanographic conditions

The techniques used should assess the significant features identified by the Technical and Operational Analysis. See Annex B3 – Defining the Marine Environment – Description of the OREI Development and how it changes the Marine Environment.

The bathymetry of the Study Area should be identified using data derived from Electronic Navigational Charts (ENC) or site-specific surveys. The key areas of shallow water and the vessel types potentially impacted by these areas (at the limits of the tidal range) should be identified. This constraint should be adopted when examining the potential routeing and operations of vessels within, around and through OREI. Particular attention should be paid to identifying those areas of shallow water which may, due to the diversion of traffic around an OREI, be a potential grounding hazard.

Tidal streams may affect the safety of navigation and, in certain areas local currents may also do so. Regions within the Study Area should be mapped that possess tidal stream or current speeds over 1, 2, 3 …etc … knots. Regions of particularly high rates should be identified, and their potential impact on the navigation of vessels highlighted. Where the OREI may change tidal stream rates, directions, timings, or tidal levels, uncertainty in the predicted effects must be taken into account e.g. by sensitivity studies.

As a guide the Canadian Coast Guard consider that following[19] limits possess the potential to impose navigation constraints in reduced sea room and increase the risk of grounding or poor vessel response during collision avoidance.

Table 25 - Tidal Streams and Currents with the Potential to Impose a Navigation Constraint

LENGTH (feet)	GROSS TONNAGE	BEAM (feet)	DRAUGHT (feet)	Vessel Types	Significant Tidal Stream or local Current Speed (knots)	
					Along Track	Across Track
1000 +	80,000 - 300,000	140' - 200'	54' - 80'	Ocean-going Tanker, Ore and Bulk Carrier	3	2
800 - 1000	30,000 - 100,000	95' - 175'	26' - 64'	Ocean-going Tanker, Ore and Bulk Carrier	3	2
630 - 800	10,000 - 60,000	60' - 140'	20' - 54'	Tanker, Ore and Bulk Carrier, General Cargo	7	3
550 – 630	8,000 - 30,000	55' - 105'	20' - 42'	Tanker, Ore and Bulk Carrier, General Cargo	7	3
300 - 550	2,500 - 20,000	43' - 105'	16' - 38'	Tanker, Ore and Bulk Carrier, General Cargo	7	3
300 – 600	2,500 - 13,000	56' - 90'	13' - 20'	Car Ferry	7	3
200 – 300	10 - 1,500	12' - 70'	2' - 9'	Car Ferry	6	4

[19] *Source: Canadian Coastguard "Preliminary Threat Rating"*

200 – 300	2,000 - 3,500	23' - 65'	9' - 20'	Tanker, Bulk Freighter, Self-Unloader, Fish Factory	7	3
200 – 250	2,000 - 3,000	40' - 60'	8' - 20'	Small Tanker, General Cargo, Fishing (Long Liner)	6	3
150 – 200	1,500 - 2,500	30' - 50'	6' - 15'	Small Tanker, General Cargo, Fishing (Long Liner)	6	2
90 – 150	200 - 800	12' - 50'	4' - 15'	Small Tanker, General Cargo, Fishing (Dragger, Long Liner)	4	2
65 – 100	40 - 250	13' - 28'	5' - 15'	Tugs, Small Draggers, Long Liners, Pleasure Craft	4	2
45 - 65	20 - 160	9' - 16'	4' - 15'	Tugs, Work Boats, Small Draggers, Inshore Long Liners, Pleasure Craft	4	2
32 - 45	8 - 50	4' - 14'	3' - 9'	Tugs, Work Boats, Fishing (Cape Islanders, Trollers), Pleasure Craft	4	3
25 - 35	4 - 20	4' - 11'	3' - 5'	Tugs, Work Boats, Fishing Trollers, Pleasure Craft	5	4
12 - 25	1 - 7	3' - 8'	2' - 4'	Tugs, Work Boats, Inshore Fishing, Pleasure Craft	5	5
15-20	*< 1*	*2'*	*< 1'*	*Additional Craft Type: Canoes, Kayaks, Paddleboards*	*2*	*2*

Following the development of the traffic routeing, areas where vessels are subjected to tidal stream or local current rates that exceed their potential limits should be identified. This identification would then be taken forward during the review of results to identify if high marine traffic risk areas also coincide with areas of significant rates that may further increase the local risk profile. These areas of potential constraint should be re-reviewed when examining the distribution of collision potential developed from a marine traffic model, as an aid to identifying whether more detailed navigation assessment is required.

The prevailing winds in the Study Area should be identified and presented. Sea areas upwind of OREI developments should be highlighted and the traffic volume passing through these areas reviewed.

The visibility within the Study Area should be identified and presented. Particular attention should be paid to the presentation of periods of reduced visibility.

Note: *Where visibility lies below 1,000 metres the term "fog" is used & where between 1,000 and 2,000 metres the terms "mist" or "haze" are used.*

Marine Traffic Modelling (MTM)

Where marine traffic modelling is appropriate it consists of a three-step process of:

- building the traffic model within a suitable simulation modelling tool
- baseline assessment and validation of the model
- forecasting using the model.

Step 1 – Building the Model

The principle steps of building the model will be dependent on the modelling tool used but the key steps are likely to be:

- Traffic Review and Development
- Set up Simulation Rules for the movement of vessels
- Set up Simulation Rules for the behaviour of mariners
- Set up Simulation Rules for manoeuvring in restricted waterways.

The key elements associated with Traffic Review and Development are illustrated below:

