Magallanes ATIR 2.0

EMEC Fall of Warness Test Site Navigational Risk Assessment Addendum

February 2026




Document History

Revision	Date	Description	Originated by	Reviewed by	Approved by
1.0	02/08/2024	First draft	AM (EMEC)	DL (EMEC)	
2.0	09/09/2024	Final draft	AM (EMEC)	DL (EMEC)	
3.0	30/06/2025	Draft for resubmission	AM (EMEC)	DL (EMEC)	
3.1	11/08/2025	Draft resubmission	AM (EMEC)	DL (EMEC)	
3.2	17/09/2025	Draft for resubmission	AM (EMEC)	DL (EMEC)	
3.3	24/02/2026	Draft – post consultation	AM (EMEC)	DL (EMEC)	
3.4	20/04/2026	Final - consultation	DL (EMEC)		
3.5	29/04/2026	Final	DL (EMEC)		

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1 Introduction

1.1 Company background

Magallanes FOW1 Limited is a leading developer of tidal energy technology. We are the UK branch of Magallanes Renovables and have been set up specifically to commercialise the Magallanes technology, leveraging the unparalleled expertise of the UK supply chain to do so. Magallanes FOW1 Limited is registered in Scotland.

Founded in 2007 Magallanes Renovables was created with the sole purpose of developing and commercialising a cost-effective tidal technology, overcoming the hurdles that have historically held the sector back. Our philosophy is simplicity and cost-effectiveness, which has led us to develop breakthrough systems, solving the many challenges encountered with innovative and cost-effective solutions.

Our technology is centered around a simple and reliable surface floating platform that leverages existing technology from the mature wind and naval industries, minimising technology risk. Our platforms deliver high output with low installation and maintenance costs.

We are a highly experienced multidisciplinary team with innovation, sustainability and quality as our core values. We have deployed and tested a full-scale platform in the unforgiving environment of the Orkney Islands. Previously we developed and tested 2 scale models to inform the full-scale design.

Key team experience

Our multidisciplinary and highly skilled team has been the main driver of our success, each individual is in charge of one of the working areas for technology development. Important decisions are taken in quorum and teamwork is part of our open working structure.

In addition, Magallanes Renovables has collaborated very closely with skilled partners in different business and technology areas needed to develop a ground-breaking system in tidal energy generation.

Since its inception, the company has been involved in multiple R&D projects focused on developing floating tidal turbines:

- 2007 to 2011 – concept development and evaluation including partial systems tests at small scale – e.g., 1:30 turbine and rotor
- 2011 to 2012 - 1:10 scale model constructed to evaluate and validate the concept. Prototype tested in Bay of Vigo and Scotland with positive results.
- 2013 to 2015 – Design of full-scale platform and systems.
- 2016 to 2017 – Construction of full scale, 1.5MW platform in Spain
- 2018 to 2018 - Sea-trials of full-scale platform around Vigo.
- 2019 - 2024 - Platform installed and grid-connected at EMEC, Scotland in early 2019.
- 2020 – upgrades to key systems on the full scale platform
- 2024 – Decommissioning of prototype platform

The accumulated project experience in areas of structural design, marine operations, control systems, energy production, mooring systems, etc. has allowed us to achieve the goal of having a demonstrated and validated floating platform.

1.2 Technology background

Magallanes was established to investigate and develop new methods of extracting electrical power from tidal currents.

Magallanes Renovables has had a full scale (1.5MW) prototype at the EMEC facility from early 2019 until mid 2023. We have accumulated thousands of hours of operational experience and demonstrated, proven and verified the performance and advantages of the technology, as well as learned from associated challenges.

Previously we developed and tested 2 scale models to inform this prototype.

Figure 1. Evolution of the Magallanes Technology

The platform has been on station and generating on most tides, apart from periods of downtime due to maintenance, upgrades, trials of new and improved systems as well as grid outages (including an outage for over 7 months due to damage to the subsea interconnector serving the island of Eday where the EMEC tidal facility is located and an extended leadtime waiting for a replacement dynamic cable).

Figure 2. Launch of the Prototype ATIR platform

Testing and demonstration activities with the full scale prototype over the last 7 years can be summarised as follows:

Activities	Year	Site	Scope	Result
Launch	2017	Vigo	Assembly & launch from quayside	• Assembly in 4 months. • Launched with cranes in Vigo Harbour. • Tow tests (not grid connected) in the bay of Vigo.
Towing Tests	2018	Vigo	Towing Test, including generation	• Towing test 500kW output
Generation	2019 - 2023	FoW (Orkney)	• Generation Test with 1 rotor • 2 rotor, low power • 2 rotor, rated power	• 1 rotor 400kW output • 2 rotors 3 months generation • 2 rotor 1.47MW. • Coeff > 48% peaks
Major maintenance	2022	Leith	Horizontal heeling and major maintenance	• Platform horizontal in dry dock • O&M works
O&M	2019 - 2023	FoW (Orkney)	O&M Works in FoW Cable and mooring options	• O&M works • New cable options • Mooring O&M
Environ-mental	2019 - 2023	FoW (Orkney)	Environmental tests and resource assessment	• Radar/Sonar • Mammal collision assessment • Birds • ADCP
H&S	2019 - 2023	FoW (Orkney)	Safe operations	• Platform visited more than 200 times • Zero incidents

Table 1. Test campaigns with the full-scale prototype

Generation and operations with the prototype platform over the last 7 years have proven the concept and validated the technology.

Work on the design of the commercial (ATIR 2.0) platform is now complete and has taken lessons learned from the ATIR 1.0 prototype and working with trusted consultants and supply chain partners. The design has been certified by Bureau Veritas - Design Approval (Design Assessment Statement received in January 2024), with full Type Certification expected mid 2025 following construction and deployment of the commercial demonstrator.

1.3 Project background

The first full scale prototype ATIR device has been deployed and operated at EMECs Fall of Warness tidal test site, which has enabled us to assess its performance in real sea conditions over multiple years. This testing has allowed us to progress the ATIR design towards commercial viability.

This proposed project will see a new platform based on the commercial design of the technology (the ATIR 2.0), deployed for up to 10 years at the EMEC Fall of Warness site (Berth 1), beginning in 2025. The device will be deployed under the current 10 MW consent until its expiry and will then utilise the 50 MW expansion Section 36 consent, which has been applied for, to generate electricity at the site under the Electricity Act 1989. It will replace the previous ATIR1.0 prototype that was deployed at the same berth from 2019 until 2023.

The project aims are as follows:

- Verify and validate the commercial version of the technology, including with an independent electrical power performance assessment.
- Gain experience installing and operating the new platform long term.
- Demonstrate the long term operational performance and reliability of the technology in a real, open sea environment.
- Learn and trial appropriate maintenance operations for long term deployments.
- Develop a business and marketing strategy to assist identification of potential customers.
- Develop the supply chain for further, commercial projects.

Data obtained from this period of testing will be crucial for future projects as it provides valuable information regarding long term operations and maintenance as well as validation of the power performance.

Existing funds have come from two separate funding sources: European Grants and the equity investment from the founder of Magallanes Renovables. These sources will secure the continuous development of Magallanes Renovables technology until its commercialisation, as well as the process of securing future projects.

2 Project Background

2.1 Device description

The full scale floating tidal device to be deployed at EMEC under this proposed project consists of a surface floating platform (upper block), with a nacelle and rotors directly below it (lower block) and a ‘mast’ (vertical block) connecting the two.

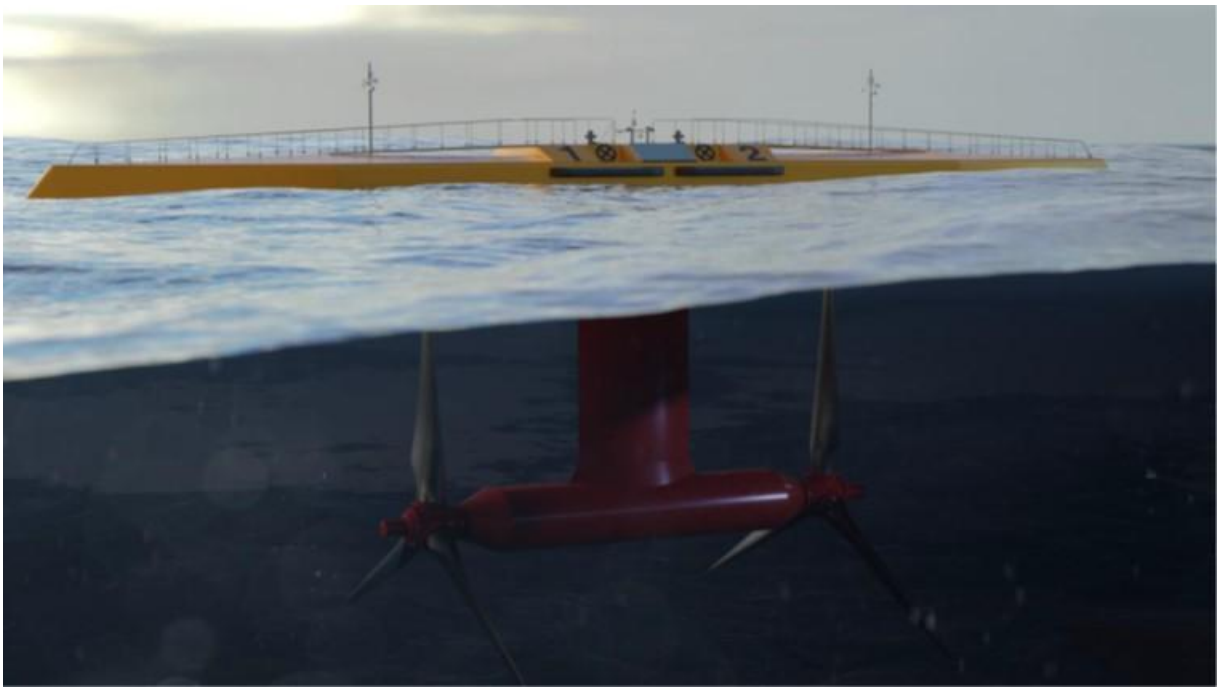

Figure 3. ATIR platform showing 'blocks'

This floating tidal energy converter has a total length of 53.6m, 7m of beam, a minimum draft of 15m without blades and 24m with blades. Its maximum weight with ballast is approximately 600tons.

Figure 4. ATIR from above

It has two counter-rotating horizontal axis turbines in series, one behind the other, so that it counteracts the efforts of one turbine with those of the other to avoid list and yaw. Each rotor consists of 3 blades with a rotor diameter of 21m.

