From:	Victoria Lane (Brodies Solicitors)
To:	Hornsea Project Three
Cc:	Karen Hamilton (Brodies Solicitors)
Subject:	Spirit Energy ISH 1 Submission - Appendix E, F, W [BRO-D.FID4510105]
Date:	14 December 2018 23:47:25
Attachments:	image013.png image014.png image015.png image016.png image017.png image018.png SE_ISH_1 - Appendix E - pb3654-marine-policy-statement- March 2011_44074352_1.PDF SE_ISH_1 - Appendix F - si 2013 - 3161 Gas Importation Order - revoking REZ_44089245_1.PDF SE_ISH_1 - Appendix W - Noble Denton Marine Services - Hornsea 3 Wind Farm Review of Marine Hazards (November 2018)_44089252_1.PDF

CONFIDENTIAL MESSAGE - INTENDED RECIPIENT ONLY

Please find attached Appendix E, F, W

Kind regards

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APPENDIX W

NOBLE DENTON MARINE SERVICES - HORNSEA 3 WIND FARM REVIEW OF MARINE HAZARDS (NOVEMBER 2018)

DNV·GL

Noble Denton marine services

HORNSEA 3 WINDFARM

Review of Marine Hazards

Spirit Energy

Report No.: A13423, Rev. 3
Date: 6th November 2018

Project name:	Hornsea 3 Windfarm	DNV GL - Oil & Gas
Report title:	Review of Marine Hazards	Noble Denton Marine Services
Customer:	Spirit Energy	Cromarty House
Contact person:	Denis Ustich / Iain Anderson	67 to 72 Regent Quay
Date of issue:	6th November 2018	ABERDEEN
Project No.:	10074959	AB11 5AR
Report No.:	A13423, Rev. 3	Tel: +44 1224 289100

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☐ Secret

Keywords:

Rev. No.	Date	Reason for Issue	Prepared by	Verified by	Approved by
0	25-10-2018	First issue	RS	SV	DS
1	25-10-2018	Second issue following client comments	RS	SV	DS
2	01-11-2018	Updated after Client comments	RS	SV	SV
3	06-11-2018	Further update – removed appendix	RS	SV	DS

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APPENDICES

NOTE: Spirit Energy is the joint venture which combines Centrica plc's E&P business with Bayerngas Norge AS. In some of the documents reviewed, and figures in the documents, reference is still made to Centrica however, where this occurs it should be considered as Spirit Energy.

1 ABBREVIATIONS & ACRONYMS

AHT	Anchor Handling Tug	PSV	Platform Supply Vessel
AIS	Automatic Identification System	Km	Kilometre
ALARP	As Low as Reasonably Practicable	M	Metre
ARPA	Automatic Radar Plotting Aid	MAIB	Marine Accident Investigation Branch
CPA	Closest Point of Approach	MAH	Major Accident Hazard
COLREGs	International Regulations for the Prevention of Collison at Sea	MGN	Marine Guidance Note
DP	Dynamic Positioning	MOU	Mobile Offshore Unit
DSV	Diving Support Vessel	Nm	Nautical Mile
EIA	Environmental Impact Assessment	NUC	Not Under Command
ERRV	Emergency Response and Rescue Vessel	NUI	Normally Unmanned Installation
FMEA	Failure Modes and Effects Analysis	OREI	Offshore Renewable Energy Installation
GOMO	Guidelines for Offshore Marine Operations	PIANC	World Association for Waterborne Transport Infrastructure
HAZID	Hazard Identification	REWS	Radar Early Warning Systems
HSE	Health and Safety Executive	ROV	Remotely Operated Vehicle
IALA	International Association of Lighthouse Authorities	SE	Spirit Energy
IMCA	International Marine Contractors Association	SIMOPS	Simultaneous Operations
IRM	Inspection, Repair and Maintenance	TCPA	Time to Closest Point of Approach
JIP	Joint Industry Party	TSS	Traffic Separation Scheme
OGUK	Oil and Gas UK	W2W	Walk to Work
PINS	Planning Inspectorate		

2 BACKGROUND

2.1 Proposed Hornsea Project Three wind farm

Ørsted Hornsea Project Three (UK) Ltd (hereinafter Orsted) has applied to develop a proposed offshore wind farm, Hornsea Project Three, in the Southern North Sea. Due to the capacity of the proposed wind farm, there is a requirement to submit an application for Development Consent to the Planning Inspectorate (PINS) to be decided by the Secretary of State for Business, Energy and Business Strategy. Hornsea Projects One and Two are located closer to the coast.

The project is anticipated to comprise of up to 300 turbines and 21 sub-stations and platforms with a total capacity of 2,400 MW. The array area is approximately 696 sq. km with an additional cable corridor to the Norfolk coast.

Further details of the planning application can be found on both the Hornsea Three and PINS websites.

It is noted the detailed number and locations for the turbines, and the type of foundations to be used have not yet been determined. The use of floating turbines has been discounted and as such, the impact of spread moorings for such turbines has not been addressed in this study.

2.2 Maritime Spatial Planning in the vicinity of the proposal

The proposed wind farm is in close proximity to a large number of offshore oil and gas industry assets. Spirit Energy is the operator of, or a partner in a number of the affected assets, especially in the Markham area to the east of the proposed wind farm limit.

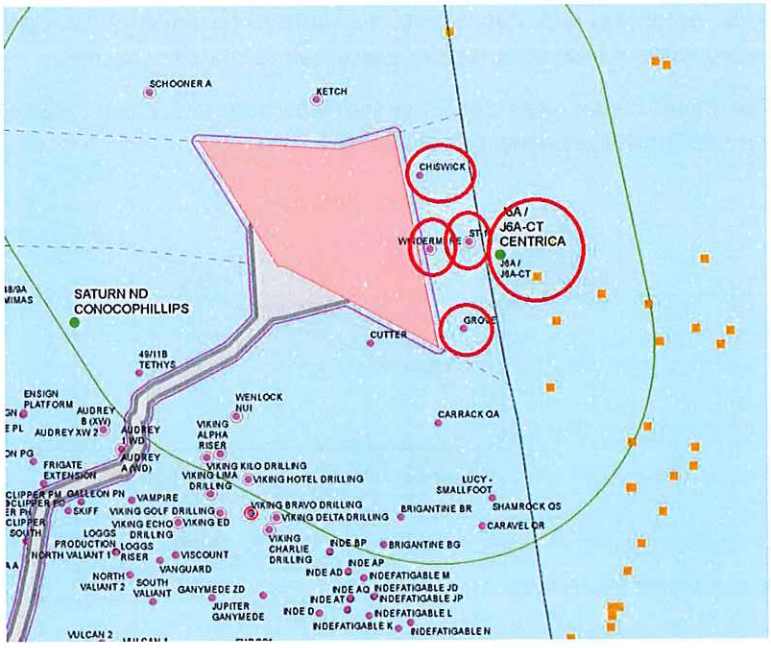

Fig 2-1: Spirit Energy assets adjacent to the proposed wind farm

Distances from the proposed wind farm limits to Spirit Energy assets in the Markham area are:

- J6A platform 6.9 nm (12.8 km);
- Chiswick platform 1.5 nm (2.7 km);
- ST1 platform 4.5 nm (8.3 km);
- Grove platform 2.4 nm (4.5 km);
- West Grove G5 well 1.5 nm (2.7 km). This well (49/10a G5(6Y) was drilled at co-ordinates Lat. 53° 04' 04" N Long. 02° 49' 48" E and is the closest Spirit Energy asset to the eastern boundary limit of the proposed windfarm.

Note that although Spirit Energy is a partner in the Windermere installation, it is scheduled to be de-commissioned and removed before construction of the proposed wind farm commences and is therefore not considered in this document.

Within their Safety Cases (please refer to section 4.2.3.1) Spirit Energy highlight that they take its role in maritime spatial planning extremely seriously due to the exceptionally high consequences of any accident, especially a marine vessel collision with a producing gas platform.

Spirit Energy is the Operator, and Duty Holder, of the Grove, Chiswick, ST1 and J6A assets.

2.3 Proximity of wind farms to Spirit Energy assets

Spirit Energy has considerable experience of co-operating with wind farm developments, especially in the Irish Sea. However, the limits of the current proposal are considerably closer to assets than previously experienced. Some of the current assets (specifically the ST1 platform) affected will be de-commissioned prior to 2023, however other assets are expected to be producing until the mid-2030s. Hornsea turbines will be significantly larger than those in the eastern Irish Sea; further exacerbating spatial concerns.

The figure below gives details of the separation distances involved in the current proposal compared with previous developments.