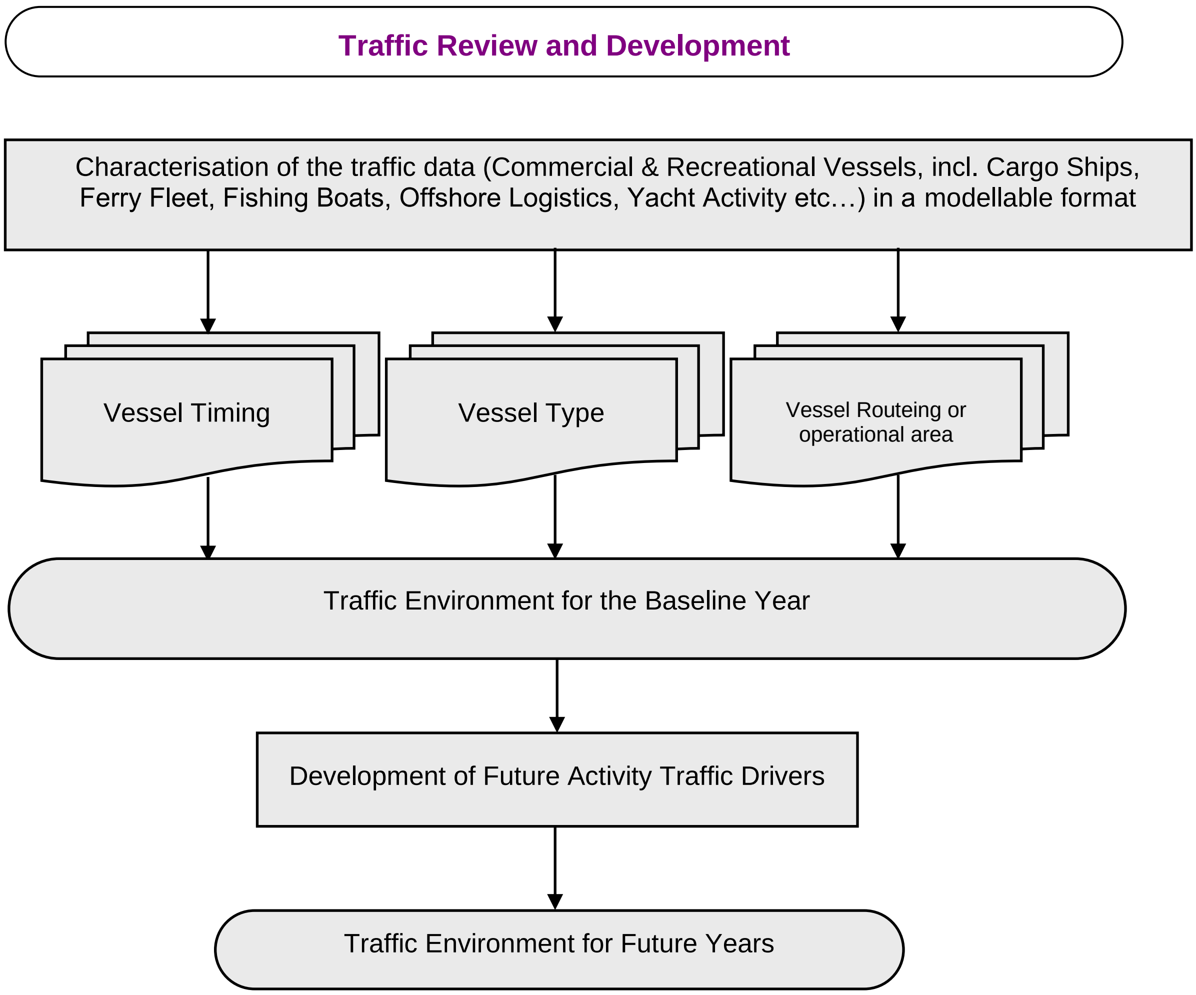


Figure 7 – Area Traffic Assessment Illustrative Example – Traffic Review and Development Flow Chart

Step 1.1 - Traffic Review and Development including

- Characterisation of the traffic data in a format capable of being assessed
- Analysis and capture of vessel timings, vessel types, routeings and operational areas. The route or operational area should be identified by geometric boundaries consistent with those identified from field surveys, and directly related to the traffic distribution mapped in the field surveys. It is suggested that, where appropriate, route widths should encompass the lateral deviation associated with +/-2 standard deviations of the

displacement of the traffic associated with movement between two locations. As a minimum the route width should accommodate 90% of all traffic transiting each route. It is noted that this process will result in variable route widths (dependent upon the sampled traffic activity).

Note: *In this context a "Route" is taken to be a track along which a significant number of vessels can be shown to navigate on largely parallel courses. "Operational areas" are those where fishing operations, recreational sailing and other marine activities take place and in which courses and speeds may vary considerably and frequently. Those interactions between vessels on routes and vessels engaged in activities in operational areas should be fully assessed as should those of all vessels with OREI structures.*

- Definition of no-route based vessel activity or operation. Where any traffic activities not consistent with point-to-point traffic are identified (i.e. recreational day sailing or fishing), the volume of this traffic should be identified, and distributions developed that best fit the available data.
- Recognition of traffic complexity. It should be emphasised that the route structure collected from survey data should capture the distribution of the full range of vessels active in the Study Area. For example, if there are a variety of vessels (coastal vessels, deep sea vessels, fishing, day sailing, high speed ferries, etc.) associated with marine traffic in the Study Area, all of these may have separate traffic distributions, time histories and vessel characteristics. All these elements and the associated complexity should be sampled and represented to as high a degree of fidelity as is feasible.
- Map routeings and operations onto a geospatial map of the area extracted from ENC charts or from site specific surveys.
- Define traffic in baseline year (See Annex B1 -Understanding the Base Case densities and types of traffic for further information). The traffic variation along routes and in operational areas should be representative of that identified from field surveys and should mimic the hourly variation in activity identified for "typical" daily conditions.
- Define traffic in future years (See Annex B2 – Predicting Future densities and types of traffic for further information).

The aim of the traffic review and development is to develop a comprehensive representation of present and future marine traffic in offshore waters, within the vicinity of the OREI. Vessel movement timings, types and routeings must be identified to develop a statistically representative sample of activity. This data may, if appropriate, allow the development of diverse vessel tracks into key characteristic routes to map present activity.

Step 1.2 – Set up Rules for the movement of vessels through the water including:

- The navigation manoeuvring characteristics of the vessels
- Realistic routes with appropriate traffic volumes, route widths, and speed profiles. The speed profile of vessels moving along a route should be representative of data identified from field surveys. This should identify vessel speeds, including average vessels speeds, together with changes in speed along routes as vessels pass across the Study Area. (Similar rules apply to vessels engaged in activities within operational areas.)

The aim of the rules for movement is to set up credible vessel behaviour; however it is recognised that the complexity of modelling this behaviour for multiple vessels within a traffic simulation may require a simplification of the navigation characteristics and thus numerical modelling may not be the appropriate technique for particular scenarios.

Step 1.3 – Set up Rules for the behaviour of mariners including:

- how they respond to the Collision Regulations (in both single and multiple encounter situations) and in all conditions of visibility.
- human error and deliberate violation in applying the Collision Regulations.

The aim of the rules for behaviour is to set up credible mariner behaviour. A key part of the representation of vessel interactions will also be to identify how vessels may interact following actions by one or more vessels which deviate from those required by the Collision Regulations. Analysis of the traffic survey data may provide this information. Failing that a credible estimate must be made.

Step 1.4 – Set up Rules for manoeuvring in restricted waterways including:

- differing behaviour for different classes of vessel
- different behaviour for different tides
- different behaviour for different tidal streams

The aim of the simulation rules for restricted waterways is to set up credible vessel and mariner behaviour appropriate to potential hazards.

Step 2 – Baseline Assessment and Validation of the Technique or Tool

This step is crucial; if the technique or tool cannot be validated for the base case year then it cannot be used to predict future years. Maritime incident data for the Strategic OREI Area and the actual OREI Area should be sought, analysed and mapped to both the encounter frequencies and frequency density and the collision, contact, grounding and stranding probabilities and probability densities.