Each rotor is equipped with a generator of 850kW of nominal power, and an associated frequency converter; allowing for a peak power of up to 1.7MW; however, the nominal power is limited to 1.5MW. It's moored to the seabed through four mooring lines, two at each end. The device is able to orient itself to different directions of current in a passive way and to generate energy efficiently on both the ebb and flood currents.

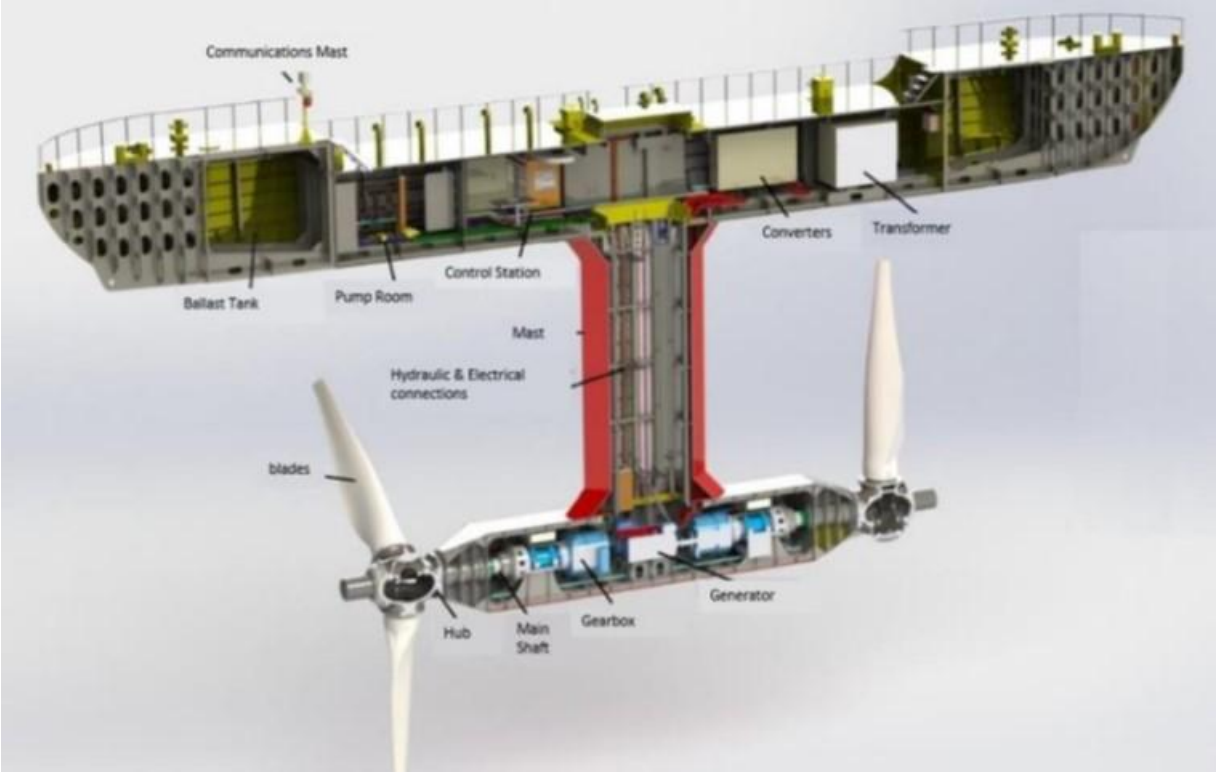

Figure 5. Main components of the ATIR platform

The floating platform (upper block) is the visible part of the device. It has an upper deck, where the entrance hatches are located. It also has 2 inaccessible compartments on both ends of the block, which are part of the variable ballast system. The accessible part of this block is composed of 3 main rooms, the first of them houses pumps and emergency systems, the other 2 have been designed to accommodate transformers, frequency converters, electric panels and other auxiliary electrical or electronic systems.

The mast (vertical block) fixes the nacelle (lower block) to the platform (upper block). It is a hollow space through which the communication and low-voltage cables connect the equipment housed in the nacelle with the parts of the electrical systems within the upper block. Rigid pipes for environmental acceptable lubricant supply and draining, among others, are also installed in the mast. It also allows access to the lower block for inspection and maintenance.

The nacelle (lower block) is significantly smaller than the upper block and is dedicated to the mechanical PTO systems. This block is where the main shafts, gearboxes and generators are located. As the platform is equipped with two counter-rotating rotors, all the components for the PTO system are duplicated (one for each rotor).

The device has electronic power converters onboard the platform that adapts the energy output to the frequency and phase of the network, in addition, it will also have a step-up transformer that will establish the output voltage of the platform at 11kV - the connection voltage).

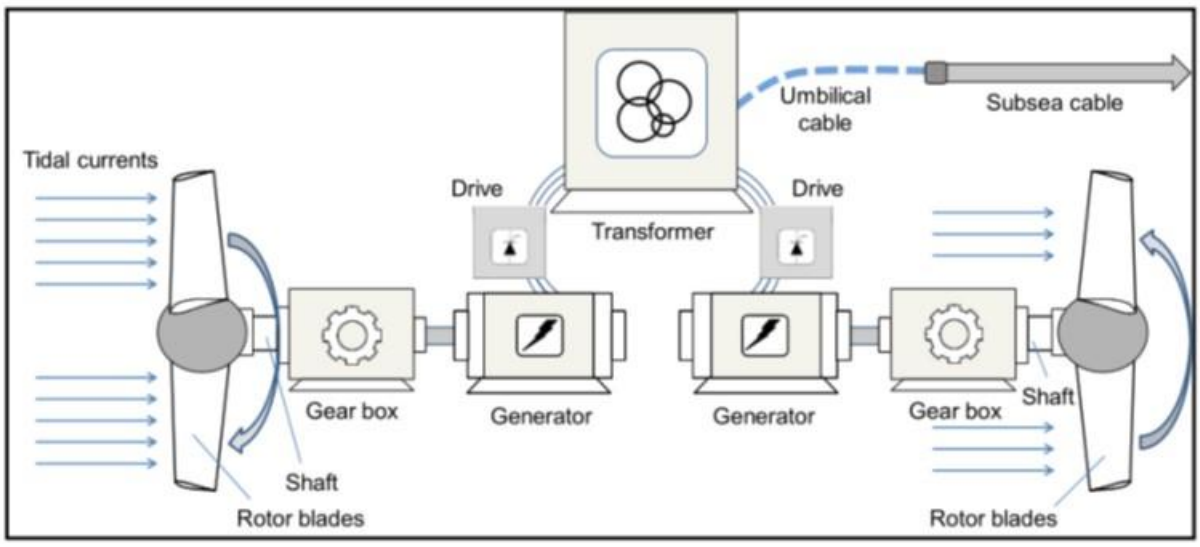

Figure 6. Diagram of electrical power generation from tidal currents

The platform will be connected to the existing EMEC export cable via a dynamic umbilical cable.

2.2 Mooring system

The ATIR 2.0 device will utilise the mooring system which currently exists on site and was used for the previously licensed ATIR device. The mooring system consists of 4 mooring lines, 2 at each end fixed to the platform, the mooring lines are redundantly dimensioned so that even if a line breaks, the other line on that side is capable of holding the platform on station.

The following parameters are currently estimated for the site, based on preliminary engineering analysis and modelling undertaken:

- Hull Attachment - A single padeye at the bow and stern, to which a single shackle is connected and from which two mooring lines are attached.
- The total length of chain per leg (including excursion limiters): approximately 290m of 76mm studlink chain.
- Mooring footprint diameter = approximately 500m (250m radius).

Gravity anchors (as detailed lower down) will be used. A basic scheme of the mooring system to be used is illustrated below in Figure 7. Gravity anchors used will be multiple chain clump weights (up to 12 per leg) with a total capacity (wet weight) varying between 90 and 165Te per leg. Anchor sizes will vary due to the statistically derived environmental loading and the larger environmental forces from the North.

Due to the positioning of the moorings in relation to the device, a vessel approaching the device would not contact the moorings without first making contact with the device. It is therefore recommended that any device keeps a 500m clearance of the device. This is shown in the figure below.

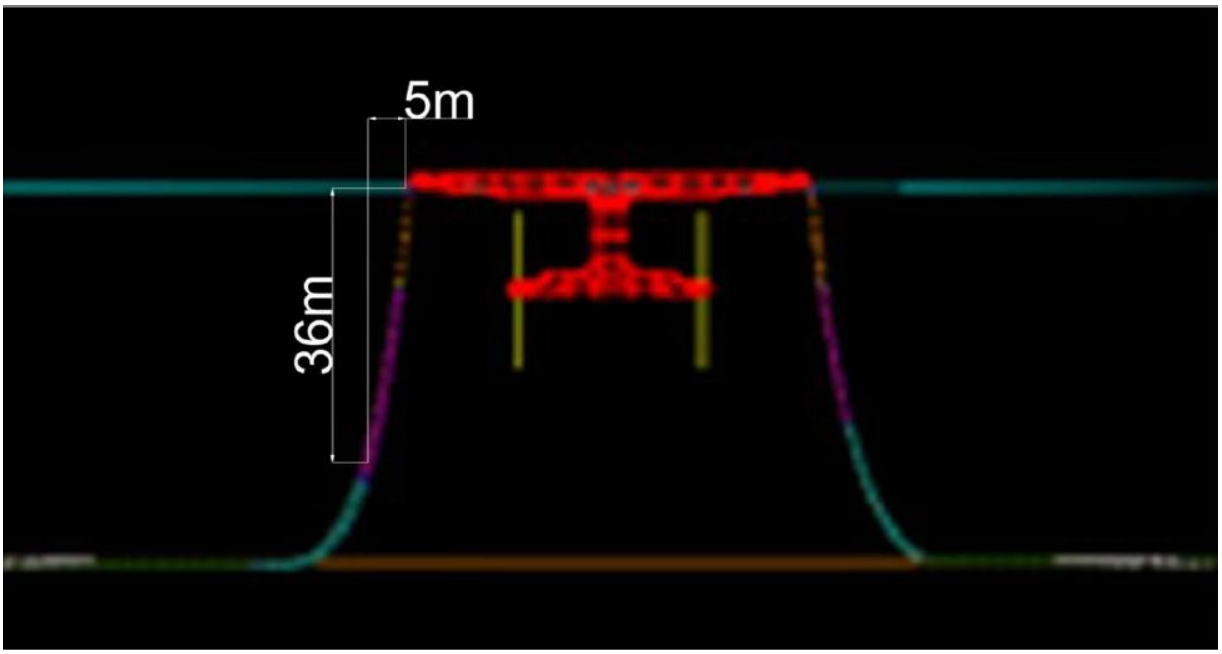

Figure 7. Moorings under keel clearance (UKC)