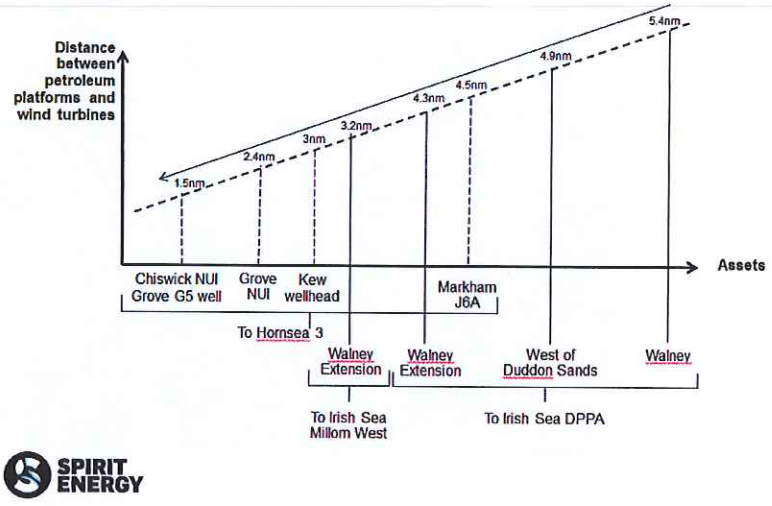

Fig 2-2: Distances between wind farm limits and Spirit Energy assets

It should be noted that separation distances in previous developments (Irish Sea) range from 3.2nm to 5.4nm however, in the current proposal, these separation distances are reduced to as little as 1.5nm between the proposed wind farm eastern limit and the Grove G5 subsea well.

3 INTRODUCTION

DNVGL Noble Denton marine services has been commissioned by Spirit Energy to conduct an independent review of the marine hazards associated with the interactions between the proposed wind farm, and current and likely operations at their adjacent gas producing assets. Within their Safety Cases Spirit Energy highlight that they take its role in maritime spatial planning extremely seriously due to the exceptionally high consequences of any accident, especially a marine vessel collision with a producing gas platform. The proposed proximity of the wind farm limits to current producing assets is of particular concern in relation to current and future operations.

This is a high level study and Hazard Identification (HAZID) which does not address in detail the risks and consequences of the hazards identified, rather it highlights issues which should be the subject of further detailed study by the windfarm developer with appropriate mitigations introduced as required before construction of the proposed wind farm commences.

The study methodology comprises a review of three categories of documentation and then identifies, via a gap analysis, issues where the proposed wind farm development compromises the measures Spirit Energy has currently in place to discharge its duties as Operator and Duty Holder at the assets under consideration. When a gap is identified, it is considered a hazard exists and it should be fully assessed to ensure the concomitant risk is reduced to ALARP.

The review of documentation in Section 4 addresses:

- A review of relevant regulatory issues, and industry best practice guidelines, on marine aspects of Spirit Energy operations and how they may be affected by the proposed wind farm;
- A review of Spirit Energy management processes and documentation currently in place to control marine operations and therefore mitigate hazards associated with operations at their assets;
- Finally, in Section 4, a review of the EIA documentation, provided by Orsted in support of the application for the proposed wind farm, to identify where the content of the document does not effectively address marine impacts in relation to the operation of Spirit Energy assets;

Section 6 then summarises how the gap analysis comparing regulatory, best practice and Spirit Energy risk management documentation and procedures may be affected by the hazards arising from the proximity of the proposed wind farm to Spirit Energy assets.

It should be noted that this study addresses marine hazards only, and not commercial or aviation hazards, other than those related to marine activity.

4 REVIEW OF MARINE CONTEXT AND GAP ANALYSIS

4.1 Review of Regulatory and Industry Documentation

4.1.1 Context

Spirit Energy operates in a complex legal regulatory system, with industry best practice support, to ensure the safety of personnel, both Spirit personnel and others affected by their actions, their installations and the environment. It is not the purpose of this paper to detail this context, rather it is to identify and explore specific aspects of the context relating to hazards which impinge on marine activities and which may be affected or generated by the proposed wind farm development.

4.1.2 Consequences of risks: HSE Research Report RR53

Oil and Gas UK, in their Guidelines for Ship/Installation Collision Avoidance recognise the consequences of a collision between a vessel and a producing gas installation are likely to be 'severe if not catastrophic'. The basis of their assessment is an HSE Research report (RR53) originally published in 2001.

The HSE cite in the period up to the year 2000, in the era of north-sea oil and gas, a large number of such collisions have taken place (in excess of 500 by the year 2000) albeit many of those were by attending vessels. Eight collisions were between passing vessels and fixed installations although the HSE report considers this as fortuitous, rather than any inherent safety feature. The number of near misses is likely to have been considerably higher. However, attending vessels are operating at low speeds, thus appearing to reduce the ship impact damage. At the same time, it should also be noted in many cases with the modernisation of offshore vessels, the size of the attendant vessels has in many cases outgrown the original design philosophy of platforms being able to cope with these collisions. Passing vessel collisions are on the other hand likely to involve much higher kinetic energy impacts and hence higher levels of damage. Installations in the southern North Sea were found to be more at risk than elsewhere due to higher traffic densities. Indeed all passing vessel collisions took place in this area. Watch keeping failure was considered as one of the main causation factors.

The HSE Report dismissed the notion that 'the existence of large numbers of vessels and installations in close proximity ought to lead to a heightened awareness among vessel watch keepers' as the data did not re-enforce the argument.

4.1.3 Marine Accident Investigation Branch

The Marine Accident Investigation Branch, via their regular reporting system also highlights significant numbers of vessels running aground or colliding with other vessels and installations due to fatigued watch keepers.

With the potential for severe or catastrophic damage, and multiple instances of fatigued watchkeepers continuing to be an issue, any development which brings higher densities of passing traffic, either commercial or fishing, closer to Spirit Energy assets should be of significant concern to the company.

4.1.4 Letter from Offshore Safety Directive Regulator dated 19/09/2018

Building on the work detailed above, this letter addressed to Oil & Gas UK, draws attention to a specific Major Accident Hazard – Potential for Structural Failure of Offshore Installations due to Collision with Attending Vessels. Spirit Energy already proactively manages this issue for attending vessels with detailed engineering analyses of the consequences of platform impacts and detailed procedures. However, the key points of the letter include:

- Structural failure due to vessel impact is seen as a major accident hazard;
- There is a need for increased awareness of the issues;
- Issues increase with increasing vessel displacements and speeds;
- The capacity of installations to withstand collisions is unchanged;
- Appropriate measures must be used to safeguard the integrity of installations and protect the workforce.

Despite the letter referring to 'attending vessels' only, Spirit Energy should ensure the same principles are applied to all other vessels likely to impact the installations as the consequences may be just as severe or catastrophic. In this context, any displacement of traffic towards Spirit Energy installations by the proposed wind farm shall be subject to detailed risk assessment and a full review of proposed mitigations.

Collision Risk Management guidance is provided by HSE in their SPC/ Enforcement/ 177 which can be obtained on their website:
http://www.hse.gov.uk/foi/internalops/hid_circs/enforcement/spcenf177.htm.

It is likely the proposed wind farm will compromise the ability of Spirit Energy to effectively discharge their duties with respect to collision risk management.

4.1.5 G-OMO (Guidelines for Offshore Marine Operations)

These guidelines were developed by a Joint Industry Party (JIP) to provide a standard global approach to encourage good practice and safe vessel operations in the offshore oil and gas industry.

All vessels chartered by Spirit Energy are expected to operate within these guidelines under the Spirit Energy Marine Operations and Vessel Assurance Standard. The following chapters and sections of G-OMO guidelines have particular relevance in the context of the proposed wind farm development:

- 3.1.2.3: Responsibilities of Offshore Facility Operators. This section outlines the responsibility of the operator i.e. Spirit Energy, for maintaining the safety of vessels and personnel operating at their installations, including allowing vessels to enter the 500m safety zone;
- 5.4.2.3 defines an Operation Level C (the highest levels of vessel crew readiness and crew capability to be at their posts) which includes high complexity operations in and around the safety zone. Whilst this does not include areas within the proposed Hornsea 3 array, the principle could be usefully adopted by Orsted;

- 7: Operational Best Practice. This chapter addresses vessel operational capability which Spirit Energy achieves by:
    - A thorough marine assurance process using independent verification;
    - Effective planning;
    - Specific planning for non-routine operations;
    - Comprehensive management of DP (Dynamically Positioned) vessel operations;
    - Specific planning for SIMOPS (Simultaneous Operations) when a vessel's actions may affect the other(s), or vessels within a safety zone;
- 8: Collision Risk Management. This chapter details the guidelines which a vessel approaching, or operating close to an installation must follow, including pre-approach checks, setting up and final approach checks both in manual and DP modes. Field transits must be made at a distance of at least 1 nautical mile from any facility or operation in progress. With the current proposed windfarm limits, dependent on locations of operations, this level of separation may not be possible;
- 11: Anchor Handling and MOU (Mobile Offshore Unit) Moving. The guidelines in respect of this chapter include:
    - A requirement for the operator to effectively plan the rig move;
    - A requirement for the operator to specify minimum horizontal clearances from other infrastructure, pipelines etc;
    - The person in charge of the MOU to ensure effective communication and the safety of the operation;
    - Contents for the work specification including communications, procedures, environmental criteria, hold and trigger points;
    - Keeping safe distances from other installations with due allowances for weather and tide, and for potential loss of power and/or tow;
    - Advising third parties with assets in the area of planned operations and to enable their participation in planning and risk assessment;
    - Not using facilities as waypoints;
- 13: Emergencies. This chapter outlines responsibilities and actions to be undertaken in emergency situations. Nothing in this chapter should be in conflict with similar provisions in the proposed windfarm procedures.