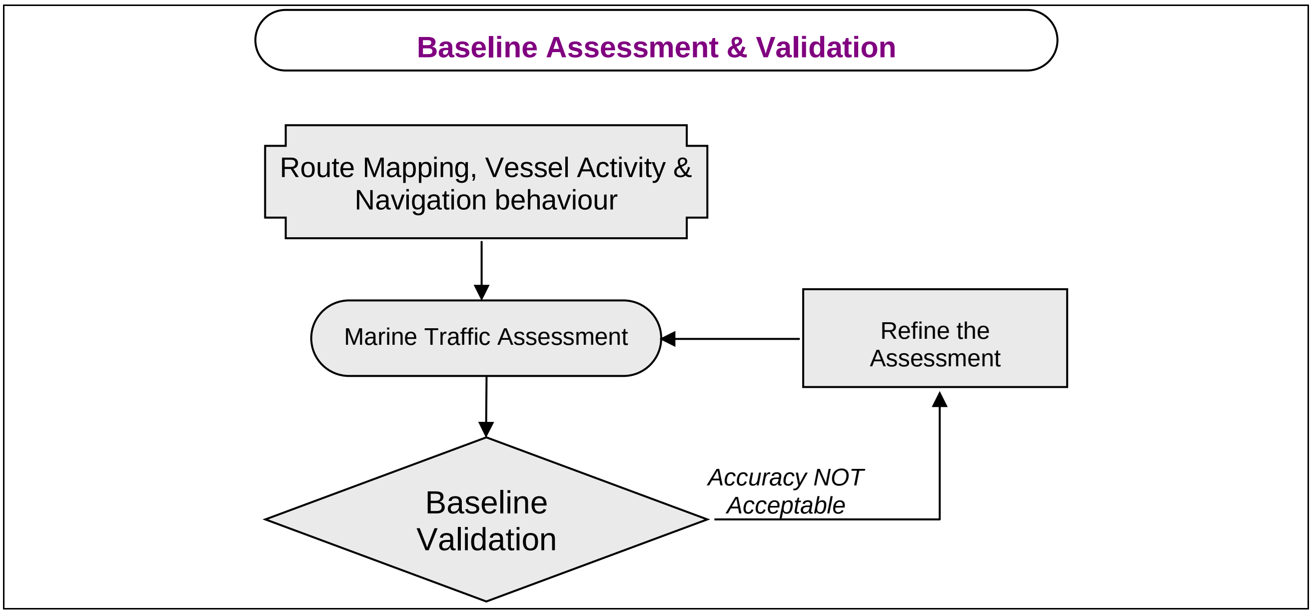


Figure 8 – Area Traffic Assessment Illustrative Example - Baseline Assessment and Validation Flow Chart

The principle steps of building a numerical model would encompass:

- Running the baseline model
- Interpreting the results
- Development of causation factors
- Model acceptance/refinement.

Step 2.1 – Running the Baseline model including:

- Multiple simulations of characteristic daily activity (for cases where the simulation develops random vessels to target frequencies)
- Review of simulations to ensure stable average activity is being presented.

Step 2.2 – Interpreting the results

- Review of boundary conditions and assessment of Study Area for validation
- Spatial mapping of model output ("encounters" or "domain violations"), this may be done on a global basis or in greater detail for different vessel types.

Step 2.3 – Development of Causation Factors

- Mapping of historic incident data in Study Area
- Identification of causation factor (Incidents from historic record/model output) for collisions and groundings. Where no site-specific data is available analysis by Fuji adopted in IALA Waterway Risk Assessment Program may be adopted if appropriate, this program being devised largely for use in closed boundary waterways such as rivers and canals.

Step 2.4 – Model Acceptance / Refinement

- Review of model incident distribution accuracy
- Adoption of model if distribution of incidents accurately represented, else investigation of key model parameters and reassessment.

The validation of the model allows the quantitative assessment of collision and contact risk to be conducted, rather than purely representing the risks as qualitative increases in hazard.

Step 3 – Forecasting using the model or other appropriate technique

This step uses the model or other technique to assess:

- future case without OREI
- base case with OREI
- future case with wind OREI

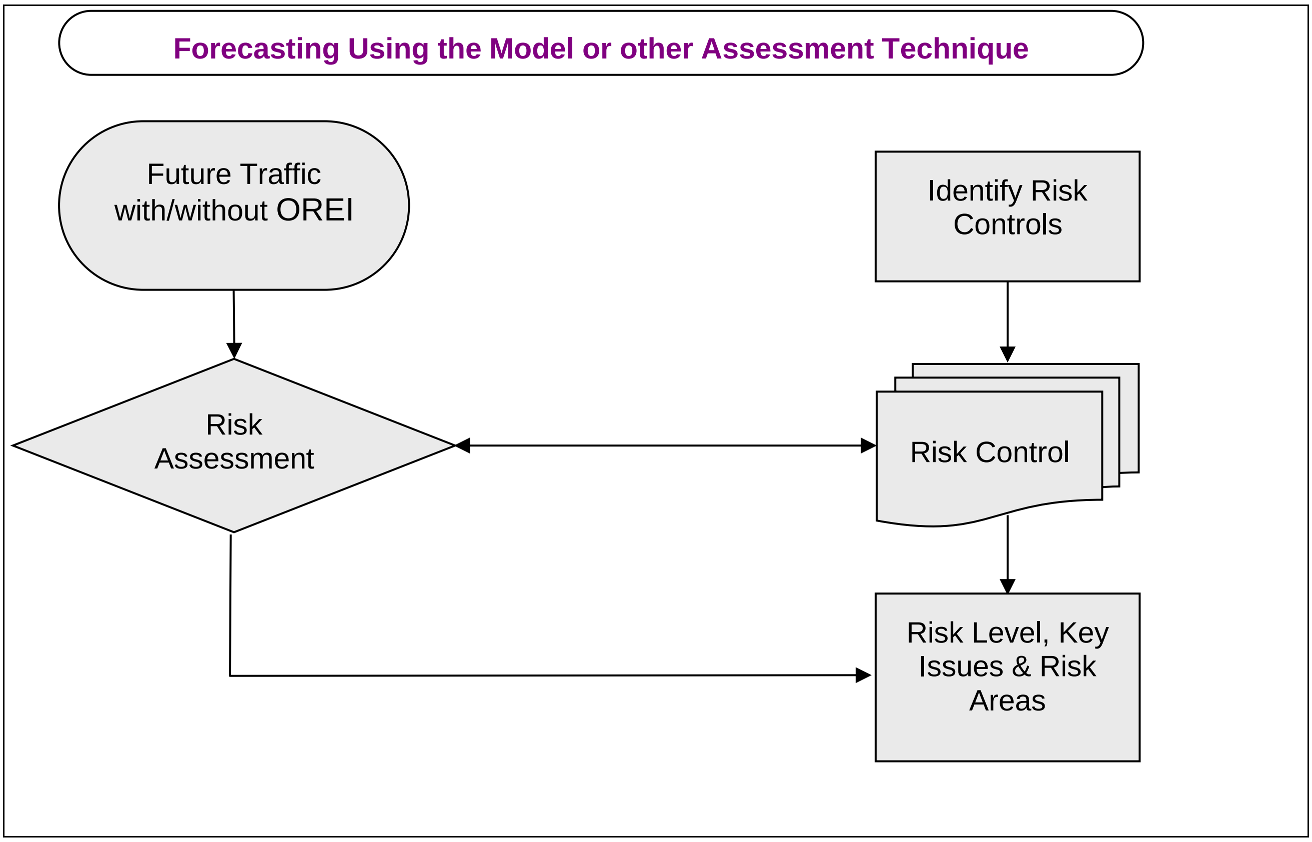


Figure 9 – Area Traffic Assessment Illustrative Example - Forecasting using the Model or other Assessment Technique Flow Chart

Step 3.1 – Future Case without OREI

- Review forecast traffic predictions
- Identify distinct vessel type, operation or route, traffic increase allocations
- Apply vessel type, operation or route, traffic increase allocations
- Represent future vessel size increases where appropriate
- Where appropriate run model, develop collision/grounding/ contact distribution
- Assess collision, contact, grounding and stranding distribution, for all vessels, and specific areas/vessels/ routes/operations identified as suffering significant increases in collision/grounding/contact risk.
- Identify Risk Regime Environment. It is recognised that the safety of marine operations is, in general, improving. Although predicted incident magnitudes and distributions may be factored to account for this improvement if supported by a review of historic incident frequency, the proviso that large area, multi-structure Round 2 wind farms and other OREI represent hazards to vessels not previously encountered should be taken into account.

This case should be reviewed against the Baseline and identify the impact of traffic increases alone on the local risk environment.