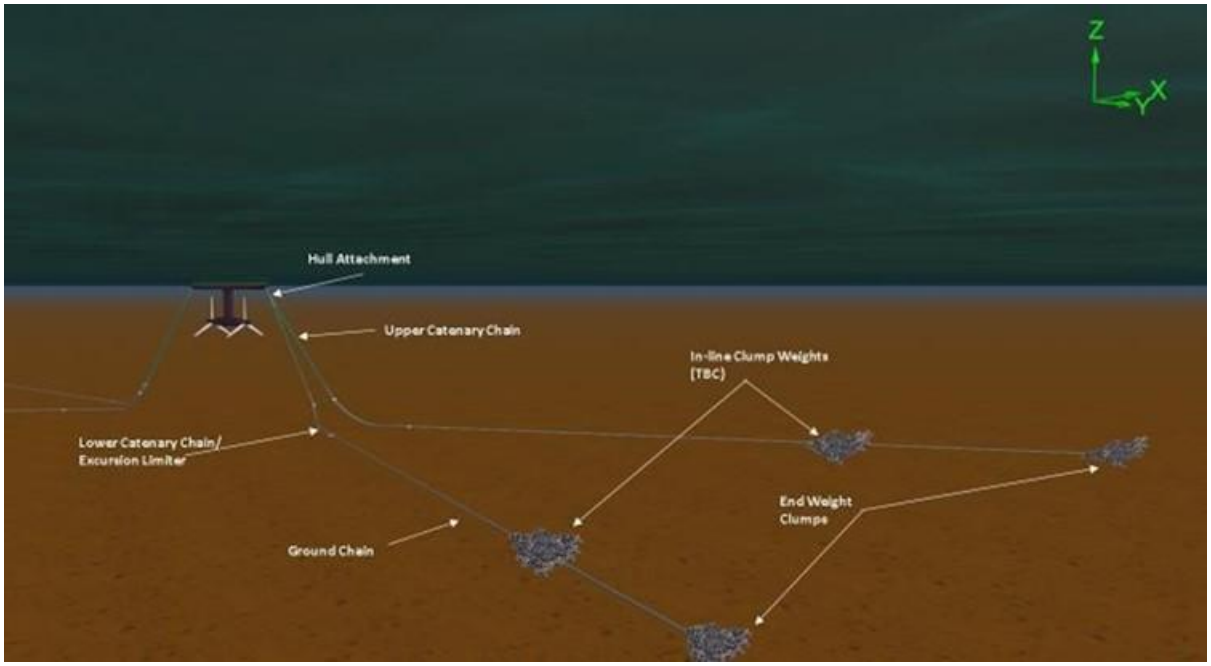

Figure 8. Scheme of mooring system with clump weights

3 Key navigational themes

In order to complete this project-specific assessment, a comprehensive review of the site-wide NRA for EMEC's Fall of Warness test site was conducted. The following navigational themes have been considered during the assessment.

3.1 Vessel routing

The Fall of Warness test site is clear of major vessel routes and vessels currently transiting the site appear to be well aware of the deployments across the site. Vessel routes tracked via AIS data and vessel routeing options are given in the below figure which has been taken from the

Fall of Warness Site-Wide Navigational Risk Assessment (10 MW and 50 MW) (EMEC, 2025). Further information can be found within this site-wide NRA which has been provided to MD-LOT.