4.1.6 Maritime and Coastguard Agency - MGN 543

The UK Maritime and Coastguard Agency regulate shipping within UK waters. As such, they issue a range of laws, rules, guidelines and other documentation relating to the safety of shipping and the environment. In the context of the proposed windfarm, their requirements are outlined in Marine Guidance Note 543 which deals with the Safety of Navigation in the

Vicinity of Offshore Renewable Energy Installations. It is noted that the contents of the MGN are not mandatory, only guidelines, however the MGN states: 'failure to accept the principles of the guidance may result in delays or objections from stakeholders'.

A key guideline includes a requirement to 'evaluate all navigational possibilities which could be reasonably foreseeable' during planning, construction, operation and de-commissioning of an OREI. The EIA (see below) in its current form does not adequately evaluate all the issues relating to potential navigational issues arising at Spirit Energy installations in the Markham area arising from the proposed wind farm. The issues not addressed relate to approaches and mooring of Jack up and crane barges.

Other points of relevant interest contained in the MGN include:

- In the UK all vessels have freedom to transit through OREIs, subject to any applied safety zones and their own risk assessments;
- 'Packed boundaries' (e.g. significant numbers of turbines collectively forming a barrier) will be assessed on a case-by-case basis. However, in the Markham area, from a marine perspective, a packed boundary will not be acceptable to Spirit Energy for the reasons discussed below;
- The MGN highlights the effects of multiple structures on marine radar;
- Guidelines are provided for calculating the width of corridors between OREIs. The MGN notes the Netherlands has made an assessment of sea room requirements using data supported by the PIANC assessment for channel design. In general, they strive for an obstacle free or buffer zone of 2nm between wind farms and shipping lanes. A similar distance would be appropriate between the proposed wind farm and current Spirit Energy assets, including subsea assets such as the Grove West well.

4.1.7 Oil and Gas UK

Oil and Gas UK produce a range of guidelines to assist their members to operate their assets effectively and safely. Of particular relevance in relation to the proposed windfarm are their Guidelines for Ship/Installation Collision Avoidance (see also 4.1.2 & 4.1.3 above). The purpose of the document is to assist operators to fulfil their duties under the Safety Case Regulations for the well documented Major Accident Hazard resulting from a collision with an infield or passing vessel. The document outlines collision risk management systems and the duties of the Duty Holder.

The Duty Holder must have a system in place that:

- Has assessed and continues to assess the probability of a vessel colliding with the installation and of the consequences likely to result from such a collision;
- Identifies passing vessels which may collide with the installation in sufficient time to take appropriate action;
- Ensures all attendant vessels are managed in such a way as to reduce the probability of colliding with the installation;
- Implements timely and effective Emergency Response in the event of a collision;
- Records events leading up to and during the incident;

- Includes means of dealing with the consequences and of rescuing installation and vessel personnel.

The Guidelines indicate operators should have equipment and procedures in place to assess and determine risk of collision and have the ability to warn approaching vessels and to shut down the installation if required, always considering the required actions for the safety of personnel. Spirit Energy complies with the Guidelines by the use of an ARPA Radar System and AIS on the manned J6 installation, or on an attendant ERRV if the platform is manned or attended by a Jack-up unit.

4.1.8 International Marine Contractors Association

The aim of this organisation is to improve the performance of marine contractors globally. The Association issues best practice Guidelines on a range of marine activities. Spirit Energy expects contractors providing vessels will comply fully with these Guidelines. This compliance is verified during the vessel assurance process, and relates, in particular, to: Marine Operations, Dynamic Positioning, Diving and ROV Operations, Heavy Lifting, Survey and Lifting and Rigging.

4.1.9 IALA Guideline: Navigational Safety within Marine Spatial Planning

In terms of marine spatial planning, this document highlights the usefulness of distinguishing between different types of risks, by means of the nature of the consequences involved. For oil and gas risks, the consequences are, in the main, much more severe than for leisure activities. The EIA for the proposed windfarm does not appear to appreciate this guideline.

However, the main thrust of the document i.e. the need for strategic marine spatial planning with full participation of the stakeholders (e.g. licence block holders) is not apparent in relation to the current application and therefore at a national infrastructure level, wind farm developments have the potential to conflict with other marine sectors.

4.2 Review of Spirit Energy Documentation

4.2.1 Introduction to existing Spirit Energy risk management documentation reviewed

Within their Safety Cases Spirit Energy highlight that they take their obligations to safely manage risks associated with their operations, including those associated with marine and producing asset operations very seriously. They strive to ensure, as far as is reasonably practicable (ALARP), the health safety and welfare of all their employees, and members of the public who are exposed to risks from its operations.

To that end, the documentation below is reviewed to outline how these operations are managed and conducted safely. This includes the safety of third party vessels and assets, including any turbines, vessels or other infrastructure associated with the proposed wind farm. Spirit Energy expect third parties, including Orsted in relation to the proposed wind farm, to plan and manage their operations including construction and de-commissioning to a similar high standard as expected by oil and gas legislation and best practice.

This section of the review focuses on the Spirit Energy documentation and how it may be affected by the proposed wind farm.

4.2.2 Spirit Energy/OGUK/HSE – Major Accident Hazard definition

Spirit Energy has a framework in place to manage Major Accident Hazards. It forms part of the risk management process. The five key elements of the framework are:

- Identify hazards which have the potential for serious danger to human health or the environment either inside or outside the facility;
- Define safety critical elements for which failure will either cause or contribute to a major accident;
- Define performance standards - defining the level of performance that is expected of a safety critical element, and the criteria against which its suitability is judged;
- Perform assurance on the safety critical element;
- Perform independent verification.

Note: Spirit Energy accepts the HSE definition of a 'Major Accident Hazard'.

As part of the above framework, Spirit Energy defines acceptance criteria for risk. These criteria specifically address normally unmanned installations such as a number of those addressed in this study. Risk criteria used are defined against international standards.

4.2.3 Installation Safety Cases

4.2.3.1 Concept of 'Safety Case' and Major Accident Hazard (MAH)

A Safety Case is a document demonstrating the ability, and means by which Spirit Energy will manage and control Major Accident Hazards (MAH) at an offshore installation. The requirement for safety cases was borne out of the Cullen Report on the Piper Alpha disaster in 1988.

Spirit Energy has identified twelve groups of major accident hazards. In relation to the proposed wind farm development these include:

- Ship impact;
- Subsequent release of hydrocarbons from risers;

Both of these MAHs have high relevance to the consequences of the proposed wind farm development due to the potential traffic displacement and other effects.

An additional MAH relating to Helicopter operations on to windfarm development vessels when in close proximity to Spirit Energy assets or attendant vessels is also identified but aviation operations and related MAH is being assessed under a separate study.

Spirit Energy has a comprehensive framework in place to manage risk associated with Major Accident Hazards using techniques including compliance with codes and standards, internal and external stakeholder consultation, benchmarking, peer review, and independent verification and assurance. Individual risk criteria are defined, including for normally non-permanently manned installations. Non-permanently manned installations shall, in the event

of a major accident, provide sufficient protection to allow attending personnel time to respond to the emergency and muster at the primary muster point.

Events since Piper Alpha, such as the Mumbai High disaster, have shown the consequences of failing to adequately address the risks associated with ship collision and associated ruptured gas risers. One oil major recently installed a floating barrier to address the risks associated with errant vessels and an exposed marine riser in the northern North Sea.

The physical construction of many platforms in the vicinity of the proposed wind farm is relatively light, and as such, collision risk from attending vessels is managed by minimising numbers of collisions and ensuring vessels which are entitled to approach the platform are of a mass, and are travelling at speeds, which will not cause significant damage. Approaches are not made to vulnerable areas of platforms, and vessels are selected by a detailed marine assurance process which ensures they have additional controls in place. Spirit Energy do not however have this level of control over passing errant vessels, including fishing vessels, but must act to mitigate the associated risks. Any development which is likely to increase this risk due to higher traffic density must be carefully assessed. A similar assessment will be required for vessels operating on the limits of the proposed wind farm development.

Brief details of the current Safety Cases for the Spirit Energy assets closest to the proposed wind farm eastern limits are given below. However, these may be subject to future updating if enhanced recovery techniques are employed in future.

4.2.3.2 Safety Case Information

In relation to the requirement to produce Safety Cases, ownership of the assets referred to in this study are as follows:

- ST1/J6A: Spirit Energy Nederland B.V. (Spirit) is the nominated Duty Holder and Installation Operator of the J6A platform on behalf of all partners involved in the Markham Field. (Duty Holder correspondence address: Transpolis Building, Hoofddorp, Netherlands);
- Chiswick: Spirit Energy North Sea Limited is the concession owner and the nominated Duty Holder, Well Operator and Pipeline Operator for the Chiswick and Kew fields. (Duty Holder correspondence address: IQ Building, Aberdeen);
- Grove: Spirit Energy Resources Limited is the licensee, registered owner and nominated Duty Holder, Well Operator and Pipeline Operator for the Grove Field and associated facilities. (Duty Holder correspondence address: IQ Building, Aberdeen);
- Windermere: The operator of the Windermere Field is INEOS UK SNS Limited. Spirit Energy North Sea Limited has a 20% equity stake in the field for which a Decommissioning Programme has been submitted.