Step 3.2 – Base Case with OREI

- Review routes impacted by OREI

- Elicit, or make judgement where appropriate, regarding the relocation and distribution of routes. For those cases where, for example, a route bisects a wind farm it is necessary to make judgements of whether to pass through the wind farm, as smaller vessels might be expected to do, or, in the case of larger vessels, to normally leave it to port or starboard. These should be reviewed with respect to the origin and destination of the traffic, navigable water space and the presence of other obstructions.
- Determine a minimum anticipated vessel clearance, for all anticipated types of vessel, as they pass an OREI boundary. In this element guidance may be taken from the initial MCA recommendations on boundary clearance distances from shipping routes[20].
- The width of the original route at the closest point of approach to the OREI must be developed. As a first guide a width 50% that of the original route width at this location to mimic the compression of traffic expected as the OREI perimeter could be adopted as a virtual way mark. Again, the initial MCA guidance on boundary clearance distances from shipping routes should be taken into account.
- Assess collision/grounding/ contact distribution, for all vessel types, and specific areas/vessels/routes/ operational areas identified as suffering significant increases in collision/grounding/contact risk.
- Impact of limited visibility. A key aspect of the wind farm case is the inclusion of loss of visibility and vessel detection capability due to the presence of wind farms. One approach would be to identify the increase in collision risk as a result of limited visibility and apply this increase in risk to all traffic encounters between two or more vessels. Potentially unable to detect each other because of the wind farm.

This case should be reviewed against the baseline and identifies the impact of the wind farm or other OREI alone on the local risk environment.

Step 3.3 –Future Case with OREI

Adopt traffic density and type allocation as per Step 3.1

- Adopt route and area of operation structures as per Step 3.2.
- Assess collision/grounding/contact distribution, for all vessels, and specific areas/vessels/routes/operations identified as suffering significant increases in collision/ grounding/contact risk.
- This case should be reviewed against the Baseline and identifies the impact of the future traffic changes and wind farms or other OREI on the local risk environment.
- This will identify the cumulative impact of changes in the traffic volumes and OREI placement and should be used as the basis for risk assessment and contingency planning.
- The acceptability level may, if appropriate, be plotted on an F-N curve of the risks within the Study Area should be examined.

Key risk areas identified in the marine traffic simulation should be scrutinised and reviewed with respect to the local marine environment and specific navigation simulations.

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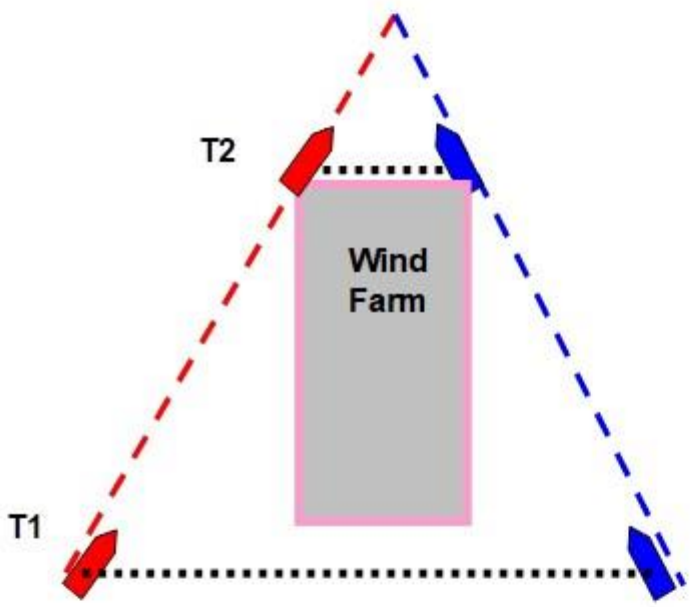
[20] "Shipping Routes – Wind Farm Template MCA: www.dft.gov.uk/mca Safety info / Navigation Safety / Offshore Renewable Energy Information



For this example it is assumed that the position at which a vessel would have normally made sighting and avoiding action occurs at T_1. In this case this coincides with the boundary of the wind farm; however this may not necessarily always be the case. Assuming neither vessel is aware of the other as they pass the wind farm, the vessels finally may have clear visibility of each other at T_2. A collision risk multiplier of some determined value (not necessarily that shown above) could then be applied for decreases in the perception distance at which acquisition is made. This may be applied for each and every vessel to vessel encounter.

Figure 10 – Area Traffic Assessment Illustrative Example - Treatment of Limited Visibility

D5 Navigation Risk Assessment – Specific Traffic Assessment Techniques

D.5.1 Use of Specific Navigation Assessment Techniques

Specific Traffic Assessment may be required to answer detailed questions about the feasibility and risk associated with specific navigation activities in or around an OREI. Typically, such assessment could be performed in response to:

- areas of "High Risk" identified by the Area Traffic Assessment
- the need for an "ALARP declaration" in the hazard log
- the need to evaluate the effectiveness of a Risk Control in the risk control log
- a request to evaluate the ability for SAR operations and for emergency response vessels (e.g. emergency towing vessels) to render assistance to vessels, in and around an OREI.

D.5.2 How to Select the Situations Requiring Specific Traffic Assessment

The situations which may require Specific Traffic Assessment could come from:

- the navigation risk assessment - Area Traffic Assessment results
    - e.g. problems identified in the Area Traffic Assessment results and not able to be assessed by this method. With respect, for example, to such factors as the creation of "choke points" including the identification of vessel types affected and potential influential parameters
- the hazard log
- the risk control log
- a need to give an overview of the Emergency Response Operations
- a need to evaluate the track of a vessel with engine (or other) failure

Other Sources

It is important the selection also takes into account the following as evaluation may be important to gain consent irrespective of the risk estimate:

- local knowledge e.g. sand waves or scouring on spring tides affecting bathymetry
- concerns of stakeholders e.g. visual and radar obstruction or spurious effects caused by the development
- some of the specific concerns of the technical guidance

Need for Assessment

The need for assessment of these situations comes from MGN guidance. An evaluation of all navigational possibilities which could be reasonably foreseeable, by which the siting, construction, establishment and de-commissioning of an OREI could cause or contribute to an obstruction of or danger to navigation or marine emergency services is required.

Specific traffic assessment may therefore be required to assess the risk of more specific navigational issues where the actual manoeuvring capabilities of the specific vessels involved in relationship to:

- the bathymetry

- the environmental conditions
- other traffic
- human action, inaction and error
- the OREI development structures

are, or may be, critical to comply with the Collision Regulations and avoid incident.

Type of Assessment

Once identified, these situations may need to be converted to scenarios that are capable of being examined and risk assessed using suitable tools. These tools include real and fast time manoeuvring and ship handling simulators. The basic scenario can then be subjected to parametric variation to investigate the hazard, the risk associated with the hazard and the effectiveness of any risk control measures.

Feedback from the results can be used to drive the parametric variation or modify the scenario based on emergent findings and thus test the appropriateness of any risk controls. It may identify further situations to be assessed or alternative risk controls to be evaluated.

D.5.3 Safety Zones

Safety zones for construction, maintenance and decommissioning will be applied for routinely through the appropriate authority e.g. BEIS, Marine Scotland, MMO, Welsh Government.

The Government's position in relation to operational safety zones for OREI is that a case must be made for the establishment of such zones. Compelling risk assessed arguments would be required for the establishment of a safety zone which excludes all vessels from the OREI area.

The IMO/UNCLOS safety zone at 500 metres considered with respect to other types of offshore structure does not imply that a direct parallel can be applied to wind farms or other types of OREI. It is used to illustrate an existing limitation but where the personnel expected to be found on structures and the potential for environmental damage are primary considerations.

D.5.4 How to Define Scenarios for Assessment

Once a situation has been selected, a scenario or numbers of scenarios may need to be defined to fully explore the situation. It is important that the scenario definition is robust, i.e. that it is capable of broad interpretation and not narrowly focused on a unique situation.