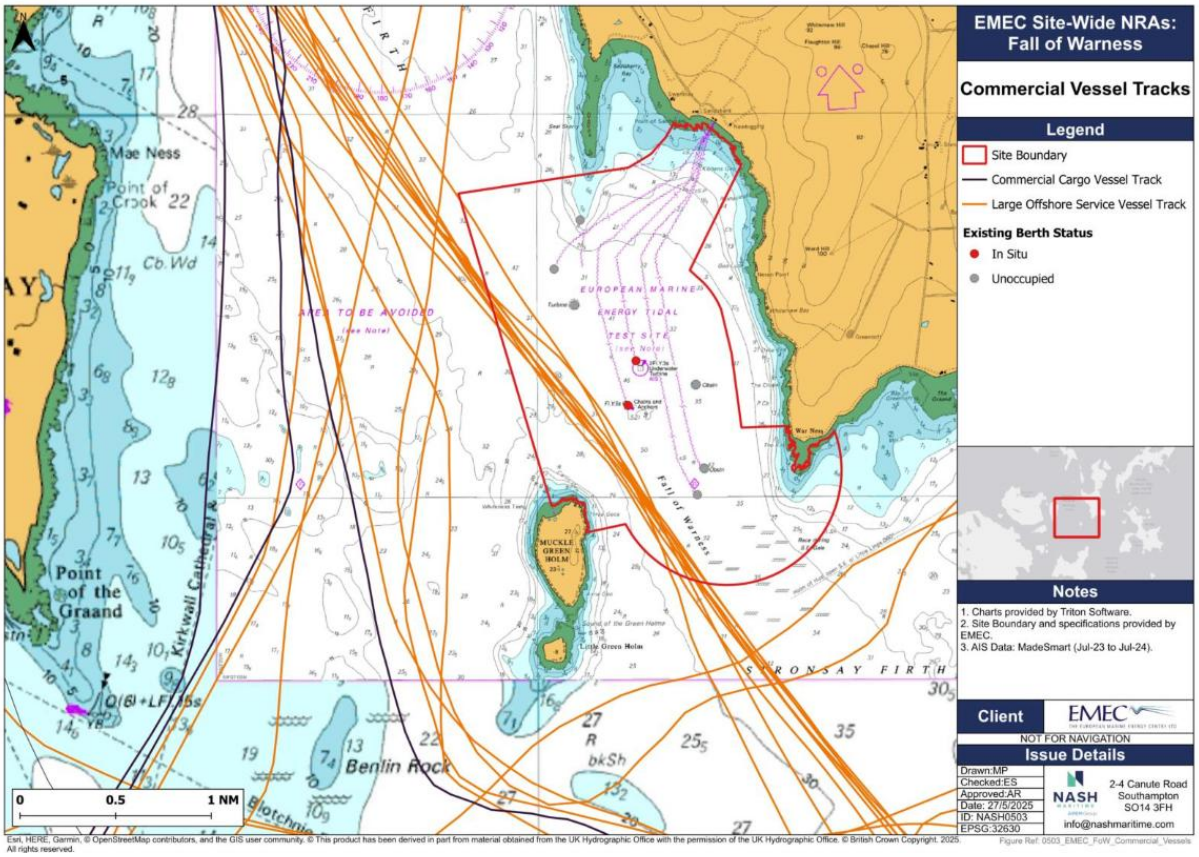

Figure 9. Commercial vessel routes

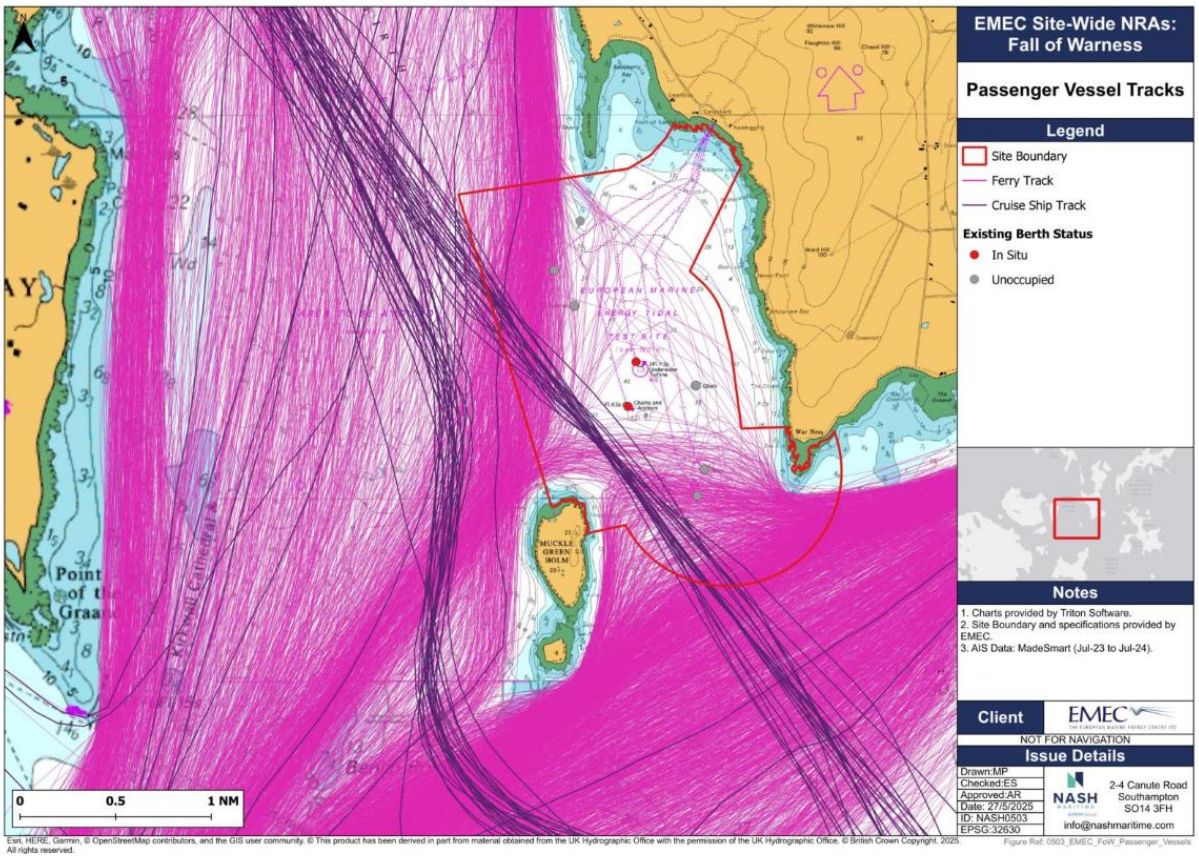

Figure 10. Passenger vessel tracks

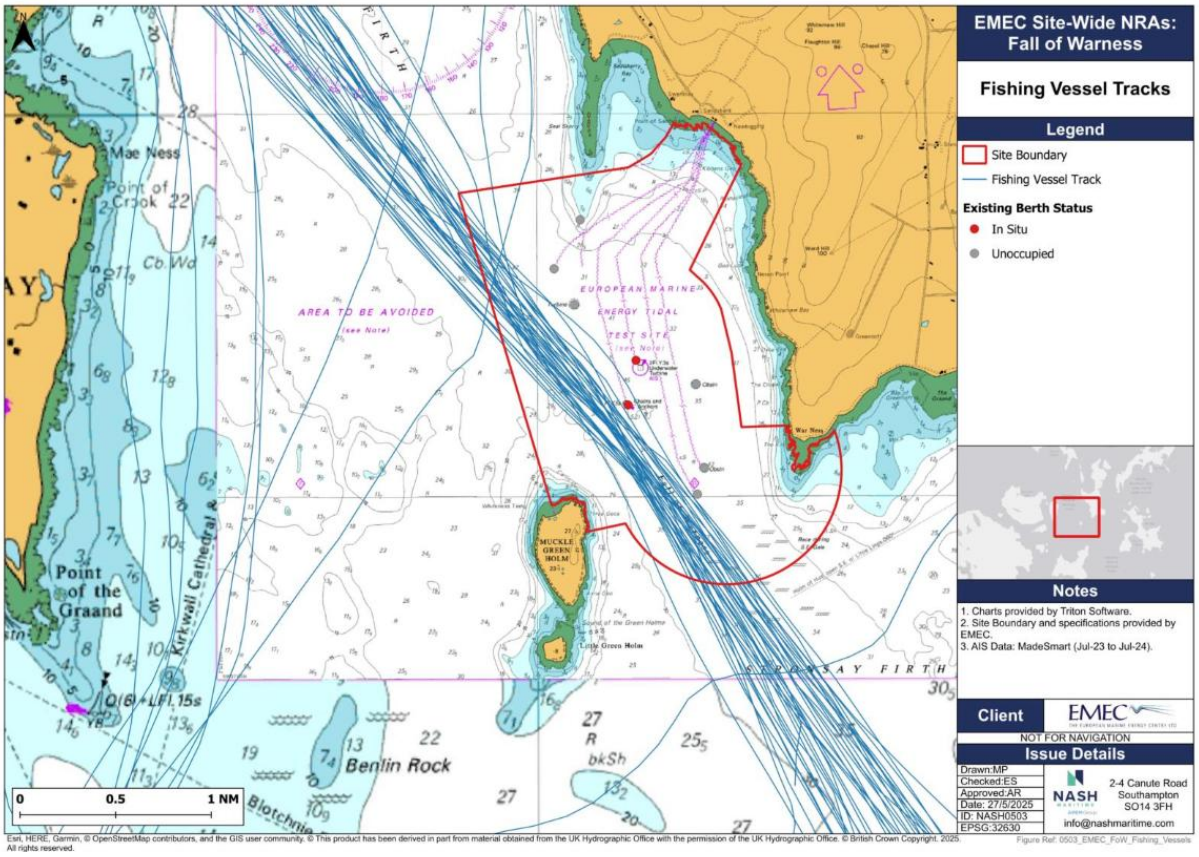

Figure 11. Fishing vessel tracks

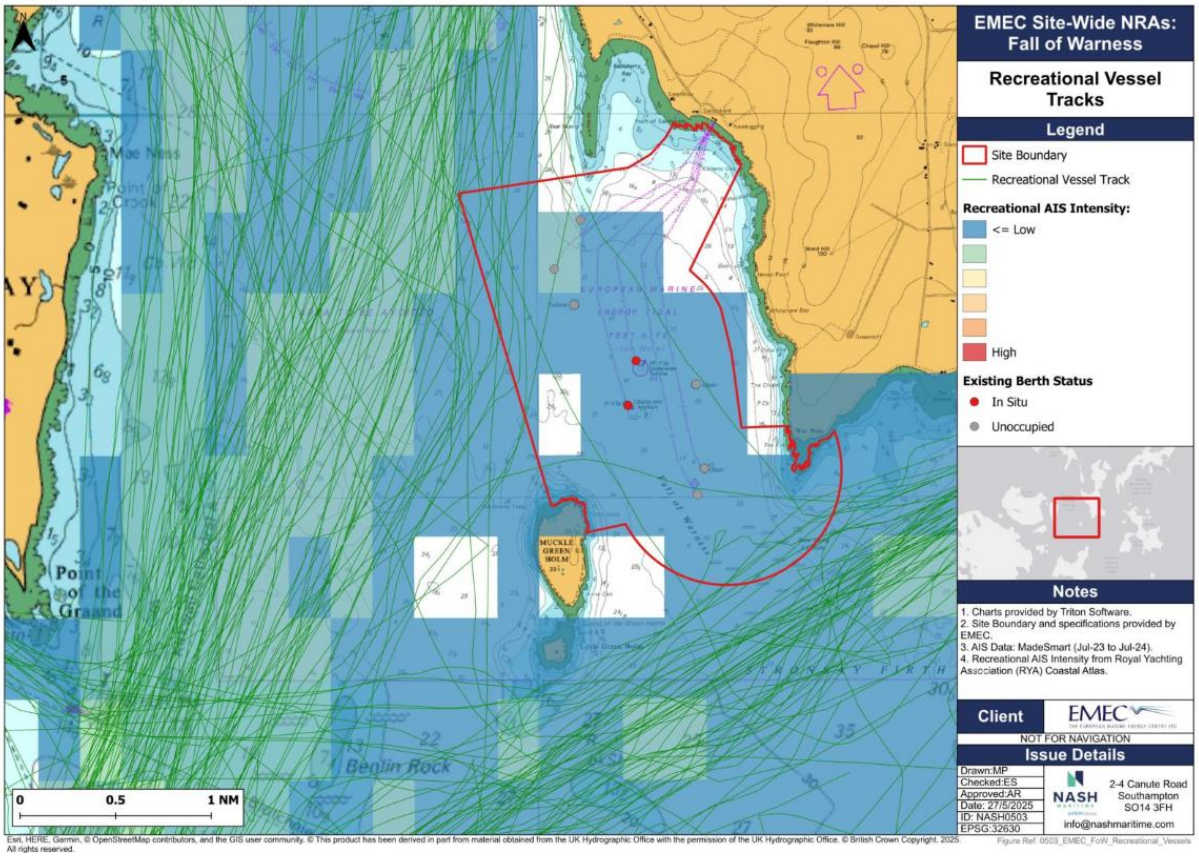

Figure 12. Recreational vessel tracks

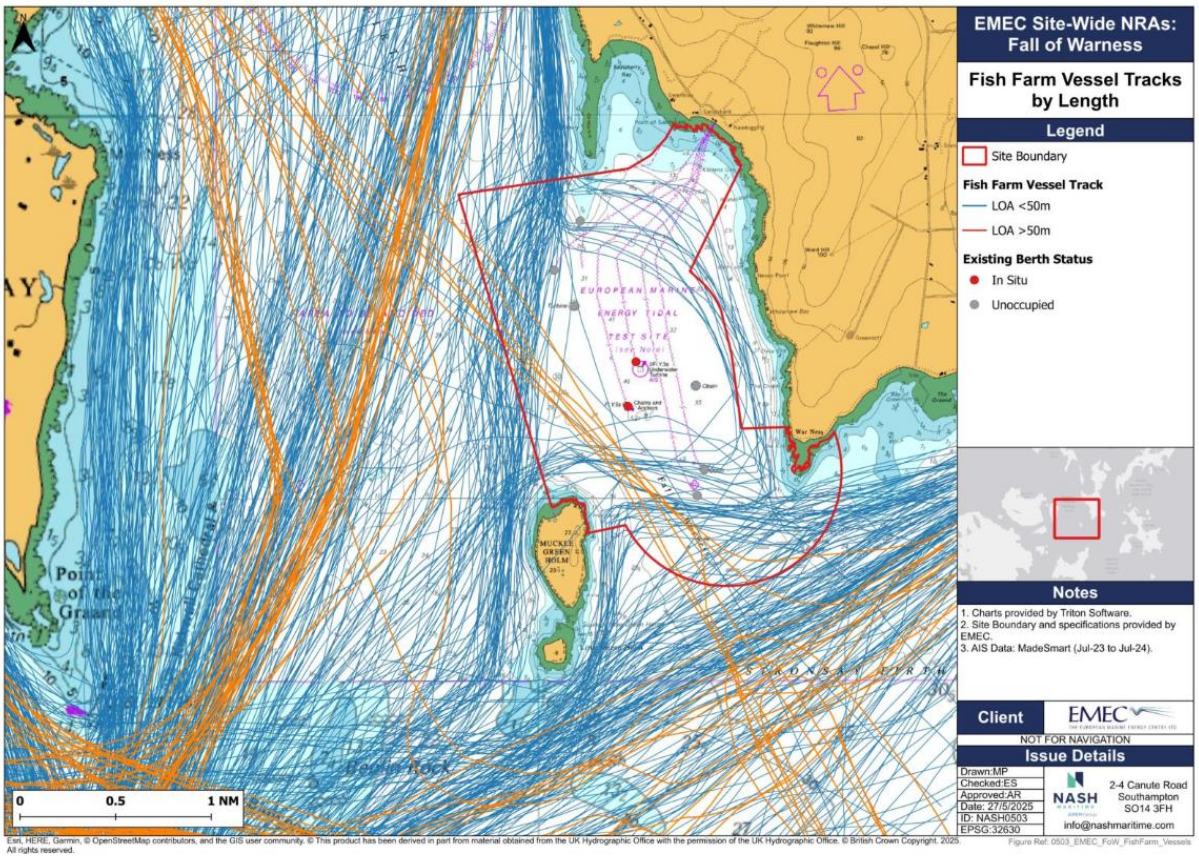

Figure 13. Fish farm vessel tracks

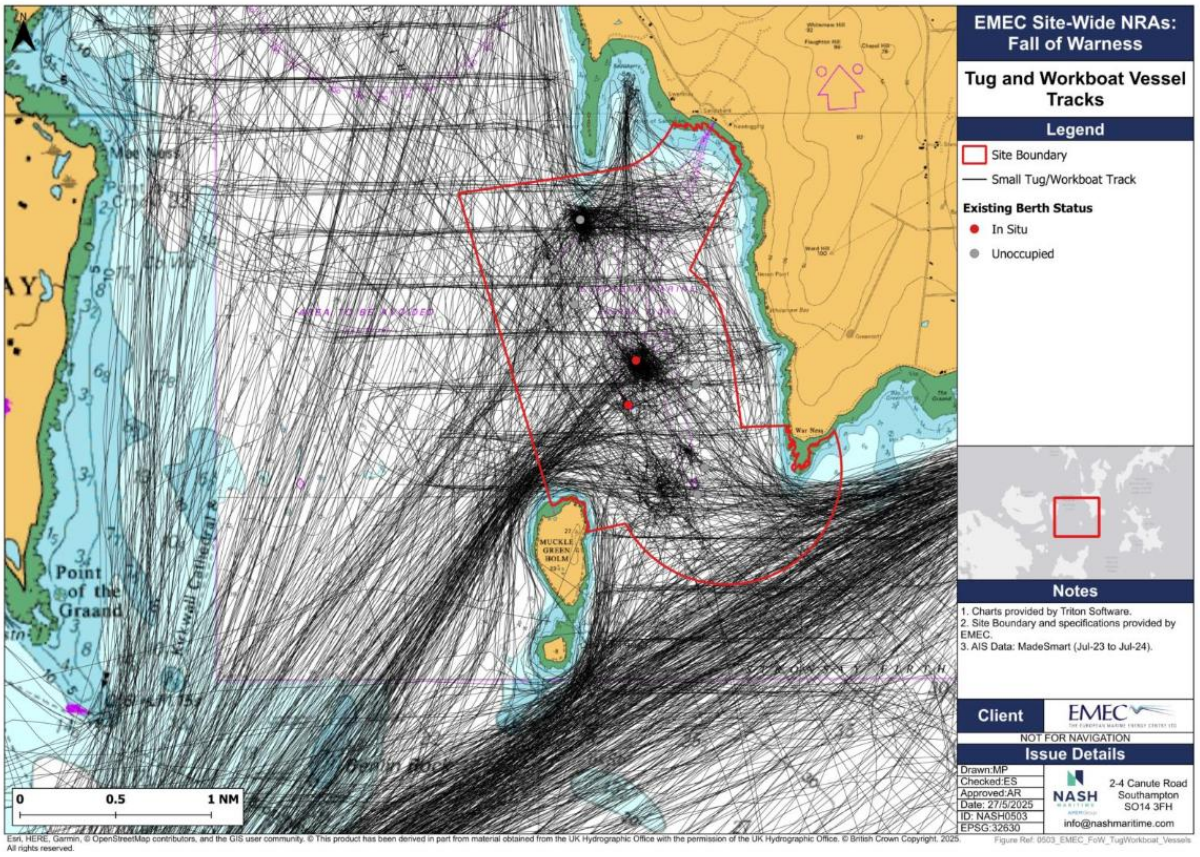

Figure 14. Tug and workboat vessel tracks

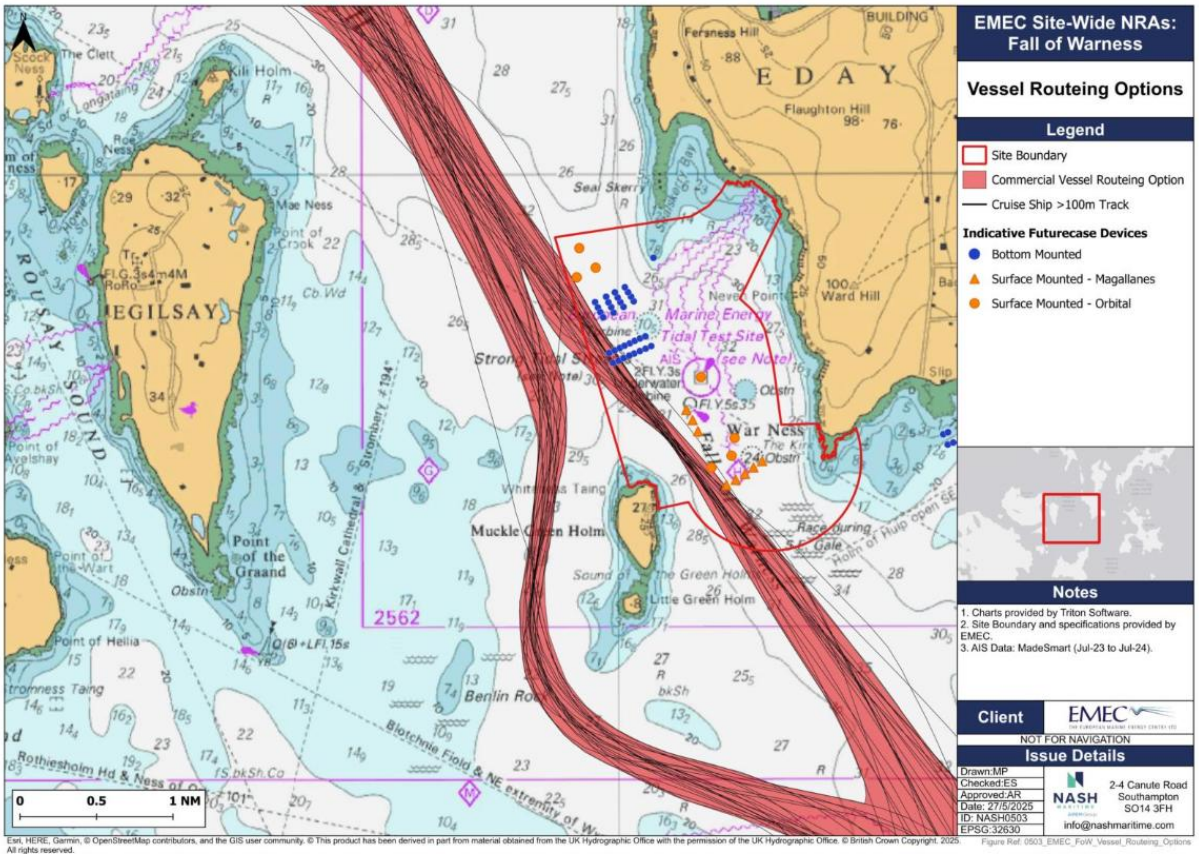

Figure 15. Vessel routeing options

3.2 Contact / allision risk

Few vessels navigate within the site and the use of appropriate marking and lighting to alert other mariners to the assets onsite should mitigate the risk of contact. All assets onsite should be charted on the United Kingdom Hydrographic Office (UKHO) charts, this information will be promulgated to the UKHO via Notice to Mariners.

3.3 Effects of tide / tidal streams and weather

Vessels take advantage of the lee behind the Muckle Green Holm when the tides are northwesterly. When the flow is from the south-east, vessels keep a wide berth from the Fall of Warness. The tidal streams therefore do not alter the routes of vessels to the area surrounding the platforms.

During consultation it was revealed the during bad weather it was common for ferries to come into the Fall of Warness site. During a strong south-easterly wind, significant overfalls, wave heights and a race can be expected to the south of Eday. Ferries would therefore pass to the east of Muckle Green Holm, come into the EMEC site passing to the north of the SR2000, before turning to come in close to the headland to the south-west of Eday. This allows the vessels some degree of shelter and means that they are not exposed beam on to the conditions