For the purposes of this study, all Spirit Energy entities are referred to as 'Spirit Energy'.

4.2.3.3 Safety Case Assumptions: Collision Impact Energy

Within the Safety Cases which follow, it is assumed collisions with an impact energy lower than 5MJ are assumed to result in local, repairable damage to the installations and it is considered that fatalities are unlikely.

If the impact energy is greater than 50MJ, it is considered immediate collapse of the installation will occur and all personnel on the platform are assumed to be fatally injured. The

fatality probability is however taken to be 80%, to take into account the ARPA/AIS system (on platform J6A) would warn personnel of a potential collision, enabling them to evacuate the installation via lifeboat prior to collision.

Impact energies between 5MJ and 50MJ are considered to have the potential to result in significant damage, but immediate collapse of the platform would not be expected.

In their report 'Effective Collision Risk Management for Offshore Installations' the HSE assumed the following Impact Energies:

Table 4-1

Vessel type	Displacement (T)	Speed (Kts)	Impact Energy (MJ)
Tanker	120,000	13	2952
Ferry	8,500	16	317
Merchant Container	22,500	11	396
PSV	3,500	10	51
Offshore Standby	1,500	10	22
Fishing vessel (large)	1,000	8	9
Fishing vessel (small)	400	8	4

From the table above, it is apparent that any passing vessel other than the smallest fishing vessel, has the potential to severely damage, or demolish the platforms in the Markham area. It is also worth noting here that displacement of large fishing vessels noted above is conservative and modern fleets are now comparable to that of PSVs. Consequently, any impact from diverted traffic by the proposed wind farm, which would increase traffic density around these platforms should be considered in detail because of the potential catastrophic consequences. Of particular concern is the proposed south-east corner of the array where traffic will be diverted close to the Grove platform.

4.2.3.4 Chiswick Safety Case (Latest update 12/02/2018)

Chiswick is a producing gas platform with tieback to subsea well (Kew) designed as a 'normally unmanned installation' (NUI). There needs to be capability to visit for unplanned maintenance at any time in addition to scheduled visits. Over a year this may equate to between 40-150 days or more if drilling or decommissioning activities take place. The jacket and topsides are designed in accordance with the relevant codes.

Chiswick has four wet gas production risers and one import riser from the Kew Well, which are co-mingled and sent to the J6A platform via a 10" gas export riser.

The platform maintains inventories of Methanol, corrosion inhibitor, Diesel, Hydraulic and Lube Oil. The installation is provided with the required navigation beacons and foghorns.

Diving, ROV, Well Intervention, further Drilling and workover activity is undertaken by chartering Jack-up or Dynamically Positioned units.

500m exclusion zones are in place around the platform and Kew Well to limit approach to surface traffic and fishing vessels. Combined radar and AIS monitoring systems have been installed on the J6A platform to give improved warning of impending, or potential, ship impact with installations in the Markham area (including Chiswick). Spirit Energy's philosophy is to avoid visiting Chiswick if the monitoring system is not available, however, if essential, a visual watch will be initiated, and in the case of longer ARPA/AIS down time an ERRV chartered. Marine communication equipment is provided on the platform.

Note: A combined ARPA (radar) and AIS (Automatic Identification System) monitoring system has been installed on J6A to give improved warning of impending or potential ship impact with installations in the Markham field, including the satellites. The purpose of the system is to detect and track vessels that have the potential to collide with an installation and, where possible, warn personnel on the installation of the impending collision to allow them to evacuate or escape. The ship collision avoidance provisions are able to detect all objects within a range of 48 Nautical Miles (NM) around J6A. Radar and AIS data is used as inputs in the computerised system to calculate and display, based upon track, course and speed record data, possible incursions into the target zone around the platforms. The system presents audible and visual warnings to operators as soon as such incursions seem possible when the target is tracked in the acquisition zone for longer than 2 minutes. The warning system allows for audible and visible alarms to be given approximately 20 minutes prior to the occurrence of a potential collision event, based upon the target ship's speed. This is considered to provide sufficient time for personnel on J6A to muster, board the lifeboat and evacuate. However, personnel will also try to contact the ship on emergency channels, e.g. channel 16 VHF. It is assumed most vessels passing the Markham Greater Area are on international voyages and therefore those vessels are equipped with AIS.

4.2.3.5 Grove Safety Case (Latest update 21/02/2018)

Grove is a platform producing gas with tieback to a subsea well (West Grove) designed as a 'normally unmanned installation' (NUI). There needs to be capability to visit for unplanned maintenance at any time in addition to scheduled visits. Over a year this may equate to between 40-150 days or more if drilling or decommissioning activities take place. The Grove West Well is located 1.5nm from the current proposed wind farm eastern limit. The jacket and topsides are designed in accordance with the relevant codes.

Grove has four wet gas production risers and one import riser from the West Grove Well, which are co-mingled and sent to the J6A platform via a 10" gas export riser.

High Power (HP) and Low Power (LP) hydraulics, electrical power and chemicals for the West grove subsea well are supplied from the Grove platform, via a dedicated subsea umbilical. The umbilical is routed from the platform topside through a dedicated 'J' tube to the subsea facilities. The umbilical terminates the control and chemicals functions at a subsea umbilical termination unit near the subsea Xmas tree. The lines are connected to the tree via flexible jumpers and cables.

The platform maintains inventories of Methanol, corrosion inhibitor, Diesel, Hydraulic and Lube Oil. The installation is provided with the required navigation beacons and foghorns.

Diving, ROV, Well Intervention, further Drilling and workover activity is undertaken by chartering Jack-up or Dynamically Positioned units.

500m exclusion zones are in place around the platform and West Grove Well to limit approach to surface traffic and fishing vessels. Combined radar and AIS monitoring systems have been installed on the J6A platform to give improved warning of impending, or potential, ship impact with installations in the Markham area (including Grove). Spirit Energy's philosophy is to avoid visiting Grove if the monitoring system is not available, however, if essential, a visual watch will be initiated, and in the case of longer ARPA down time an ERRV chartered. Marine communication equipment is provided on the platform.

4.2.4 Metocean Criteria Data

A high level review of the Metocean Criteria for Block J6a was undertaken and a comparison made with data presented in Orsted document HOW03_6.2.1_Volume 2_Marine Processes. The comparison indicated that:

- Wind directions and speeds were very similar in both documents, with higher frequency and wind speeds from the southwest quadrant. However, annually, wind is experienced from all directions, at significant wind speed;
- Wind generated waves were most prevalent from the same quadrant as wind although peaks in wave energy may also contain a swell component, generated from distant storms;
- Tidal directions were similar in both documents in general, a depth averaged study gives flows as WNW/ESE with spring rates of up to 2.5 knots.

The above are of importance when considering vessels passing or manoeuvring at the Eastern limit of the array, and alongside Spirit Energy assets.

Wherever practicable, vessels approach Spirit Energy installations in a 'drift off' configuration. This configuration ensures in the event of a contingency situation arising, the vessel will drift away from the platform. However, in a large number of cases, this will now mean the vessels will also be in a 'drift on' configuration to the turbines and windfarm construction vessels. Similarly, in winds from the west/tides setting to the East, vessels servicing the array will be in a 'drift on' configuration to Spirit Energy assets.

The major implication from the above relates to Orsted chartered, or third party vessels, close to the Eastern limit (either inside or out with the array) of the proposed wind farm which may go Not Under Command as defined in the COLREGs. In effect the proximity of such vessels to Spirit Energy assets, either current installations or a Jack-up rig over the subsea wells, would lead to very short drift and reaction times before a collision took place. Due to the presence of cables within the array area, NUC vessels would not be able to anchor there. Maintenance of the current Spirit Energy standard in relation to monitoring 'errant vessels' will not be practical. In this case of a vessel going NUC at the Eastern edge of the windfarm limit and drifting towards a Jack-up rig on the Grove West Well, with a potential tidal stream of over 2 knots and a wind driven drift of up to 4 knots, drift time to impact would be reduced to a small number of minutes. This is not adequate time to implement the Spirit Energy standard in relation to safety of personnel. The hazards associated with drifting vessels at the Eastern limit of the proposed wind farm should be addressed.

4.2.5 Spirit Energy Marine Operations Procedures

In the context of statutory requirements, and best practice guidelines, to ensure safe management of marine operations at their installations, Spirit Energy has developed a Marine Operations and Vessel Assurance Standard (Spirit Energy document SPT-MAL-GEN-STA-0010) and associated procedures. This document applies to all vessels chartered by Spirit Energy and covers vessel selection, contracting, operations and assurance. For Spirit Energy chartered vessel purposes, a two mile radius round an installation is considered a 'controlled area'. In the context of the proposed wind farm, marine operations covered includes: PSVs, ERRVs, AHTS, DSV, Well Intervention Vessels, Heavy Lift, W2W, Offshore Construction, Seismic Survey, ROV and Guard Vessels.

