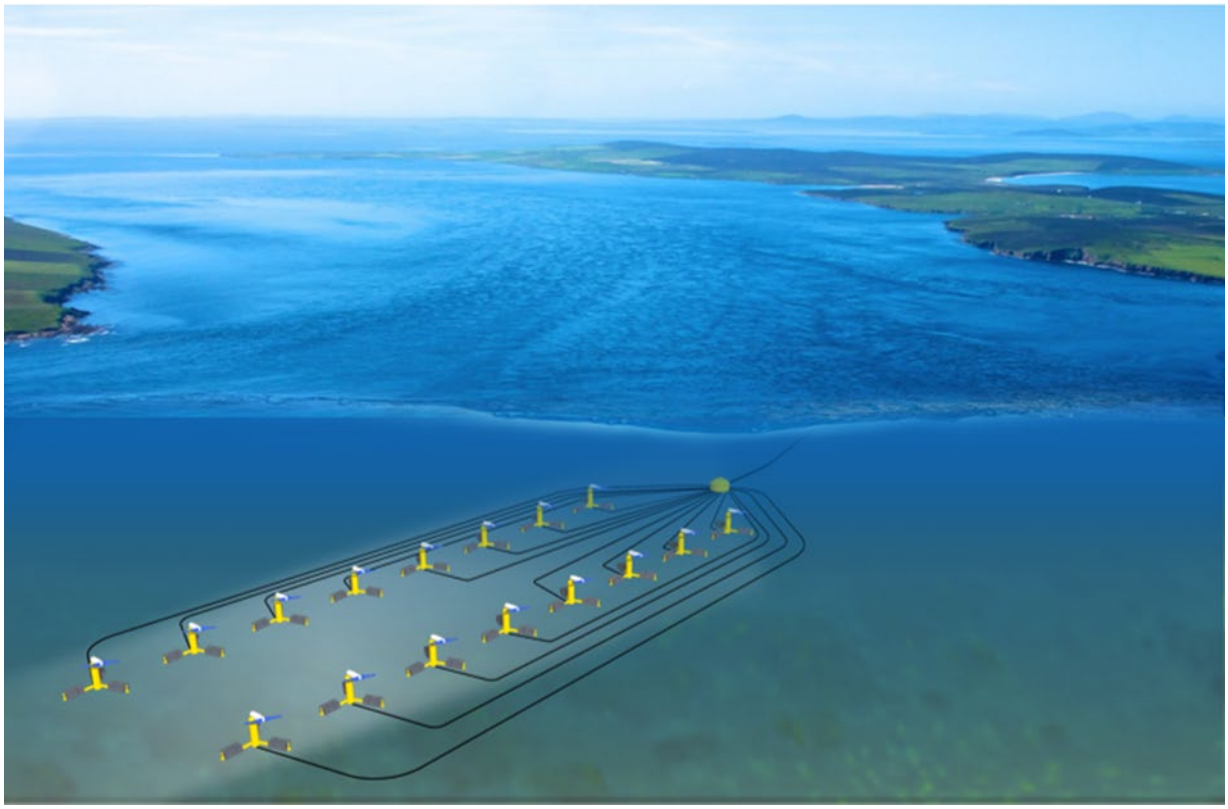
Nova Innovation | SEASTAR Project

Project Information Document

EMEC Fall of Warness

December 2023



Document History

Revision	Date	Description	Originated by	Approved by
1.0	21/12/23	Final draft for issue to MD-LOT	Kate Smith	Gavin McPherson

Disclaimer

This document entitled Nova Innovation SEASTAR Project - Project Information Document EMEC Fall of Warness has been prepared by Nova Innovation Ltd. This document in whole or in part may not be used by any person for any purpose other than that specified, without the express written permission of Nova Innovation.

Any liability arising out of use by a third party of this document for purposes not wholly connected with the above shall be the responsibility of that party who shall indemnify Nova Innovation against all claims costs damages and losses arising out of such use.