Each scenario requires a core or base starting point which will include:

- the ENC charts of the OREI location or site-specific bathymetric surveys
- modifications to the ENC chart with details of the OREI configurations
- the characteristics of the subject vessel or vessels.

Analysis based on Annex B3 (Guidance on Defining the Marine Environment) and Annex C3 (Influences on the Level of Risk) should be used as the source of information for the use in the scenario.

The details of the OREI that need to be added to the ENC chart include:

Shape and configuration

- size (number and type of structure, spacing)
- location
- orientation

Associated structures

- ancillary platforms
- floating structures
- transformers
- meteorological towers

Development Status

- proposed
- part constructed
- completed and operational

Marking

- navigation lights
- aviation lights
- AIS marks

Example of an Electronic Navigational Chart modified with a Wind Farm

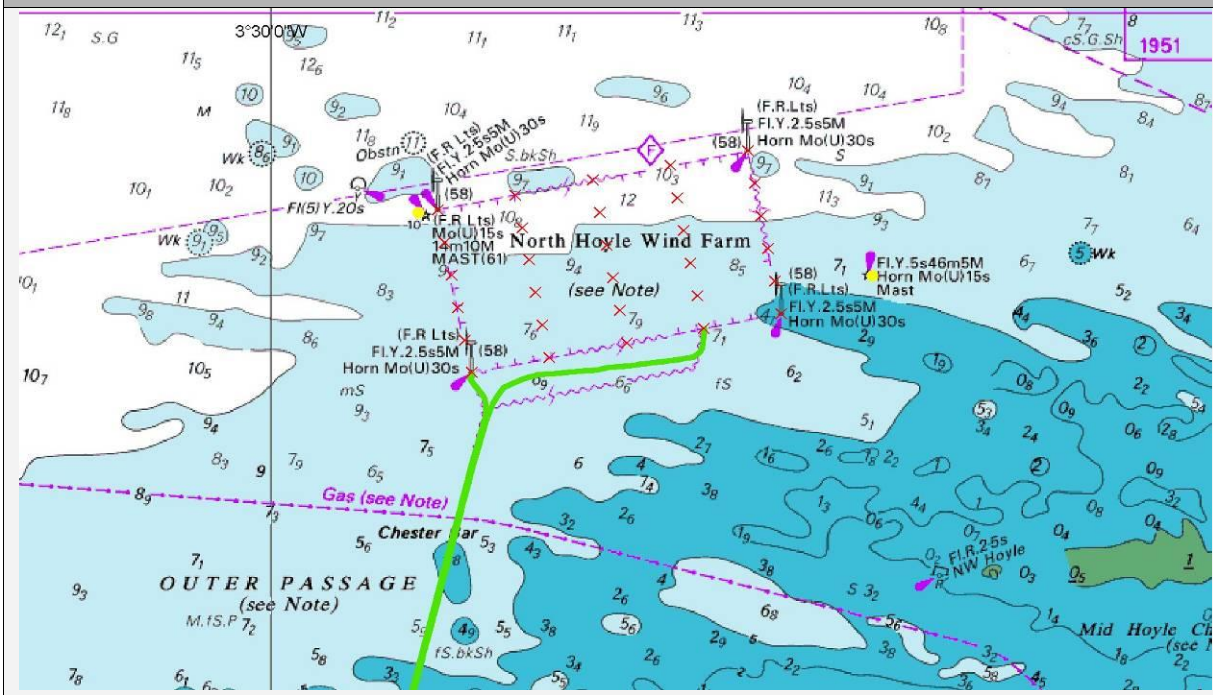


Figure 11 - Example of an Electronic Navigational Chart modified with a wind farm

Scenario Planning

The particular scenario which has been defined will then drive the definition of site-specific parameters which need to be defined and investigated.

Each scenario needs to be defined by the base case plus the relevant parameters selected for parametric variation.

This can be extended as necessary to include all relevant parameters and levels of parametric variation. Control measures may form part of the original scenario or may be derived from the results in which case new control measures can then be used to redefine the base scenarios.

Minimum Clearance Distances of Wind Farm Boundaries from Shipping Routes

MCA provides preliminary guidance in the form of a shipping route template to developers in setting the distance of a wind farm boundary from a recognised shipping route. The template combines the results of researched ship domain theory with those of radar and detection trials carried out at wind farm sites, to indicate the inter-relationship between shipping routes, offshore wind farms and the avoidance of collision between vessels and contact with wind farm structures. The template indicates the process by which consent applications may be considered by Government.

The template is not a prescriptive tool but needs intelligent application. For example, there may be opportunities for the interactive boundaries to be flexible where vessels are able to set themselves greater clearance distances from turbines, providing more reassurance without significant penalty and, conversely, at shipping route nodal points greater clearances from turbines may have to be set. The template, however, takes no account of the sea area bathymetry or of other hazards to navigation.

The positioning of an interactive boundary will be site specific and will require interpretative flexibility but is to be evidence based. The marine traffic survey information will inform such boundaries. Traffic surveys should establish any route traffic bias where mariners may naturally offset themselves to starboard to facilitate passing encounters in accordance with the International Regulations for the Prevention of Collision at Sea (COLREG). Additionally, the marine traffic surveys should identify vessel type or category or operation which may consequently require larger domains. In the approaches to ports this is particularly relevant. UK Hydrographic Charts and/or site-specific surveys will supply the necessary bathymetric data. All this additional information will influence where boundaries need to be established.

D.5.5 Simulator Specifications for Training Mariners Operating within or Close to OREI or for Assessing an Appropriate Scenario

If a navigational simulator exercise is to be used to train mariners operating within or close to offshore wind farms and other OREI developments or for assessing an appropriate scenario using subject mariners then this will require a technique which can accurately represent and apply the various parameters to the base case. Such a tool can range from a “desktop” exercise to a Full Mission Simulator System, the choice of tool and its parameters having been discussed with MCA. Suitability experienced and qualified instructors/assessors and mariners are required, particularly when the mariner is an important element in the scenario. Occasionally, however, non-mariners may be required as control groups. The required qualifications of instructors and assessors are those detailed in Section A-I/12 subsection 9 of the IMO’s STCW Convention.

The mariner's domain and general approach to navigating close to any offshore development structures will be directly related to the relevant subject, their skill and experience, the size and type of the vessel and crucial to the relevance of the results.

Implementing the Scenario in a Modelling Tool

If simulation modelling is selected as the assessment technique the modelling tool will need to be set up to include the following attributes:

- the manoeuvring characteristics of the Vessel
- interface with the Mariners / subjects e.g. vessel steering and power cuts
- information on the Environment e.g.:
  - ENC Chart derived information
  - Meteorological and sea conditions
  - Interactive traffic
- information display to the subjects e.g.:
  - 3-D Views e.g. bridge, bridge wing, etc.
  - Integrated radar simulation and other navigation information
  - Ship dimensions, draft, type and loading Information
- the parameters of the scenario.

ANNEX E DECIDING ON THE RISK CONTROLS

E1 Creating a Risk Control Log

The concept of offshore renewable installations (OREI) and potential risk is accepted and therefore developers will be expected to manage risk by the identification, application and proven worth of risk controls.

Annex G Table 28 provides a list of example risk controls (see also MGN 654 Section 4.15

E.1.1 Background

OREIs are in an environment where there are already considerable controls and mitigations (comprising rules, risk controls, risk mitigations and emergency plans) in place to manage risk. The developer is responsible for:

- interfacing with these existing controls and mitigations
- implementing new controls and mitigations for new risks (or change in level of existing risks).