Key features of this document include:

- Vessels must comply with all relevant national and industry standards and guidelines including requirements to have a Safety Management System which incorporates crew hours of work and rest;
- Expectations for risk assessment and management are defined;
- Vessel selection is carefully managed and subject to marine assurance by a specialist contractor. Additional attention is given to specialist vessels with DP, Dive and Heavy Lift etc. capabilities;
- The use of checklists to confirm suitability and preparations of vessels before entering safety or controlled zones;
- Provision of comprehensive installation data to vessels before entry to zones;
- Setting of weather limits for all Marine Operations;
- Detailed standards for the operation of DP vessels including incorporation of IMCA standards for FMEA and Annual Trials;
- IMCA standards for DP Operator training and competence;
- Approaches to installations: operations in the drift on condition shall be avoided if the vessel can be operated in the drift off condition;
- Detailed management guidelines for:
    - Platform Supply Vessels;
    - Emergency Response and Rescue Vessels, including tracking of errant vessels and use of Radar Early Warning Systems (REWS);
    - Survey/Seismic Survey Vessels, including seismic/piling/diving interfaces and use of laser devices;
    - ROV support/construction/Walk to Work vessels;
    - Diving including use of saturation, and air diving spreads;
    - Anchor Handling Vessels and anchor patterns;
    - Jack up Vessels;
    - Guard Vessels;

- Pipelay Vessels;
- Shuttle Tankers (not currently relevant to the proposed windfarm).

It should also be noted that many of these specialist vessels will use helicopters for crew changes and for delivery of urgent equipment. It is likely that vessel helicopter operations will be significantly affected by the proposed wind farm in the Markham area. This risk will however be addressed elsewhere in the Spirit Energy response to the EIA.

4.2.6 Rig Move Procedures for Chiswick, Grove, ST1 platforms and Kew well

4.2.6.1 Review of rig move procedures and reports

Well interventions on the above platforms and wells are undertaken by Jack-Up Drilling Rigs. A number of rig moves have taken place recently. Of these, the following typical Rig Move Procedures and reports have been reviewed to identify issues which may have arisen if the proposed wind farm limits had been in place at the time of the move:

- Noble Byron Welliver from Rotterdam to Kew KY Well dated 06/2013;
- Paragon B391 from Great Yarmouth to the Grove installation, dated 10/2016;
- Paragon B391 from Harwich to ST1 installation dated 02/18;
- Noble Hans Deul from Cromarty to Chiswick installation, dated 04/2018.

Common features of these procedures include:

- Due to the design of most Jack-up Rigs, combined with the preferred orientation at current installations and with the prevailing tidal streams, the final approach (tow-in) on location is always from a direction between west and north;
- Preparations for tow in commence between 1.5 and 2 nautical miles from the final location, in the quadrant between West and North. These preparations involve up to three Tug boats and the Jack up RIG manoeuvring in close proximity in tidal streams;
- Permission is required to enter the 500 m safety zones;
- Final tow in will usually commence at a range of between 800m to one mile;
- At this point three vessels are connected to each of the three corners of the rig with towlines of anything up to 400m (i.e. total radius of the slow moving tow spread may be up to 900m);
- Leg lowering will commence around 1 nautical mile from the platform or subsea installation;
- Once at a position or around 80m to 200m from the platform/well, the rig will be lightly pinned, partially elevated, and anchors for controlling the final approach run out to distances of up to 800m. Whilst running anchors, the length of the Anchor Handling Tug and also the length of work wire used must be considered. Alternately, pre-laid anchors may be used at a range of up to 1,200m from the installation;
- At least one operator of Jack-up Rigs also uses a procedure for dealing with 'errant vessels' (and one for drifting vessels). These procedures currently address vessels at

up to 8 nm range if they have a CPA of less than 1 nm. The rig will prepare for evacuation if a vessel is at 2 nm range and has a CPA of less than 500 m.;

- During departures, the rig will usually be moved on the alongside heading (generally between 315 and 360 degrees, with the drift off tidal stream (usually NW), until the legs are fully retracted. In normal circumstances, this will be within 1 to 2 nautical miles but if problems are experienced, may be more;
- More than one tow vessel, usually three, are connected during initial departure to mitigate against tow wire failure and tidal streams, again giving a tow spread radius of up to 900m;

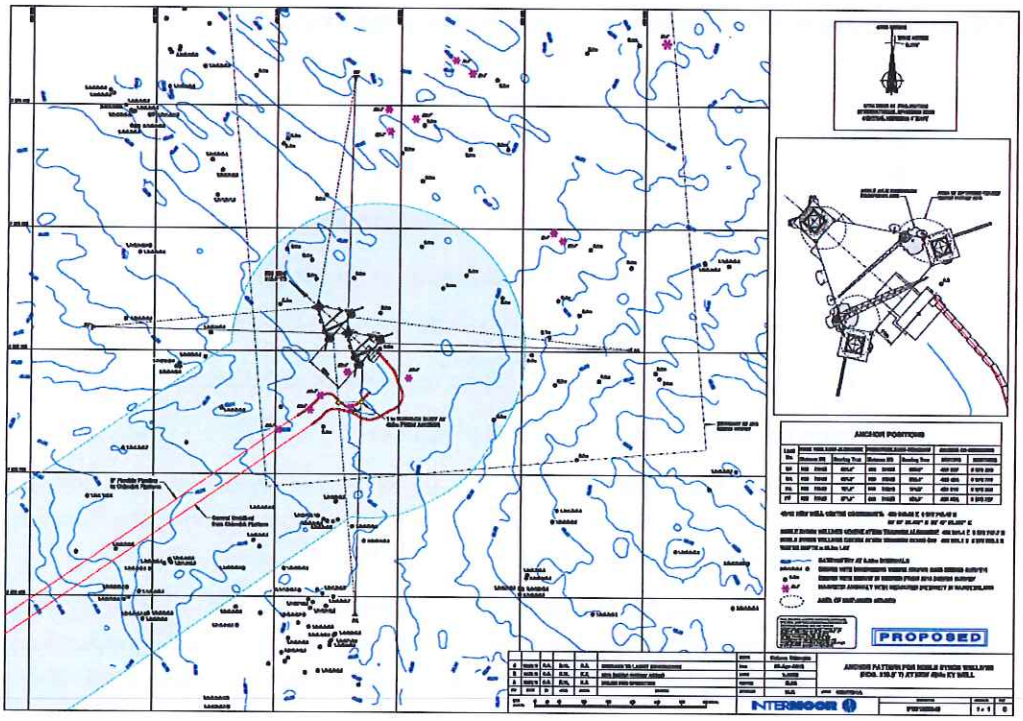

Fig 4-1: Typical positioning of jack-up rig with anchors deployed, heading North West

4.2.6.2 Issues arising with respect to proposed wind farm

If the proposed wind farm array limits are adopted as planned, with the potential for turbines close to the limit, the following issues will arise:

- Current standard approaches for Jack up Rig spreads will be compromised, especially at the Grove and Chiswick installations and the Grove West Well;
- Laying of positioning anchors may be compromised at the Grove and Chiswick installations, and will be compromised at the Grove West Well location;
- Observation and monitoring of 'errant vessels' may be compromised due to the array reducing lines of vision and radar interference with consequent reduced detection and prediction times;
- In the event of contingencies during approach and departure, the 800/900 m (approx.) diameter, slow moving spread of a Jack-up and three Tugs will be unable to abort to

the west which is currently the natural direction as the operation will be planned to take place during the north-west setting tide.

4.2.7 Management of other marine operations

4.2.7.1 Decommissioning and platform removal

The ST1 platform, to the west of the proposed wind farm limit, is currently scheduled to be removed by 2023. The methodology to be used involves a spread moored Crane Barge.