3.4 Under keel clearance

The radius of the blades is 10.5 metres max and the apex of the swept area is 3 metres below the surface. Given the width of the surface platforms (7m), there are potentially 7 metres of swept area either side of the platforms.

For a navigating vessel to collide with the blades, the vessel must be within 7 metres of the device and drawing at least 3.6 metres. It is therefore far more likely that the vessel would collide with a platform than damage the blades, and small vessels would be incapable of contacting the blades. The mooring arrangements are chain and, given the depth of water, will not compromise Under Keel Clearance (UKC) including when scouring is taken into account.

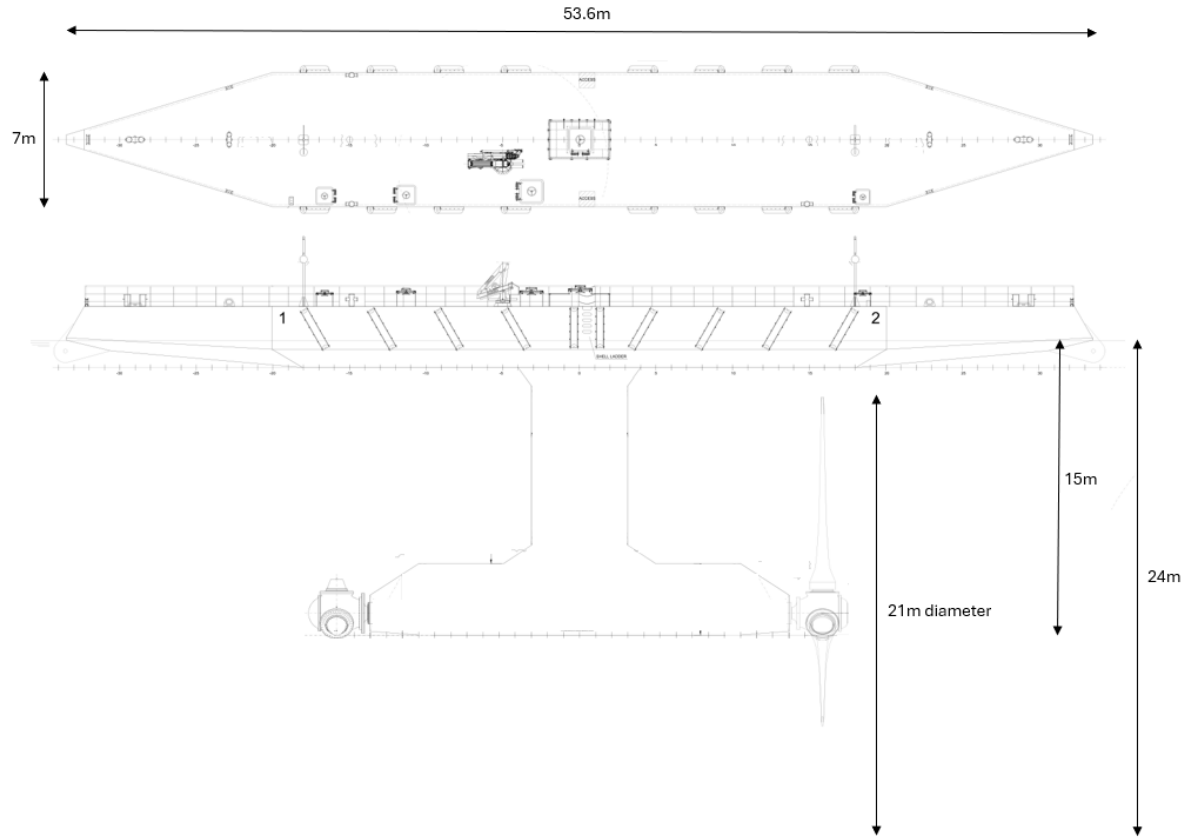

Figure 16. Key Dimensions of the ATIR 2.0

3.5 Collision risk and visual navigation

The device is less than 5.5 metres high (approx.4m above the water-line) and will therefore ensure that most vessels will be visible over the top when navigating in the area. The exception may be small craft such as open top RIBs or pleasure craft as well as maintenance vessels working on the device. Prudent mariners will provide sufficient clearance from the device when navigating and this will further reduce the chance of a hidden vessel emerging in a collision scenario.

The location is not on the leading line of any navigational aids nor will significantly alter the visibility of other lights or buoyage. It should be marked in accordance with the requirements

of the Northern Lighthouse Board and could serve as an additional aid to navigation for navigating vessels.