E.1.2 Risk Control and Mitigation

To meet the Marine Navigational Safety Objectives:

- appropriate assets must be identified, consultations with appropriate stakeholder bodies held, agreement with the competent body reached, and the assets have to be put in place by the responsible body.
- applicable rules must be identified, consultations with appropriate stakeholder bodies held, agreement with the competent body reached, and the rules have to be implemented by the responsible body.
- standard or relevant good practice risk controls must be identified, consultations with appropriate stakeholder bodies held, agreement with the competent body reached, and the risk controls have to be implemented by the responsible body.
- risk control options have to be identified, consultations with appropriate stakeholder bodies held, agreement with a competent body reached, on risk controls that are capable of reducing risk to that which is As Low As Reasonably Practical and are assessed by risk assessment and the assessment used to decide if they will be incorporated
- emergency and contingency plans must be put in place and exercised.

E.1.3 Assets supporting Navigation Activities

Assets are of three main type functions:

- to reduce probability of an accident (typically called risk prevention assets)
- to reduce the consequence of an accident (typically called risk mitigation assets)
- emergency response.

Any given asset may be involved in all three.

E.1.4 Suggested Process for Creating a Risk Control Log

The suggested process for creating a risk control log is:

Risk Control Description

- identify all the relevant risk controls
- define the type of control (asset, rule, good practice and/or option)
- define what effect of control (prevention, mitigation and/or emergency response).

Risk Control Description – Example of Spreadsheet Format

DESCRIPTION			RISK CONTROL TYPE				RISK CONTROL EFFECT		
C1			Asset	Rule	Good Practice	Option	Prevention	Mitigation	Emergency Response
1		*All*							
2		**Vessel Assets**							
	1	Emergency Response - Requisitioned Vessels	√						√

Figure 12 – Example Risk Control Log - Risk Control Description

Consultation, Approval & Implementation

- identify appropriate stakeholder bodies for consultation
- identify the competent body for approval
- identify the responsible body for implementation.

Consultation, Approval & Implementation – Example Spreadsheet Format

DESCRIPTION			CONSULTATION, APPROVAL & IMPLEMENTATION		
C1			Appropriate Stakeholder Bodies for Consultation	Competent Body for Approval	Responsible Body for Implementation
1		*All*			
2		**Vessel Assets**			
	1	Emergency Response - Requisitioned Vessels			

Figure 13 – Example Risk Control Log - Consultation, Approval & Implementation

Implementation Options

- identify the possible project phases for implementation (i.e. during pre-construction, construction, operation and maintenance phases)
- identify the best phase for implementation (e.g. O = Optimum, P = Possible, C = Costly, N = Not Feasible).

Implementation Options - Example of Spreadsheet Format

DESCRIPTION			IMPLEMENTATION OPTIONS				
C1			Pre-Construction	Construction	Operation	Maintenance	Decommissioning
1		*All*					
2		**Vessel Assets**					
	1	Emergency Response - Requisitioned Vessels			**O**		

Figure 14 – Example Risk Control Log - Implementation Options

Implementation Plan

- describe the chosen plan for implementation
- highlight risk controls that are controlling major risks that are not being implemented by the developer.

Implementation Plan – Example of Spreadsheet Format

DESCRIPTION			IMPLEMENTATION PLAN
C1			
1		*All*	
2		**Vessel Assets**	
	1	Emergency Response - Requisitioned Vessels	

Figure 15 – Example Risk Control Log - Implementation Plan

E2 Navigation and SAR Stakeholders and Stakeholder Organisations

There are a large number of stakeholders who will have an interest in the effect on navigation of the OREI and it is important that their views are recognised, and they are consulted through the appropriate stakeholder organisation.

This section gives an indicative list of stakeholders and stakeholder organisations.

E.2.1 Stakeholders and Organisations

Table 26 - Example Stakeholders

Navigation Stakeholders
Commercial shipping owners, operators and associations
Fishing industry – individuals, groups and associations
Recreational mariners, groups and organisations
Port/Harbour Authorities and representatives of groups and associations
Other ports e.g. not a Statutory Harbour Authority
Offshore Oil and Gas Industry
Ministry of Defence
Chamber of Shipping
Mariners – Masters, sailors, crew
Search and Rescue Stakeholders
RNLI
HM Coastguard
Wind Farm Stakeholders
Developer
Owner
Operator
Regulatory Stakeholders
UK Hydrographic Office
Flag State of neighbouring countries
MAIB
DfT
General Lighthouse Authority
Maritime and Coastguard Agency
Civil Aviation Authority
Health and Safety Executive
Other Stakeholders
The Crown Estate
The Crown Estate Scotland
Legal Services
Marine Consultants
Marine licensing authorities

ANNEX F EXAMPLE HAZARD IDENTIFICATION

Table 27 - Example Hazard Identification

DESCRIPTION				
Ref				Description of Causal Chain (Event Sequence) (Accident Sequence)
1				**General Navigation Safety**
1	**2**			**Collision**
1	2	01	a	Merchant vessel [broken down by type] navigating near or around an OREI collides with another vessel that is navigating near or around an OREI
1	2	01	e	Merchant vessel [broken down by type] navigating through an OREI collides with another vessel that is navigating through an OREI.
1	2	02	a	Fishing vessel collides with another vessel navigating near, around or through an OREI
1	2	02	b	Presence of fishing vessels causes collision between other navigating vessels.
1	2	03	a	Recreational vessel collides with another navigating vessel navigating near, around or through an OREI
1	2	03	b	Presence of recreational vessels causes collision between other navigating vessels.
1	2	04	a	Anchored vessel collides with another navigating vessel navigating near, around or through an OREI
1	2	04	b	Presence of anchored vessels causes collision between other navigating vessels.
1	2	05	a	Vessel engaged in servicing an OREI collides with another navigating vessel navigating near, around or through an OREI
1	2	05	b	Presence of vessels engaged in servicing an OREI causes collision between other navigating vessels.
1	2	06	a	Vessels engaged in servicing an OREI (e.g. a mother and daughter vessel arrangement) collide with each other
1	2	06	b	Vessels engaged in servicing an OREI (e.g. a mother and daughter vessel arrangement) collide with another navigating vessel navigating near, around or through an OREI
1	2	06	c	Presence of vessels engaged in servicing an OREI (e.g. a mother and daughter vessel arrangement) causes collision with other navigating vessels
1	**3**			**Contact**
1	3	01	a	Vessel [broken down by type, inc personal watercraft] under control makes contact with a floating or fixed OREI structure e.g. foundation, platform, transition piece, blade, substation, accommodation platform
1	3	01	b	Vessel servicing an OREI structure makes contact with an OREI structure
1	3	01	c	Vessel not under command makes contact with an OREI structure
1	**8**			**Grounding and Stranding**
1	8	01	a	Vessel under control grounds or becomes stranded on an OREI structure e.g. foundation, transition piece, collapsed wind turbine.
1	8	01	b	Vessel servicing an OREI structure grounds on an OREI structure
1	8	03	a	Vessel not under command grounds or becomes stranded on an OREI structure
1	8	04		Due to restricted manoeuvring a vessel navigating near, around or through an OREI grounds or becomes stranded.
1	8	07	a	Due to naturally shifting sand banks a vessel navigating near, around or through an OREI grounds or becomes stranded.
1	8	08	a	Due to the effect of scour a vessel navigating near, around or through an OREI grounds or becomes stranded.
2				**Other Navigation Safety**
2	**1**			**Foundering and Capsizing**