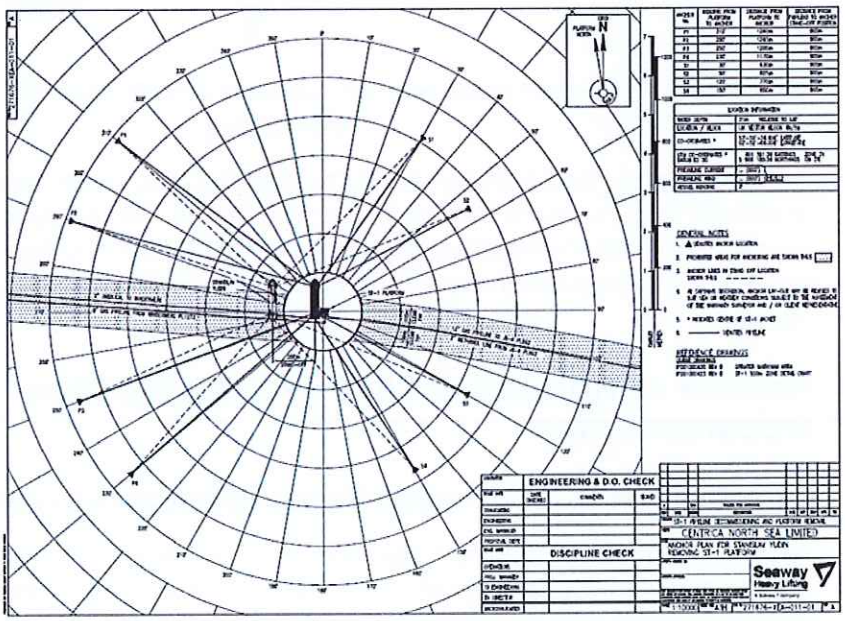

Figure 4-2: Spread moored crane barge at ST1

The anchors involved in this operation are planned to be deployed at up to 1,245m from the installation. Anchoring will take place at a 'standoff' position, in a 'drift off' configuration. Laying the anchors involves the use of an Anchor Handling Tug, and a work wire of at least 200m length. A clearance of 200m is always allowed from any other infrastructure. In exceptional cases, if anchors do not hold when test tensioned, a piggy back anchor may be used which could add a further 200m length to the mooring. In total, this could require a vessel to be at up to 1,600m range from the installation, with a preferred safety distance of a further 1,000m giving a requirement for a clearance of up to 2,600m. Anchors are marked with large buoys to facilitate recovery. In cases where mooring wires cross seabed obstructions, mid line buoys may be used to alter the catenary to ensure adequate vertical clearance, further reducing available sea room for passing vessels.

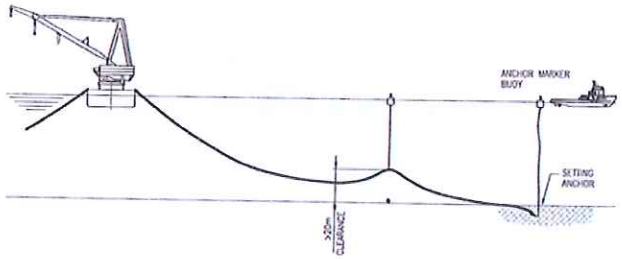

Fig 4-3: Use of mid line buoys to ensure adequate vertical clearance. Courtesy of Seaway Heavy Lifting

Whilst the above may not be an issue in the case of ST1, a similar arrangement will likely be eventually used for the Chiswick and Grove installations. The ability to carry out such an operation, with associated buoyage which would likely impinge on the proposed wind farm limits, will be compromised and will substantially reduce safe transit areas for passing vessels.

4.3 Review of Hornsea 3 Windfarm Application Documentation

4.3.1 Introduction to Application Documentation Reviewed

As part of the proposed wind farm Application Process, Orsted has produced an Environmental Statement presenting the results of an Environmental Impact Assessment (EIA) for the potential impacts for the project. This document, produced by an Orsted subcontractor RPS, outlines their assessment of the impacts of the project on a range of environmental issues including the physical environment, natural environment, and other users of the proposed project areas.

It should be noted that the document covers the array area, cable corridor and also the land areas affected by the proposal.

Relevant Chapters of the statement are reviewed below. Each chapter comprises an introduction, a planning context, how issues raised to date have been addressed, a baseline position, and a methodology before assessing potential impacts and includes a justification for the application.

4.3.2 Methodology

The methodology adopted in assessing navigational risk appears to be similar to that defined by the Department of Trade and Industry in 2005 (Ref /11/):

- Estimate "base case" level of risk;
- Predict "future case" level of risk;
- Create a hazard log;
- Define risk controls and create a risk control log;
- Predict "base case with wind farm" level of risk;

- Predict "future case with wind farm" level of risk.

From the point of view of Spirit Energy, the output of this study should be considered as input to the hazard log for use in reviewing the safety cases.

4.3.3 Document: HOW03_6.2.1_Volume 2-Ch 1- Marine Processes

This Chapter presents the results of the EIA on marine processes. 'Marine Processes' is a collective term for water levels, currents, waves, frontal systems, sediments and geology, seabed and coastal geomorphology.

It is noted that:

- the spatial extent of the study area has primarily been determined using expert judgement, and previous knowledge without indicating in depth the nature of the expert knowledge in relation to Oil and Gas Marine Operations;
- There may be some potential during the construction phase, especially around Markham's Hole where muddy sediments exist, for sediments in suspension to be carried, during a tidal period, to the vicinity of Spirit Energy assets with potential implications for cooling water intakes and Diver visibility (Figure 1.4);
- Environmental data provided is broadly in agreement with Spirit Energy Metocean Data (Section 4.2.4 which see) for the area;
- Suction Dredgers may be employed for foundation preparation works and cable route preparations with a minimum spacing of 1000m. Spoil disposal from these dredgers requires to be carefully managed to ensure that Spirit Energy current and potential future operations are not compromised. This includes disposal of spoil near assets, or potential future asset locations, or close to vessels undertaking underwater operations;
- Similarly, although expected to be less of an issue if only undertaken within the array, jack up vessel leg spudcan penetrations may interfere with future operations. This is of a greater concern if vessels are in a layby position waiting to go on hire or enter the array area;
- No Oil and Gas Project overlaps have been considered. Whilst this is currently primarily a commercial issue, any marine operations associated with future Oil and Gas projects will be compromised by the proposed wind farm development (see 4.3.5 of this study).

4.3.4 Document: HOW03_6.2.7_Volume 2-Ch 7 – Shipping and Navigation

This Chapter presents the results of the EIA on shipping and navigation. The study area is defined as a 10nm buffer applied around the array area, and a 2nm buffer around the cable corridor. These areas are frequently transited by vessels chartered by Spirit Energy to service a number of their assets.

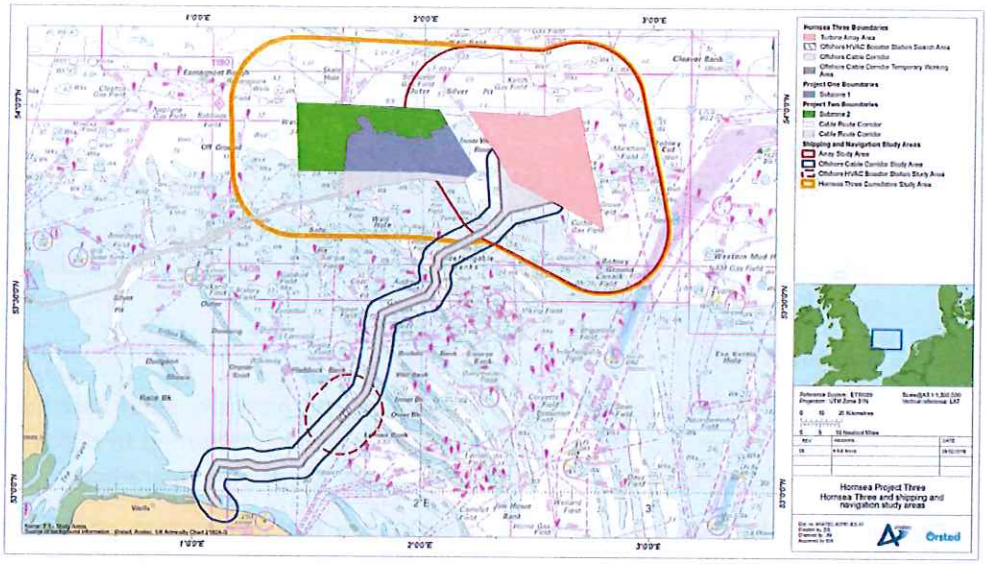

Figure 4-4: Hornsea Three shipping and navigation study area (ref: Chapter 7 Environmental Statement Volume 2 – Infrastructure and other users)

In relation to this document it is noted:

- Para 7.7.1.3 (Navigational Features) recognises the proximity of Spirit Energy assets Chiswick and Audrey, however, no cognisance is given to the Grove assets, in particular the subsea well 5 (Grove West). This is of particular concern as traffic will be diverted round the South-East corner of the array in close proximity to Grove, especially if interacting with traffic in the adjacent TSS;
- Para 7.7.2.3 (Commercial Vessel Analysis) states that oil and gas vessels servicing drilling rigs were excluded from the analysis whilst vessels supporting permanent installations were retained. As many operators use the same vessels to support all activities this distinction could be misleading;
- In relation to fishing activity, it can be seen from the document that considerable fishing operations are prosecuted both in and to the East of the array area, in the vicinity of the Markham area. No meaningful assumptions or assessment has been made as to the displacement effect on this activity at any stage of the proposed windfarm, or the effect on Spirit Energy assets or operations;

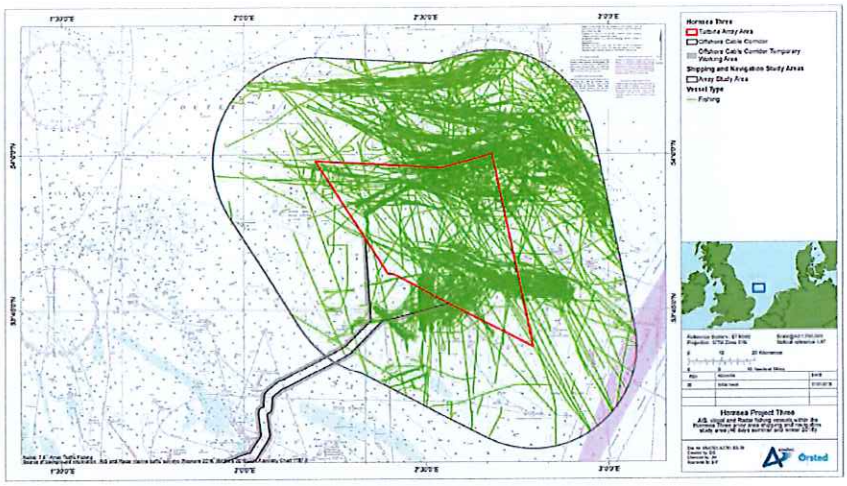

Fig 4-5: Fishing activity in the study area of the proposed wind farm (ref: Chapter 7 Environmental Statement Volume 2 – Infrastructure and other users)

This document does not address the potential navigation and collision impacts of construction, O&M and de-commissioning activity associated with the proposed wind farm in detail. This is of particular concern in relation to displaced vessels (cargo and fishing) on the assets and operations of Spirit Energy in the Markham area.