As the turbines are subsurface, there would be minimal noise generated and so it would not interfere with sound signals used by vessels or aids to navigation.

3.6 Communication, radar and positioning system

The scale of the assets to be installed during this project are not likely to impact on electronic communication or positioning systems.

3.7 Moorings

The Fall of Warness mooring systems consists of 4 chain catenary legs, two north and two south, attached to the hull at attachments in the bow and stern of each platform. The mooring systems hold the platforms in line with the current flow.

The anchor size has been supported by a statistical assessment of simulated loads using Orcaflex software, namely that the peaks in anchor tensions are momentary spikes of a few seconds in simulated one in 10-year storms.

3.8 Station keeping

GPS Alerting for movement of the devices. Remote monitoring of the devices to detect any major movements that might indicate a breakout for immediate response.

3.9 Fishing activity

Relatively little fishing takes place in the study area and fishermen would generally be expected to take precautions in order to avoid any underwater assets that may be present across the test site.

3.10 Recreational activity

There is no racing or small boat sailing at the test site, most recreational vessels are yachts on passage.

3.11 Subsea cables

There is no evidence of anchoring or gear snagging at Fall of Warness historically.

3.12 Search and rescue

The device will not alter the capability of search and rescue operations in the area, or interfere with neither RNLI or helicopter operations.

3.13 Cumulative and in-combination

The Fall of Warness site, as a device test centre, is home to other devices. Of these, most are well clear with the exception of the Orbital O2. For those deep draught vessels whose passage is through the Fall of Warness, it is likely that they would pass to the west of the ATIR platform and Orbital O2 rather than in between the two devices due to the limited sea room.

4 Hazard Identification

The hazards identified in Table 2 are those assessed within the combined 10 MW and 50 MW site-wide (EMEC, 2025) NRA. Additionally, a hazard log which was created as part of the site-wide NRA is included within Appendix A. As the ATIR 2.0 falls within the parameters of the currently consented 10 MW envelope, these hazards are deemed the most likely during its deployment.

The results of the Fall of Warness 10 MW risk assessment are indicated in Table 3 and are to be reflected against Appendix A. By the nature of their operations, maintenance vessels will be most likely to navigate close to the device and so have the highest risk score within the 10 MW assessment and third highest in the 50 MW assessment. Therefore, there is a risk of a hard contact when manoeuvring around the ATIR 2.0 device which could cause both damage and injuries. These risks can be mitigated by the training and experience of the maintenance vessel skippers, as well as sufficient marking of each device. Furthermore, maintenance is typically limited to periods of good weather and slack tides, reducing the risks. Other incidents involving maintenance vessels such as grounding or collision whilst on passage are not considered likely given the relatively low density of traffic within the area and the expertise and local knowledge of the skippers.

The second highest scoring within the 10 MW assessment and top hazard for the 50 MW assessment was a passenger ferry contacting a device when manoeuvring through the site during adverse weather conditions. Descriptions of these manoeuvres and reasons for taking them are explained in section 5.3 of the site-wide NRA. However, Masters of Orkney Ferries have operated these routes for decades and have done so with previous devices in place with no reported incidents caused by their presence. The ATIR 2.0 will also be placed in the location in which the first iteration of the device was which vessel Masters were already aware of and could manoeuvre around. Therefore, it is expected that the single ATIR 2.0 device will not cause greater impacts to these.

Breakout of devices has also been given a low probability score due to the mooring certification which will be given for the ATIR 2.0 and active monitoring of the device during its operational phase.

Table 2. Hazard List

#	Title	Rationale
1	**Large Commercial Vessel Contacts a Device**	Analysis identifies that large vessels up to 250 m in length are known to navigate through the site. Given the tidal conditions and waterway hazards, a contact with a device whilst on passage is feasible.
2	**Passenger Ferry/Cruise Ship Contacts a Device**	Analysis and consultation identified that ferries make frequent transits through the site in specific metocean and tidal conditions. Furthermore, cruise ships up to 250 m in length and are known to navigate through the site. Given the tidal conditions and waterway hazards, a contact with a device whilst on passage is feasible.
3	**Fishing/Fish Farm Vessel Contacts a Device**	Analysis and consultation identified that fishing boats transit through the Fall of Warness and some smaller boats fish

		within the site. Given the proximity of operations, a contact with a device is feasible.
4	**Recreational Vessel Contacts a Device**	Analysis and consultation identified that recreational vessels transit through the Fall of Warness. Given the tidal conditions and waterway hazards, a contact with a device whilst on passage is feasible.
5	**Tug & Service/Maintenance Vessel Contacts a Device**	O&M support vessels necessarily navigate within the site and in close proximity to the device. A contact with a device is a realistic scenario during operations.
6	**Fishing Gear Interaction with Device/Cables**	Analysis and consultation identified that fishing boats transit through the Fall of Warness and some smaller boats fish within the site. Given that some devices are subsurface, fishing gear may become snagged with device infrastructure.
7	**Collision Due to Avoidance of Device**	The presence of the device may influence vessel traffic flows, increasing interactions between non-project vessels that might result in a collision.
8	**Grounding Due to Avoidance of Device**	The presence of the device may influence vessel traffic flows, increasing the proximity to shallow water which could result in a grounding.
9	**Collision with Site Maintenance Vessel**	The movements of site maintenance vessels poses an additional risk of collision to other transiting vessels.
10	**Grounding of Maintenance Vessel**	O&M support vessels necessarily navigate within the site and near to shallow water which could result in a grounding.
11	**Breakout of a Device from Moorings**	The devices moorings could be damaged and a breakout occur which poses a risk to other navigating vessels.

Table 3. Ranked hazard list (referenced from site-wide NRA which the ATIR 2.0 will fall under)

Hazard ID	Hazard Rank	Hazard title	10MW	50MW
5	1	Tug & Service/Maintenance Vessel Contacts a Device	8.9	8.9
2	2	Passenger Ferry/Cruise Ship Contacts a Device	8.4	12.0
8	3	Grounding Due to Avoidance of Site	6.7	9.6
9	4	Collision with Site Maintenance Vessel	6.6	7.5

3	5	Fishing/Fish Farm Vessel Contacts a Device	6.3	8.9
4	5	Recreational Vessel Contacts a Device	6.3	8.9
10	5	Grounding of Maintenance Vessel	6.3	7.1
1	8	Large Commercial Vessel Contacts a Device	5.5	8.6
7	9	Collision Due to Avoidance of Site	3.8	4.8
6	10	Fishing Gear Interaction with Device/Cables	3.7	7.4
11	11	Breakout of a Device from Moorings	3.2	6.4

4.1 Risk matrix

The site-wide NRA (EMEC,2025) contains a risk matrix for the full envelope of devices that could potentially be deployed at the Fall of Warness test site. Table 24 within the site-wide NRA is based on the likelihood and each of the four severity scorings and risk scores were derived using a risk matrix. Table 23 showing the value interpretations and Table 24 showing the Risk matrix can be found within section 6.2 of the site-wide NRA (EMEC,2025).

As this single device deployment sits comfortably within the 10MW envelope, the likelihood value interpretations and risk matrix presented is representative of this deployment.

5 Risk controls

5.1 Site-wide risk controls

A number of risk controls are embedded by the processes EMEC has implemented in order to operate the site and the layout of the Fall of Warness test site. These risk controls are highlighted in Appendix B. The embedded risk control measures are detailed in Table 2, with any project-specific actions including any divergence from the specified control discussed.

ID	Embedded risk control	Description
1.	PPE Requirement	Maintenance teams to wear suitable PPE when working on the assets, including life jackets.
2.	Training of staff	Staff to be trained to the required standards for their work and have suitable local knowledge of regulations and operations in the Orkney Islands.
3.	Emergency Response and Cooperation Plan (ERCoP)	ERCoP for site developed and agreed with the MCA and SAR bodies to be consulted.
4.	NtM and Promulgation	In addition to NtM, EMEC's Maritime Safety Information Standard Operating Procedures (SOP) ensures that all key navigational consultees are informed prior to any works. Distribution could include HMCG, Orkney Harbours (available via Orkney Islands Council Marine Services website), Orkney Marina noticeboards (as necessary), Orkney Fisheries Association, Scottish Fisheries Federation and UKHO. Stakeholders are targeted with information about relevant assets based on their activities and location.
5.	Incident monitoring and reporting	EMEC to encourage incident/near miss reporting and monitor any safety issues at the test site. If necessary, risk control to be reviewed. Risk assessments to be reviewed following any incidents.
6.	EMEC Procedures	EMEC has a number of SOPs and standards in place to reduce navigation risks, such as: • Task risk assessment; • Control of work (permit to access) • Hazard identification reporting; and • Maritime safety information.
7.	Hydrography	Contractual responsibility for developer to return the site to the original condition post-decommissioning.
8.	Charting	Site is marked on nautical charts including a chart note.

9.	Site Monitoring	EMEC's SCADA system provides real time status information, trends, alarms and remote-control access to facilitate a safe working environment, comprehensive assessment and safe operation of the sites.
10.	CCTV	Fall of Warness test site is monitored by CCTV, located at Caldale, EMEC's onshore substation, to satisfy operational requirements for control and monitoring of test site activities, visual checks of the test site environment, monitoring of lone worker safety, effective plant operation and substation security.
11.	Liaison with local stakeholders	EMEC regularly liaises with key local stakeholders to identify any potential issues as soon as possible. Regular updates include information regarding upcoming deployments and significant operations at the site.
12.	500m advisory exclusion zone	A 500 m advisory exclusion zone exists around all test devices located at EMEC test sites.

Table 4. EMEC embedded risk controls for Fall of Warness test site

5.2 Project-specific risk controls

The following table provides a description of the risk controls that will be implemented during the project.

ID	Project-specific risk control	Description
1.	Radar reflectors	Use of radar reflectors to improve marking during times of poor visibility.
2.	AIS	Use of AtoN AIS (or virtual AIS if permitted) fitted to all surface piercing assets to improve visibility to passing vessels. AIS should be Category 3 with at least 97% up time and use Message 21, or as directed by the Northern Lighthouse Board (NLB).
3.	Heightened monitoring in adverse metocean conditions	During gale force winds, periodic monitoring of the assets is recommended to ensure excessive forces are not acting on the moorings which might cause a breakout.
4.	Inspection and maintenance programme	Regular maintenance regime by developer to check the asset, its fittings and any signs of wear and tear. This should identify any failings which might result in a mooring failure and breakout. Refer to the findings of your third party verification mitigation against device breakage.
5.	Remote shut down including feathering of blades	Device to be fitted with ability to shut down in an emergency, such as feathering any blades or braking to allow access or prevent contact with a vessel.
6.	GPS alert system for asset moving	Remote monitoring of device to detect any major movements that might indicate a breakout for immediate response. Implement GPS excursion monitoring.