DESCRIPTION				
Ref				Description of Causal Chain (Event Sequence) (Accident Sequence)
2	1	02	a	Subsea obstacle e.g. cable, fallen structure snags anchor heeling vessel and causing it to founder or capsize.
2	**4**			**Fire**
2	4	01		Wind turbine or other OREI structure fire requires emergency rescue of servicing staff
2	4	03		Release of fire suppression (real or spurious triggers) releases inert gases into the air intakes of supporting helicopters
3				**SAR Aviation Safety**
3	**17**			**Aviation Accidents**
3	17	01		Helicopter flying to a turbine, OREI structure, sub-station, service base or accommodation base hits blades or tower and crashes
3	17	02		Helicopter flying to a nearby installation or in transit hits blades, tower or other OREI structure and crashes
4				**Other Safety**
4	**20**			**High Probability Events**
4	20	01		Contact between a service vessel and an OREI structure when transferring personnel
4	20	02		Injury of service personnel when transferring to/from an OREI structure
4	20	03		Man overboard of service personnel when transferring to/from an OREI structure
4	20	04		Navigation in potential safety zones
4	**21**			**High Severity Outcomes**
4	21	01		A major incident with a large Cruise Vessel or Passenger Ferry leading to a major search and rescue event
4	21	02		Emergency response operations following a major incident with a large oil tanker leading to large scale pollution
4	21	03		Emergency response operations following a major incident with a Liquefied Gas Tanker close to a major centre of population resulting in a large-scale explosion risk
4	**22**			**Low Confidence/High Uncertainty**
4	22	01		No risks have been identified where there is significant uncertainty in the assessment, the probability or of the outcome
5				**Search and Rescue**
5	**30**			**Overall**
5	30	01		Presence of an OREI increases the risk of an accident (e.g. collision, contact, stranding or grounding) and also inhibits search and rescue.
5	**31**			**External to Internal**
5	31	01		Person or vessel requiring search and rescue drifts into an OREI and the presence of the OREI restricts search and rescue.
5	**32**			**Internal to Internal**
5	32	01		Activities within an OREI both generate an increased need for search and rescue and the presence of the OREI inhibits search and rescue.
5	**33**			**Internal to External**
5	33	01		Activities within a an OREI generate an increased need for search and rescue in the areas surrounding the OREI
5	**34**			**External to External**
5	35	01		Person or vessel requiring search and rescue drifts through an OREI and the presence of the OREI inhibits search and rescue during the transit stage.
5	**35**			**Worst Case**
5	35	01		Search and Rescue operations following a major incident with a large Cruise Vessel or Passenger Ferry
6				**Emergency Response**
6	**30**			**Overall**
6	30	01		Presence of an OREI increases need for emergency response from Foundering, Capsizing, Collision, Grounding or Stranding.

DESCRIPTION				
Ref				Description of Causal Chain (Event Sequence) (Accident Sequence)
6	30	02		Present an OREI ce of inhibits ability to provide emergency response.
6	**31**			**External to Internal**
6	31	01		Pollution outside an OREI drifts into the OREI and presence of the OREI inhibits clean up
6	**32**			**Internal to Internal**
6	32	01		Activities within an OREI both generate an increased risk of pollution and the presence of the OREI inhibits clean up.
6	**33**			**Internal to External**
6	33	01		Activities within an OREI generate an increased risk of pollution in the areas surrounding the OREI
6	**34**			**External to External**
6	34	01		Pollution from outside an OREI drifts through the OREI and the presence of the OREI inhibits clean up during the transit stage.
6	34	02		Routeing of vessels (or post collision, contact or grounded vessel) results in hazardous cargoes closer to areas of population
6	**35**			**Worst Case**
6	35	01		Emergency response operations following a major incident with a large oil tanker
6	35	02		Emergency response operations following a major incident with a Liquefied Gas Tanker close to a major centre of population

ANNEX G EXAMPLE RISK CONTROLS

Table 28 - Example risk controls for developer and navigation stakeholders

DESCRIPTION			RISK CONTROL TYPE				RISK CONTROL EFFECT		
			Asset	Rule	Good Practice	Option	Prevention	Mitigation	Emergency Response
1		**Vessel Assets**							
	1	Emergency Response - Requisitioned Vessels	✓						✓
	2	Search and Rescue – Inshore	✓						✓
	3	Search and Rescue - Lifeboats	✓						✓
	4	Search and Rescue Requisitioned Vessels	✓						✓
	5	Tugs	✓						✓
	6	GLA Tenders	✓						✓
	7	OREI Support Vessels	✓						✓
2		**Aviation Assets**							
	1	Search and Rescue - Helicopter	✓						✓
	2	Oil Spill Dispersant - Aircraft	✓						
3		**OREI Assets**							
	1	AIS Base Station on / depicting OREI	✓						
	2	VTS Radar on OREI	✓						
	3	Marks and Lights	✓				✓		
	4	Sound Signals	✓				✓		
	5	CCTV	✓						
	6	Design specifications e.g. to aid SAR	✓					✓	✓
4		**OREI Control Room Assets**							
	1	AIS monitoring	✓				✓		
5		**Shore-based Assets**							
	1	Marine Radar, Navigation and Communications Systems	✓				✓		
	2	Marine Rescue Coordination Centres	✓						✓
	3	Vessel Traffic Service	✓				✓		
	4	Shore Radar	✓				✓		
6		**Other Assets**							
	1	Pilot Services	✓				✓		
	2	Charts	✓				✓		
7		**Consent**							
	1	Deny consent to the OREI				✓	✓		
8		**Configuration and Design**							
	1	Optimise location, alignment, size and layout			✓		✓		

DESCRIPTION			RISK CONTROL TYPE				RISK CONTROL EFFECT		
			Asset	Rule	Good Practice	Option	Prevention	Mitigation	Emergency Response
	2	Minimum safe (air) clearances		✓			✓		
9		**Site Designation**							
	1	Safety zones of appropriate configuration and extent during construction, operation and decommissioning phases.				✓	✓		
10		**Routeing and Routeing Management**							
	1	Implementation of IMO routeing measures within or near the development e.g. Traffic Separation Scheme, Recommended Route, Area to be Avoided etc.				✓	✓		
	2a	Manage traffic through VTS from OREI Control Centre				✓	✓		
	2b	Manage traffic through VTS from MCA Control Centre				✓	✓		
	3	Continuous watch by multi-channel VHF, including Digital Selective Calling (DSC) from OREI Control Centre			✓		✓		
	4	Monitoring by radar, AIS and/or closed-circuit television (CCTV) from OREI Control Centre				✓	✓		
	8	Speed limits to control wash			✓		✓		
11		**Navigational Marking**							
	1	External Marking of OREI to GLA requirements based on IALA recommendations		✓			✓		
	2	Internal Marking of OREI to GLA requirements		✓			✓		
	3	ID Marking of Individual Structures		✓			✓		
	4	Aids to Navigation to GLA requirements		✓			✓		
12		**Communication and Training**							
	1	Promulgation of information and warnings through notices to mariners and other appropriate media		✓	✓		✓		
	2	Marking on Navigation Charts		✓			✓		
13		**Safety Management**							
	1	Operator's Safety Management System			✓			✓	
	2	Operators Safety and Operations Plan			✓			✓	
	3	Operators Emergency Plan			✓			✓	
	4	Contingency plan if GPS switched off/failed			✓				