Whilst the activity associated with Supply Vessels is mentioned (11.7.16.1) the navigational activity and restrictions associated with Jack-up Drilling, Accommodation Rigs and other mobile units, spread moored Crane Barges and other specialist vessels is not. These are amongst a number of vessel types used throughout the life of oil & gas platforms.

There is an assumption noted in the document (refer December 2017 Trinity House Consultation Meeting) that commercial vessels will not navigate within the array. However, the MCA has made it clear (MGN 543) such navigation may be undertaken. Whilst vessels of reputable companies and Flags may not undertake such passages following risk assessment, many less reputable companies and Flags vessels may, in particular if commercial advantage can be gained and such transits are likely to become more prevalent as the sea areas subsumed into wind farms increases. These vessels may be the most likely to have reduced, hence fatigued, crews which may add to the hazards associated with detection of vessels within the array, and the major accident hazard of vessel/installation collision.

4.3.5 Document: HOW03_6.2.11_Volume 2-Ch11 – Infrastructure and Other Users

This Chapter presents the results of the EIA on infrastructure and other users. The scope is wide ranging and includes other users from canoeists, through leisure sailors, aggregate extraction to oil and gas operators. Exclusions include collision risks to other vessels which are stated to be covered in the document reviewed at 4.3.3 above. The study area only includes other oil and gas operators within 1 km of the proposed array area for infrastructure, and up to 35 km for Radar Early Warning Systems on installations. A maximum design scenario is considered for assessment purposes.

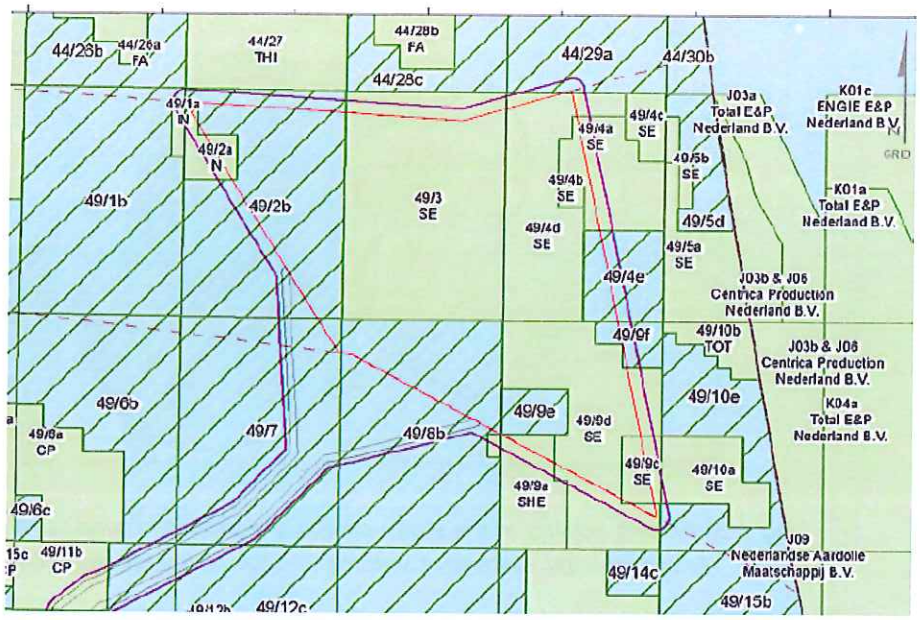

Figure 4-6: Study area indicating Blocks where Spirit Energy (SE) are designated as Operator (ref: Chapter 11 Environmental Statement Volume 2 – Infrastructure and other users)

As shown elsewhere in this study, 1 km is an inadequate separation for a number of oil and gas activities including Jack up Rig Moves, and Crane Vessel spread mooring hence the EIA does not address hazards associated with current Spirit Energy activities of this nature.

The chapter also addresses how the maximum design scenario of the proposed wind farm will affect oil and gas operations (Table 11.20) including how the proposed wind farm:

- Will restrict potential seismic survey activity. The scope of this cannot be known as wind farm infrastructure and Diving operations may preclude seismic operations for extended periods through and beyond the array area. The chapter considers this justified however apparently without full consideration of the future impact on Spirit Energy licence blocks in the subsequent EIA (Table 11.28). However, as this is a commercial, rather than marine related issue, no further comment is made, other than highlighting the proposed wind farm will restrict any future seismic activity within the array area;
- Will impact on drilling and future placement of oil and gas infrastructure both in the array and cable corridor. The justification is that construction will take place over time without consideration of the full final impact on marine activity on current Spirit Energy licence blocks;
- Safety zones of 500m, and advisory safety zones of 1,000m may interfere with oil and gas activity. However, the detail of how these zones may interfere with operations at Spirit Energy assets, especially in the Markham area, is not addressed in detail;
- May impact on seismic operations due to noise from piling operations. However, the impact of noise from piling and underwater operations on Diving operations is not addressed and is a more likely/higher impact scenario during frequent IRM activities.

Spirit Energy has a detailed ten-year plan of inspections for platforms in the Markham area. Although these inspections are undertaken by ROV, any subsequent intervention required is by use of Divers;

- May impact on physical access to oil and gas platforms. However, there is no indication the assessment considers the specialist access requirements of Jack-up Drilling Rigs, spread moored vessels, specialist DSV/construction vessels, Walk to Work and workover vessels;

NOTE: the above are considered in each of the construction, operation and de-commissioning phases within the EIA.

Chapter 11.9.1 gives an overview of the EIA methodology, and indicates additional documents and references which have been considered. Whilst documents referring to recreational cruising and surfing are considered, no such consideration has been given to oil and gas industry documentation other than licencing rounds and pipeline crossing agreements. As a minimum, consideration should be given to all relevant HSE & OGUK documentation, especially relating to major accident hazards and vessel/installation collision avoidance. In this chapter, it is noted that:

- Hornsea Three will continue to consult with current oil and gas operators and licensees;
- Mitigation measures shall be put in place to reduce the effect of Hornsea Three on the REWS (term used in the EIA) on the Spirit Energy J6A platform. This recognition of a major issue for Spirit Energy is welcome. It is stated the mitigation measures will be based on the mitigation measures identified for Hornsea Project Two for the Saturn platform and developed in consultation with Spirit Energy. Undoubtedly, with the number of wind turbines proposed, and the potential proximity to Spirit Energy assets in the Markham area, the effectiveness of the ARPA on J6A will be compromised through the proximity of turbines, shadow effect, increased clutter and false target generation with radar waves reflected from towers and turning blades. Radar manufacturers are improving the effectiveness of radars to cope with such interference however it is beyond the scope of this report to address this issue in detail other than to state that this interference will have to be overcome to retain the effectiveness of the system on J6A. **NOTE**: The report considers the significance of the effect on the J6A REWS to be 'minor adverse' however with the number of turbines and their proximity, this significance could be much higher with large shadow areas precluding effective operation of the system.