7.	Marking and Lighting	Assets to be lit to the requirements of NLB and marked in line with IALA guidance, IALA Guidance G1162 (2021)[1]. The following is typically requested by the NLB: • Yellow day marking/painting; • Flashing yellow special mark light (Category 1) (larger devices may require 2 lights at each end which are synchronised; light ranges should be at least 3 nautical miles); • Day top mark (if deemed necessary); • Radar reflector; and • AIS AtoN (mandatory for floating devices at EMEC). Appropriate statutory sanctions must be in place to exhibit, alter or discontinue lighting.
8.	Tow risk assessment and passage plan	As required under Orkney Harbours Pilotage Directions 4(3)[2], prior to conducting a towing operation, a risk assessment and passage plan for the move should be conducted. The plan should account for the size of the tow, manoeuvrability restrictions, tow arrangements and metocean conditions. Additionally, MCA will be contacted prior to towage operations to ensure compliance with the appropriate Survey and Inspection requirements.
9.	Guard vessels	During major construction or maintenance activities, a guard vessel may be considered to assist in protecting the devices from contacts with passing vessel traffic. Due to the low density of traffic, this is not considered necessary except for extraordinary circumstances.

[1] When identifying the marking requirements, it must be taken into consideration that some tidal devices:
- Have fast-moving sub-surface elements such as whirling blades; and
- Do not allow for safe under keel clearance (UKC).

The level of marking should be decided after a risk assessment has been conducted.
It is recommended that:

a) Subject to the proper risk assessment, areas containing on surface or sub-surface wave or tidal devices are marked by appropriate AtoN. In addition, radar reflectors, retro-reflecting material, racons and / or AIS transponders should be considered where the level of traffic and degree of risk requires.
b) The AtoN must be visible to the mariner from all relevant directions in the horizontal plane, by day and lighted at night.
c) Taking the results of a risk assessment into account, lights must have an appropriate nominal range and vertical divergence and may be synchronized.
d) Individual wave and tidal energy devices within a site that extends above the surface are painted predominantly yellow above the waterline and have yellow retro-reflective tape as required by the competent authority. If navigation is permitted within site, marking of individual devices may be required.
e) If marked, the individual devices should have flashing yellow lights. The flash character of such lights must be sufficiently different from those displayed on the boundary lights with a nominal range of not less than two Nautical miles.
f) Floating AtoN could be located outside the moorings of the floating structures.

Based on risk assessment, a single wave or tidal energy extraction structure, standing alone, may be marked as follows:
- isolated Danger mark; or
- special mark.

The AtoN described herein should comply with IALA recommendations and guidelines and have an appropriate availability normally not less than 99.0% (IALA Category 2).

[2] Orkney Islands Council Competent Harbour Authority (2016) The Orkney Pilotage Direction 1988 (as amended 2007, 2010 and 2016).

		If guard vessels are to be used onsite, it is important that such vessels employed to guard the site follow appropriate guidelines, with clear instructions on when to intervene in a potential incident.
10.	Liaison with local stakeholders	Consultation should be undertaken with Orkney Marine Services, the MCA and NLB prior to installation of device to confirm that adequate risk controls are in place. EMEC also conducts regular stakeholder consultation events to ensure that local marine users are aware of the pipeline of activity.
11.	Installation, maintenance and removal	All vessels undertaking activities on site should comply with EMEC standard operating procedures. Vessels should be mindful of other navigating vessels and avoid disrupting the activities of others.
12.	ERCoP	Project-specific annex to be incorporated into site-wide ERCoP.
13.	Charting	UKHO will be informed of the device's deployment, including the associated mooring arrangement, for updating appropriate navigational charts

Table 5. Project-specific risk controls

6 Summary and conclusion

This document has been prepared to support a marine licence application for the Magallanes ATIR 2 platform in Berth 1. This document is provided as an addendum to and should be read in conjunction with the document Fall of Warness Site-Wide Navigational Risk Assessment (10 MW and 50 MW) (EMEC, 2025).

With the ATIR 2.0 replacing its first iteration in the same location – as previously assessed and charted – there is lessened risk in the sense that surrounding vessels and activities have had experience in manoeuvring around this area and type of deployment in combination. Additionally, Magallanes can provide full certification from Bureau Veritas for the platform and mooring link. The moorings will also be reviewed with Leask Marine and Orcades Marine in which a TPV will be provided for their current state. The device (and its trailer) is also expected to be registered as part of updated guidance on towing requirements provided by MCA.

In summary, the NRA has concluded that the deployment of the single device is low risk with suitable risk controls in place. EMEC recognises that array projects at the Fall of Warness test site should require a full project-specific NRA. However, a full project-specific NRA should not be required for this single deployment and the addendum should suffice.

The most recent site-wide NRA concludes that 'This NRA, conducted in compliance with MGN 654 has identified that the existing navigational risks at the Project are managed below ALARP. It is recommended that this NRA is updated periodically (MGN 654 suggests two-yearly) to account for changing activities at the Project, following major incidents or in the context of a step-change in the numbers or types of devices installed.'

Appendix A: 10 MW hazard log

Hazard ID	Hazard Rank	Hazard title	Hazard type	Designed in Mitigation (Refer to Mitigation Table Below)	Possible causes	Realistic Most Likely Consequences	Realistic Most Likely Scores					Realistic Worst Credible Consequences	Realistic Worst Credible Scores					Overall Risk Score	Overall Risk Rating
							People	Property	Environment	Business	Frequency		People	Property	Environment	Business	Frequency		
1	3	Large Commercial Vessel Contacts the Device	Contact / Allision	EMER (1-5) OPS (2/6/7/9/10/11) PROM (1-4) DES (1-4)	Insufficient Lookout Inadequate Passage Planning Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints Failure of Navigational Aids on Device Charts not up to date Confusion on Site Layout	Minor injury; Minor damage: No pollution; Moderate adverse publicity / short erm interruption to EMEC/Operators.	1	2	1	3	3	Single fatality; Major damage; Moderate pollution ncident (Tier 2); Moderate adverse publicity / long erm interruption to EMEC/Operators.	4	4	3	4	1	5.5	Low Risk - Broadly Acceptable
2	2	Passenger Ferry/Cruise Ship Contacts the Device	Contact / Allision	EMER (1-5) OPS (2/6/7/9/10/11) PROM (1-4) DES (1-4)	Insufficient Lookout Inadequate Passage Planning Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints Failure of Navigational Aids on Device Charts not up to date Confusion on Site Layout	Multiple major njuries; Minor damage: No pollution; Moderate adverse publicity / short erm interruption to EMEC/Operators.	3	2	1	3	3	Multiple fatalities; Major damage; Moderate pollution ncident (Tier 2); Moderate adverse publicity / long erm interruption to EMEC/Operators.	5	4	3	4	2	8.4	Low Risk - Broadly Acceptable
3	5	Fishing/Fish Farm Vessel Contacts a Device	Contact / Allision	EMER (1-5) OPS (2/6/7/9/10/11) PROM (1-4) DES (1-4)	Insufficient Lookout Inadequate Passage Planning Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints Failure of Navigational Aids on Device	Multiple minor njuries; Negligible damage: No pollution; Minor adverse publicity / short erm interruption to EMEC/Operators.	2	1	1	2	3	Single fatality; Moderate damage; Minor pollution Tier 1); Moderate adverse publicity / long erm interruption to EMEC/Operators.	4	3	2	4	2	6.3	Low Risk - Broadly Acceptable

					Charts not up to date Confusion on Site Layout															
4	5	Recreational Vessel Contacts the Device	Contact / Allision	EMER (1-5) OPS 2/6/7/9/10/11) PROM (1-4) DES (1-4)	Insufficient Lookout Inadequate Passage Planning Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints Failure of Navigational Aids on Device Charts not up to date Confusion on Site Layout	Multiple minor njuries; Negligible damage: No pollution; Minor adverse publicity / short erm interruption to EMEC/Operators.	2	1	1	2	3	Single fatality; Moderate damage; Minor pollution Tier 1); Moderate adverse publicity / long erm interruption to EMEC/Operators.	4	3	2	4	2	6.3	Low Risk Broadly Acceptable
5	1	Tug & Service/Maintenance Vessel Contacts the Device	Contact / Allision	EMER (1-5) OPS (1-11) DES (1-4)	Insufficient Lookout Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints Failure of Navigational Aids on Device	Multiple minor njuries; Negligible damage: No pollution; Minor adverse publicity / short erm interruption to EMEC/Operators.	2	1	1	2	4	Single fatality; Moderate damage; Minor pollution Tier 1); Moderate adverse publicity / long erm interruption to EMEC/Operators.	4	3	2	4	3	8.9	Low Risk Broadly Acceptable
6	10	Fishing Gear Interaction with Device/Cables	Obstruction	EMER (1-5) OPS 2/6/7/9/11) PROM (1-4) DES (1-6)	Insufficient Lookout Unawareness of device ayout Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints Failure of Navigational Aids on Device Charts not up to date Confusion on Site Layout	Multiple minor njuries; Minor damage: No pollution; Minor adverse publicity / short erm interruption to EMEC/Operators.	2	2	1	2	2	Single fatality; Moderate damage; Minor pollution Tier 1); Moderate adverse publicity / long erm interruption to EMEC/Operators.	4	3	2	4	1	3.7	Negligible Risk Broadly Acceptable
7	9	Collision Due to Avoidance of Device Location on Site	Collision	EMER 1/2/4/5) OPS (2/9) PROM (1-4) DES (1-4)	Reduced searoom with device Increased maintenance raffic Human Error/Fatigue Equipment or Mechanical Failure on Vessel Reduced Seakeeping due to Tidal or Weather Constraints Poor Visibility	Multiple minor njuries; Minor damage: No pollution; Minor adverse publicity / short erm interruption to EMEC/Operators.	2	2	1	2	2	Single fatality; Major damage; Moderate pollution ncident (Tier 2); Moderate adverse publicity / long erm interruption to EMEC/Operators.	4	4	3	4	1	3.8	Negligible Risk Broadly Acceptable
8	3	Grounding Due to Avoidance of Device Location of Site	Grounding	EMER 1/2/4/5) OPS (2/9)	Reduced searoom with device Human Error/Fatigue Equipment or	Multiple minor njuries; Minor damage: No pollution;	2	2	1	2	3	Single fatality; Major damage; Moderate pollution ncident (Tier 2);	4	4	3	4	2	6.7	Low Risk Broadly Acceptable