DESCRIPTION			RISK CONTROL TYPE				RISK CONTROL EFFECT		
			Asset	Rule	Good Practice	Option	Prevention	Mitigation	Emergency Response
	5	Emergency Response Plan	✓				✓	✓	✓
14		**Regulatory**							
	1	Application of the principles of the Port Marine Safety Code to OREI				✓			
15		**Search and Rescue**							
	1	SAR response planning			✓				✓
	2	SAR asset provision planning			✓				✓
	3	Turbine mast design (e.g. including safe refuge).		✓				✓	
	4	Standards and procedures for wind turbine generator shutdown		✓			✓		
	5	Aviation lighting and ID marking of external and internal structures		✓					✓
	6	Emergency Response Cooperation Plan		✓					✓
16		**Emergency Planning**							
	1	Salvage response planning			✓			✓	
	2	Salvage asset provision planning			✓			✓	
	3	Oil Spill response planning			✓			✓	
	4	Oil Spill asset provision planning			✓			✓	

ANNEX H CATEGORIES, TERMS AND REFERENCES

H1.1 Marine Accident Categories

Table 29 - Marine Accident Categories

	Category	Description
1	Foundering	To sink below the surface of the water.
2	Collision	Collision is defined as a vessel striking, or being struck, by another vessel, regardless of whether either vessel is under way, anchored or moored; but excludes hitting underwater wrecks.
3	Allision	Defined as a violent contact between a vessel and a fixed structure.
4	Contact	Contact is defined as a vessel striking, or being struck, by an external object that is not another vessel or the sea bottom. Sometimes referred to as Impact
5	Fire	Fire is defined as the uncontrolled process of combustion characterised by heat or smoke or flame or any combination of these.
6	Explosion	An explosion is defined as an uncontrolled release of energy which causes a pressure discontinuity or blast wave.
7	Loss of Hull Integrity	Loss of Hull Integrity (LOHI) is defined as the consequence of certain initiating events that result in damage to the external hull, or to internal structure and sub-division, such that any compartment or space within the hull is opened to the sea or to any other compartment or space.
8	Flooding	Flooding is defined as sea water, or water ballast, entering a space, from which it should be excluded, in such a quantity that there is a possibility of loss of stability leading to capsizing or sinking of the vessel.
9	Grounding	Grounding is defined as the ship coming to rest on, or riding across underwater features or objects, but where the vessel can be freed from the obstruction by lightening and/or assistance from another vessel (e.g. tug) or by floating off on the next tide.
10	Stranding	Stranding is defined as being a greater hazard than grounding and is defined as the ship becoming fixed on an underwater feature or object such that the vessel cannot readily be moved by lightening, floating off or with assistance from other vessels (e.g. tugs).
11	Machinery Related Accidents	Machinery related accidents are defined as any failure of equipment, plant and associated systems which prevents, or could prevent if circumstances dictate, the ship from manoeuvring or being propelled or controlling its stability.

	Category	Description
12	**Payload Related Accidents**	**Payload related accidents include loss of stability due to cargo shifting and damage to the vessel's structure resulting from the method employed for loading or discharging the cargo. This category does not include incidents which can be categorised as Hazardous Substance, Fires, Explosions, Loss of Hull Integrity, Flooding accidents etc.**
13	**Hazardous Substance Accidents**	**Hazardous substance accidents are defined as any substance which, if generated as a result of a fire, accidental release, human error, failure of process equipment, loss of containment, or overheating of electrical equipment; can cause impairment of the health and/or functioning of people or damage to the vessel. These materials may be toxic or flammable gases, vapours, liquids, dusts or solid substances.**
14	**Accidents to Personnel**	**Accidents to personnel are defined as those accidents which cause harm to any person on board the vessel e.g. crew, passengers, stevedores; which do not arise as a result of one of the other accident categories. Essentially, it refers to accidents to individuals, though this does not preclude multiple human casualties as a result of the same hazard, and typically includes harm caused by the movement of the vessel when underway, slips, trips, falls, electrocution and confined space accidents, food poisoning incidents, etc.**
15	**Accidents to the General Public**	**Accidents to personnel are defined as those accidents which lead to injury, death or loss of property amongst the population ashore resulting from one of the other ship accident categories.[21]**
16	**Capsizing**	**The overturning of a vessel after attaining negative stability**

[21] This definition is interpreted from MGN 654 rather that a generally recognised marine accident category.

H1.2 References

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Appendix 5 – Notes from Svitzer and SMS Evidencing Tug Provision requested at question NS.2.50 & NS.2.51

NS2.50

I can confirm that Svitzer now operate two tugs on the river Humber which have a maximum LOA of 24.11 mtr. If required, the company have other tugs of this size which could be relocated if required. As part of a modernisation/ standardisation process the majority of new tugs to be built will either be of this size. We are expecting a brand new 24.11mtr tug by the end of Q3 2024 as it stands to replace one of our older/ larger tugs. This tug will have a minimum bollard pull of 70T (same as the other two) and will be FIFI1.

NS.2.51

All Svitzer tugs are now fuelled by HVO fuel.

Confirmation that the fuel is compliant with MAPROL annex VI emissions standards below.

<u>SOx</u>

For SECAs (Sulfur Control Emissions Areas) and UK ports the max sulfur content is 0,1% by mass. GD+ fuel is produced according to HVO standard EN15940 which dictates max sulfur content of 5mg/kg (0,0005%).

<u>NOx</u>

NOx is not controlled and regulated by observing the fuel specification, but rather depend on how the engine is certified as it was constructed and tested on a testbed. It is documented in the so-called "NOx technical code" which each engine is delivered with. Depending on operations area and when the engine was constructed the engine must comply with NOx limits as per Tier I, II or III in Marpol VI. In the North Sea and English Channel from 01.01.2021, all new or major overhauled engines must comply with Tier III. Otherwise its Tier II.

We confirm that our tugs all comply.

Further, the NOx output is also dependant on fuel type used. To that effect, IMO did in June 2022 during the MEPC78 assembly pass a Unified Interpretation of regulation 18.3 of Marpol Annex VI to the effect that provided that the engine can run on biofuel without having undergone any changes to the NOx control equipment, then that biofuel shall be considered equal to the fossil fuel for NOx purposes and no new technical assessment is to be conducted.

In addition to this we have agreement from MCA on this particular matter.

Hope the above is sufficient.

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SMS TOWAGE

Fleet and Environment latest.

Regarding our tug fleet and environmental performance please have a look at what we have been doing below.

Our fleet renewal and acquisition programme has been going on for two years. We've just taken delivery of a brand new tug, taking our total on the Humber to 8. We now have the youngest towage fleet in the country, and as well as being fitted with the latest equipment it means breakdowns are reduced, increasing tug availability. Should demands of vessels and conditions change we may reallocate the fleet to allow the 3 larger tugs (70T's plus) to operate in the Humber.

The new Marfle software on all vessels gives us the ability to record numerous performance metrics including showing the carbon burn per nautical mile. The skippers and technical department monitor fuel used, and the consumption has dropped over 25%, a cost and fuel burn saving that's quite noticeable.

As soon as a secure source of HVO is available we can move away from MGO, this will mean a reduction in NOx & SOx.

Discussions to have shore power on the Humber are underway; we have benefitted as has the environment from the installations in Belfast and Portsmouth.

We are also seeking a level playing field to allow usage of the eastern berths at Immingham on the outside. This would be for 4 tugs and save enormous amounts of crew working time and fuel burn by not having to lock in and out to tow ships. With the PMIS system coming in to increase communications for tugs and pilots and a more efficient offering for ships, SMS can help by being on the outside. Our tugs are also live on board, so their availability to work is immediate, not a 2 hour notice.

New tugs are always being considered in line with the growth of our client base. In the last 6 years we have gone from 14 vessels to 20. If there is an upturn in jobs, we can add to the fleet and meet the demand. Another large tug manufacturer is being audited in Turkey this month to assess their new build credentials.

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