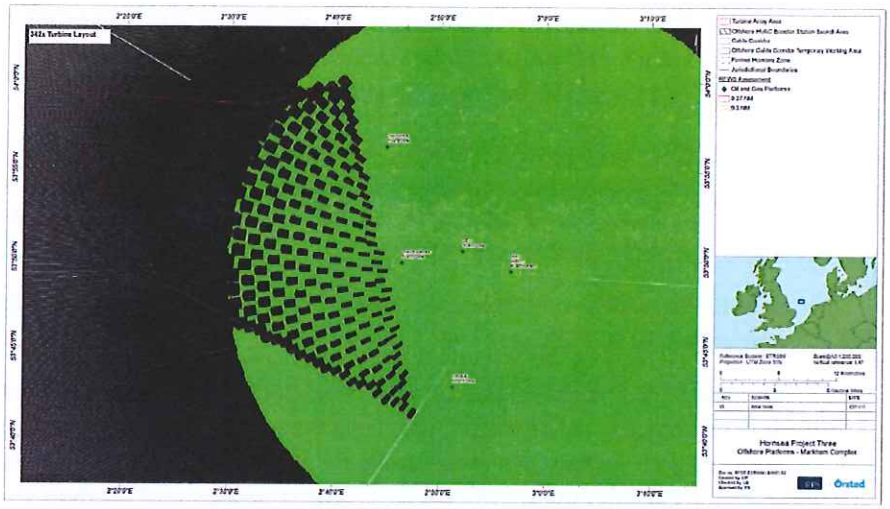

Figure 4-7: Modelled radar shadow areas

- The sensitivity for Spirit Energy with respect to REWS is already considered high in the EIA;
- The presence of proposed wind turbines in previously open sea areas will deviate vessels which may cause a change in CPA and TCPA alarms on oil and gas platforms protected by REWS. This topic is dealt with in depth in the EIA. The issue which should be of most concern is however the actual risk of vessel/installation collision. Whilst collision risk is to be dealt with in Document: HOW03_6.2.7_Volume 2-Ch 7 – Shipping and Navigation above, nowhere in the documents is the likely impact of diverted traffic in the restricted Markham area dealt with in adequate detail. This includes wind farm construction and O&M traffic, passing and displaced traffic, fishing vessels including displaced fishing vessels and oil and gas traffic. See Summary below.

Furthermore, it is noted that pipeline crossing and proximity agreements will be established with relevant pipeline operators.

With respect to the EIA it is noted:

- 11.11.1.52 That the Magnitude of Impact on Spirit Energy is considered by the EIA in block 49/4b to be major; moderate for 49/3, 49/4c and 49/4d and negligible for 49/10a. Spirit Energy should review these assessments in relation to their activities.
- The sensitivity of the licence operator has been assessed as low for Spirit Energy.

Collision risks to other vessels, due to the proposed windfarm limits and associated displacement effects, stated as being addressed in the document referred to in 4.3.3, do not adequately address the risks associated with specialist oil and gas vessels operating near Spirit Energy assets. These include Jack-up Oil Rigs under tow, Heavy Lift Vessels on approach to installations and other vessels preparing to service Spirit Energy installations.

It is somewhat incongruous that the EIA appears to address impacts to canoeists, surfers and recreational sailors in similar detail to impacts on oil and gas activity where the consequences of 'getting it wrong' could have severe to catastrophic consequences.

5 SUMMARY OF HAZARDS IDENTIFIED AND COMMENTARY

In relation to the proposed wind farm, with respect to the hazards identified, the following ranking system has been adopted for the purposes of this study only and is considered prior to any proposed mitigation:

Traffic Light	Status	Criteria
	Green	Minor impact on Spirit Energy operations, including costs; Can be managed within current Spirit Energy risk management processes; Not likely to significantly increase impacts and risks to Spirit Energy personnel, assets, or the environment.
	Amber	Significant impact on Spirit Energy operations including cost impacts; Will incur significant additional management of risk; Likely to significantly increase impacts and risks to Spirit Energy personnel, assets or the environment.
	Red	High impact on Spirit Energy operations including cost impacts; Will incur significant additional management of risk at Safety case level; Impacts and risks to Spirit Energy personnel, assets and the environment likely to be unacceptable.

During the review process in 4 above, the following marine hazards were identified:

Hazard	Description of Hazard	Status
The proposed wind farm eastern boundary is much closer to Spirit Energy assets in the Markham area than previously experienced by Spirit Energy elsewhere. The hazards associated with this aspect of the proposed wind farm are:		
1	Interference with Supply Vessel operations to installations in the vicinity due to the requirement to divert round windfarm infrastructure.	
2	Displacement of third party passing traffic towards Spirit Energy assets, increasing the traffic density and hence risk of collision with installations with severe or catastrophic consequences. This displacement will increase the major accident hazard risks in the Markham area, especially near Grove.	
3	Displacement of fishing vessel operations towards Spirit Energy assets with potentially severe consequences.	
4	If the proposed wind farm eastern boundary has an excessive number of turbines i.e. a 'packed boundary', this could reduce the ability of Spirit Energy to manage the risks associated with approaching vessels, especially errant or NUC vessels, due to the lack of visibility.	

Hazard	Description of Hazard	Status
5	Considerable reduction of drift and hence reaction times to vessels going NUC close to the eastern limit of the proposed wind farm (either inside or out with the array) before potential impact with Spirit Energy assets. The increase in traffic, including construction traffic and fishing vessels due to the proposed wind farm will also increase the likelihood of such events. Due to the presence of cables within the array, such vessels will not be able to anchor there.	
6	The ability to safely manoeuvre Jack up Rigs onto, and off, locations (e.g. Grove, Grove West and Chiswick) close to the eastern limit of the proposed wind farm may be compromised.	
7	The effects of the proposed wind farm on the operation of Construction Vessels, Diving Vessels, Pipe Lay and Walk to Work Vessels at Spirit Energy assets has not been adequately assessed and may be compromised.	
8	The use of Helicopters by these specialist vessels may be compromised by the proximity of turbines and helicopter traffic associated with the proposed wind farm	
9	The noise associated with piling operations during construction, on Diver operations at Spirit Energy assets, has not been adequately assessed	
10	Compromising the ability to deploy spread moored vessels, including heavy lift vessels, at Spirit Energy assets	
In addition, the following generic hazards were identified:		
11	The potential for future marine operations within the array such as drilling, pipelay and installation of surface and subsea assets will be severely compromised. From a marine perspective, the potential to conduct seismic surveys and indeed a range of other surveys (benthic, ROV etc) within the array and cable corridor will be severely restricted by the presence of the proposed wind farm	
12	The de-commissioning of old pipelines in the vicinity of the cable corridor may be compromised	
13	A reduction in the effectiveness of the J6A installation ARPA/AIS, or of an ERRV, to monitor and manage 'errant vessels' approaching installations. Note, MGN 543 indicates vessels can pass through OREIs, and the presence of the array will degrade the ability to detect such vessels. In Section 4.1.6, the OGA outlines the HSE requirement for the Duty Holder to have a system in place to manage this issue. The assumption that commercial vessels will not navigate within the array is based on an ideal world scenario and the hazards associated with third party vessels passing through the array should not be 'scoped out'.	

Hazard	Description of Hazard	Status
During the construction and de-commissioning phases, the following additional hazards have been identified:		
14	Current borne sediments in suspension to be carried to Spirit Energy assets with the potential to interfere with cooling water intakes and Diver visibility.	
15	Jack up spud can placement causing seabed disturbance that could interfere with future operations.	
16	Dumping of spoil from dredgers to cause similar disruption to the bullet point above, or seabed disturbances which could interfere with future operations	
17	Noise from piling operations to interfere with essential Diver IRM interventions	
18	Emergency response procedures may be compromised by the proposed wind farm	

It is noted Spirit Energy currently operates a robust management system for chartered vessels operating close to its assets, however, it will have no control of third party vessels outwith the 500m safety zones. Spirit Energy currently controls all chartered vessels at 2nm radius from the radius under their Marine Procedures. However, the principles applied for chartered vessels, could in agreement with Orsted, be applied to their chartered vessels.

In accordance with the regulatory requirement, and in the absence of a strategic Marine Spatial Plan for the area under consideration, Spirit Energy will require to ensure the risks associated with the Major Accident Hazards identified, especially collisions as discussed above, are reduced to ALARP, always bearing in mind the potentially severe or catastrophic consequences of a vessel/installation collision.

The conclusion of the study is that the marine hazards introduced by the proposed wind farm, in relation to Spirit Energy assets and marine operations, have not been adequately addressed in the EIA. In a number of instances, the authors have been too ready to 'screen out' issues at a high level rather than consider the detail. In particular, this applies to the Major Accident Hazards associated with displaced vessels in the Markham area.

It is noted that no attempt has been made to detail the economic cost to Spirit Energy from the impacts of the proposed wind farm on their southern North Sea marine operations.

The current assessment of channel design adopted by the Netherlands, supported by the PIANC guidelines of striving for a 2nm buffer zone between wind farms and shipping lanes would appear an appropriate width to be adopted between wind farms and offshore installations, including subsea installations, to enable legitimate marine operations to be prosecuted safely. Similarly, the five-mile buffer zone for installations with Helicopter Pads adopted in the Netherlands White Paper, would appear to be an appropriate separation distance.

6 EXTERNAL REFERENCES

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/4/ Letter to OGUK, Oil and Gas Regulator, 19/09/2018;

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/6/ MGN 543 – Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response, Maritime and Coastguard Agency, 01/2016;

/7/ A Report on the Investigation of the Collision between the offshore supply vessel Highland Pioneer and the DA jack-up rig, Marine Accident Investigation Branch, 04/2001;

/8/ Guidance for Ship/Installation Collision Avoidance, Oil and Gas UK, 02/2010;

/9/ Navigational Safety within Marine Spatial Planning, International Association of Marine Aids to Navigation and Lighthouse Authorities, 06/2017

/10/ White Paper on Offshore Wind Energy, Netherlands Ministry of Infrastructure and the Environment, 09/2014.

/11/ Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations – 2013 (Original Version – 2005)

APPENDICES

APPENDIX A - NIL

About DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers make the world safer, smarter and greener.