				PROM (1-4) DES (1-4)	Mechanical Failure on Vessel Reduced Seakeeping due to Tidal or Weather Constraints Poor Visibility	Minor adverse publicity / short erm interruption to EMEC/Operators.						Moderate adverse publicity / long erm interruption to EMEC/Operators.							
9	4	Collision with Device Maintenance Vessel	Collision	EMER 1/2/4/5) OPS (1-11) PROM (1-4) DES (1-4)	Insufficient Lookout Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints	Multiple minor njuries; Minor damage: No pollution; Minor adverse publicity / short erm interruption to EMEC/Operators.	2	2	1	2	3	Single fatality; Major damage; Minor pollution Tier 1); Moderate adverse publicity / long erm interruption to EMEC/Operators.	4	4	2	4	2	6.6	Low Risk - Broadly Acceptable
10	5	Grounding of Maintenance Vessel	Grounding	EMER 1/2/4/5) OPS (1-11) PROM (1-4)	Insufficient Lookout Inadequate Passage Planning Human Error/Fatigue Equipment or Mechanical Failure on Vessel Reduced Seakeeping due to Tidal or Weather Constraints Poor Visibility	Multiple minor njuries; Negligible damage: No pollution; Minor adverse publicity / short erm interruption to EMEC/Operators.	2	1	1	2	3	Single fatality; Moderate damage; Minor pollution Tier 1); Moderate adverse publicity / long erm interruption to EMEC/Operators.	4	3	2	4	2	6.3	Low Risk - Broadly Acceptable
11	11	Breakout of a Device rom Moorings	Breakout	EMER (1-5) OPS 2/7/8/9/10) DES (1-4) MON (1-3)	Severe metocean conditions Insufficient mooring arrangements Installation failure	Minor injury; Minor damage: No pollution; Minor adverse publicity / short erm interruption to EMEC/Operators.	1	2	1	2	2	Multiple major njuries; Moderate damage; Minor pollution Tier 1); Moderate adverse publicity / short erm interruption to EMEC/Operators.	3	3	2	3	1	3.2	Negligible Risk - Broadly Acceptable

Appendix B: Risk Mitigation Controls for the Fall of Warness Test Site (EMEC, 2025)

Number	Title	Description	Responsible	EMEC Reference
Emergency Response and Incident Investigation (EMER)				
EMER1	Site Wide ERCOP	Emergency Response and Cooperation Plan, to ensure that arrangements are in place for the protection of all employees and other persons that may be present in the area or premises and/or reputation in the event of an emergency occurring. Includes: -Liaison arrangements between EMEC and HMCG -Details of the Sites and Activities (including layouts) -Roles and Responsibilities -Procedures and Communications Channels -SAR Assets Details and Capabilities	EMEC	ERP014 v7 01/09/2023 ERP015 v13 23/04/2024
EMER2	Developer ERCOP	Provision of details, pictures and arrangements of specific devices/vessels by developers to update the site-wide ERCOP.	Developer	FORM264 v3 04/02/2022
EMER3	Emergency Shutdown	If there is an indication of an incident with a device onsite (e.g. mooring failure, device loss) the EMEC duty manager has the ability to initiate a shutdown and/or disconnection of a device remotely.	EMEC / Developer	ERP014 v7 01/09/2023
EMER4	Periodic Exercises	Periodic emergency management and response exercises will be run at EMEC, ran in conjunction with CGOC/SAR.	EMEC / HMCG	ERP014 v7 01/09/2023
EMER5	Incident Reporting and Investigation	There are statutory incident reporting requirements and expectations: -MAIB (Merchant Shipping Act) -HSE (RIDDOR) -Orkney VTS if in Harbour Authority Area -EMEC Duty Manager Site-Wide/Device Specific risk assessments to be reviewed following incidents, and additional risk controls identified if appropriate.	Various	FORM024 v7 03/05/2019 SOP008 v9 27/07/2023
Operational Management (OPS)				
OPS1	Control of Work	The EMEC Permit to Work and Permit to Access Site systems are intended to allow EMEC and contractors to control/coordinate safe activities within the site. Method Statements and Task Risk	EMEC	SOP003 v18 02/08/2023

		Assessments are required to be approved prior to access to or any works on site.		
OPS2	Marine Operating Guidelines	Detailed guidance for marine operations to promote high standards in the areas of health, safety and the environment during the planning and execution of all work on EMEC sites. Includes -Health and Safety -Management of Operations -Emergency Response -Equipment and Vessels -Environmental Management -Stakeholders	EMEC	GUIDE010 v5 17/02/2022
OPS3	Control of SimOps	Full assessment of the risks arising from simultaneous operations prior to authorising site access.	EMEC	SOP093 v3 28/11/2019 SOP095 v2 31/10/2019
OPS4	Vessel Standards	All work vessels accessing an EMEC site require: -MCA Vessel Coding (e.g. SCV) -Appropriate Insurance -Crewed by suitably trained/qualified personnel -AIS (Class A/B) on any vessel operating/installing in EMEC sites. -VHF (Ch16 and EMEC's private channel P1) -Mooring Arrangements (e.g. Minimum spacing or moorings to cables)	Developer	ERP014 v7 01/09/2023 GUIDE010 v5 17/02/2022
OPS5	PPE	Personnel operating on site are to wear appropriate Personal Protective Equipment (e.g. hard hats, work boats, protective glasses, lifejackets, thermally insulated floatation suits). PLBs are rarely used at EMEC sites, but some of EMECS lifejackets are equipped with GPS PLBs that activate on inflation.	EMEC / Developer	GUIDE010 v5 17/02/2022 ERP014 v7 01/09/2023
OPS6	Guard Vessels	During major construction or maintenance activities, a guard vessel may be considered to assist in protecting the devices from contacts with passing vessel traffic. Due to the low density of traffic, this is not considered necessary unless for extraordinary circumstances and has been rarely used. If guard vessels are to be used onsite, it is important that such vessels employed to guard the site follow appropriate guidelines, with clear instructions on when to intervene in a potential incident.	Developer	GUIDE010 v5 17/02/2022

		Required if unlighted, unmarked navigational hazards are present on site as a result of developer activities. Guard Vessels are required to comply with EMEC Vessel requirements.		
OPS7	Inspection and Maintenance Programme	Regular maintenance regime by developer to check the device, its fittings and any signs of wear and tear. This should identify any failings which might result in a mooring failure and therefore prevent breakout.	Developer	
OPS8	Task Risk Assessments	To ensure that all activities and operations within the control of EMEC are assessed for the risks they present to staff, suppliers and the public and that those risks are reduced to a level as low as reasonably practicable. Required as part of Control of Work procedures.	Developer	FORM025 v7 17/01/2022 SOP004 v6 10/01/2023
OPS9	Device Specific NRAs	Each developer is required to create a device specific addendum to the site-wide EMEC NRA to support applications to deploy, operate and remove assets at EMEC t~~T~~est s~~S~~ites.	Developer	FORM292-295
OPS10	Tow risk assessment and passage plan	As required under Orkney Harbours Pilotage Directions 4(3), prior to conducting a towing operation, a risk assessment and passage plan for the move should be conducted. The plan should account for the size of the tow, manoeuvrability restrictions, tow arrangements and MetOcean conditions	Developer	
OPS11	Training	Developers are responsible for ensuring that all staff engaged on operations are competent to carry out the allocated work.	Developer	GUIDE010 v5 17/02/2022
Promulgation and Awareness (PROM)				

PROM1	Notice to Mariners	To ensure that the appropriate authorities are informed of works being carried out in waters within EMEC's tTest sSite areas and of the installation of any permanent/semi-permanent structure such that the information is promulgated through appropriate channels to mariners. To include: -United Kingdom Hydrographic Office (UKHO) -Orkney Harbour Authority -Orkney Ferries -HMCG Shetland -NLB -Orkney Fisheries Association -Orkney Fisheries Society -Scottish Fishermen's Federation -Marine Scotland -RYA Scotland -The Orcadian (if appropriate)	EMEC / Developer	FORM068A v7 19/12/2018 FORM068B v7 03/05/2018 SOP063 v18 27/07/2021
PROM2	Consultation	Consultation with key stakeholders prior to site installations to ensure effective micrositing.	Developer	
PROM3	Site Marking and charting	Site is marked on nautical charts including an appropriate chart note.	EMEC / Developer	GOV017/018
PROM4	500 m Advisory restricted zone	A 500 m advisory restricted zone exists around all test devices located at EMEC. Nautical charts indicate that mariners should exercise caution whilst navigating in this area and obtain local knowledge (FoW). Nautical charts indicate that mariners should avoid passing within the test area marked by cardinal buoys (BC).	EMEC	SOP094 v6 07/08/2023
Site and Device Design (DES)				
DES1	Device Marking	Device to be lit to the requirements of NLB and marked in line with IALA guidance. Appropriate statutory sanctions must be in place to exhibit, alter or discontinue lighting.	Developer	
DES2	AIS	AIS transmitting an AtN Type 21 message should be installed on all surface piercing devices.	Developer	
DES3	Radar Reflectors	Use of radar reflectors to improve marking during times of poor visibility.	Developer	

DES4	Marking and Lighting	Device to be lit to the requirements of NLB and marked in line with IALA guidance. Appropriate statutory Sanctions must be in place to exhibit, alter or discontinue lighting.	Developer	
DES5	Hydrography	Contractual responsibility to return the site to the original condition post-decommissioning.	Developer	
DES6	Cable protection	From 15 m depth to shore, cast iron cable protectors are used (Billia Croo/FoW). Buried to 12 m from MLWS (Billia Croo) and "buried" (FoW).	EMEC	
Site Monitoring (MON)				
MON1	Site Monitoring: CCTV, Radar and AIS Monitoring	To satisfy operational requirements for control and monitoring of ~~Test~~ ~~Site~~Project activities, visual checks of the ~~Test~~ ~~Site~~Project environment, monitoring of lone worker safety, effective plant operation and substation security. EMEC's SCADA system provides real-time status information, trends, alarms and remote-control access to facilitate a safe working environment, comprehensive assessment and safe operation of the sites. Note – only relevant if test support buoy is deployed Billia Croo monitored from Black Craig/substation FoW monitored from Caldale substation (Eday). Not monitored 24/7	EMEC	ERP014 v7 01/09/2023
MON2	Heightened monitoring in adverse met-ocean conditions	During gale-force winds, periodic monitoring of the devices is recommended to ensure excessive forces are not acting on the moorings which might cause a breakout	EMEC / Developer	
MON3	GPS alert system for turbine moving	Remote monitoring of device to detect any major movements that might indicate a breakout for immediate response. Implement GPS excursion monitoring.	EMEC / Developer	

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