Contents

1 Introduction

1.1 Purpose of document

Nova Innovation (Nova) seek permission to install, operate and decommission a 4 MW tidal array, comprising sixteen of its proven seabed-based tidal turbine technology and associated offshore infrastructure at the EMEC Fall of Warness tidal site Eday, Orkney Islands.

The 4 MW SEASTAR (Sustainable European Subsea Tidal Array) project will be implemented under EMEC's site-wide licence for the Fall of Warness under Section 36 of the Electricity Act 1989. Nova is also required to obtain a marine licence from The Scottish Government Marine Directorate under Section 20(1) of the Marine (Scotland) Act 2010.

This Project Information Document (PID) provides Marine Directorate Licensing Operations Team (MD-LOT) and their consultees with information on the SEASTAR Project to support Nova's application for a marine licence. This document forms part of the marine licence application and is accompanied by the following additional documents:

1. Marine Safety Navigational Risk Assessment[1].
2. Project Specific Environmental Monitoring Plan[2].
3. Decommissioning Programme[3].

EMEC and Nova will work together to manage installation of SEASTAR Project offshore infrastructure and associated activity to ensure that the project is installed and operates in accordance with site-wide consents for the Fall of Warness, both alone and in combination with other activities at the site. This is considered further in Section 1.4 of this document and in the additional SEASTAR documents listed above, to provide reassurance to MD-LOT, its advisors and other stakeholders that if a marine licence is awarded, **the SEASTAR Project will be implemented and managed in strict accordance with site-wide consents**. This will ensure that the envelope of development across the site and the corresponding predicted impacts is strictly maintained within consented levels, so that the **total number of devices deployed (or any other parameter) does not breach any limit in the overarching section 36 consent for Fall of Warness**.

1.2 Company background

Nova is one of the world's leading players in driving forward the development of the nascent tidal stream energy industry. Nova was the first in the world to deploy an offshore array of tidal stream turbines (in 2016 in Bluemull Sound, Shetland), and since then its turbines have clocked up more than 65,000 generating hours. Of approximately fifteen offshore tidal stream turbines that are currently deployed around the world, three are Nova's: designed and manufactured in Scotland. Headquartered in Edinburgh, Nova has so far grown to over 30 staff.

1.3 Project overview

The SEASTAR Project will demonstrate a step-up in array size to sixteen turbines, almost three times larger in terms of deployed devices than the largest array in the world to date. This step-up in size will showcase the growing maturity of the tidal energy sector, demonstrating for the first time: bulk manufacturing of tidal energy devices, offshore electrical architecture, and deployment

[1] SEASTAR Project Navigational Risk Assessment Addendum, EMEC Fall of Warness. December 2023. pp24.
[2] SEASTAR Project Environmental Monitoring & Mitigation Plan, EMEC Fall of Warness. December 2023. pp27.
[3] SEASTAR Project, EMEC Fall of Warness. Decommissioning Programme. December 2023. pp22.

and operational methodologies for large multi-turbine tidal arrays. Further, it will provide the opportunity, for the first time, to understand the environmental effects of tidal at large array scale. In doing so it will de-risk future, larger projects, paving the way for the growth of tidal energy as a sustainable, predictable energy source.

The largest tidal array deployed to date is Nova's Shetland Tidal Array in Bluemull Sound, Shetland. The devices for this array were ordered and built in small batches, which limited the potential to benefit from economies of volume in procurement, manufacturing, deployment and operation. At sixteen devices, the SEASTAR Project will enable Nova to build and demonstrate the world's first manufacturing assembly line for tidal energy devices, and bulk delivery and deployment of the turbines to the site.

Nova has previously demonstrated operations and maintenance (O&M) of single devices and of small batches of turbines at the Shetland Tidal Array. This included a planned annual service of 3 turbines, which was undertaken over a 3 week period in 2020. Through the 16-turbine SEASTAR Project Nova will take this to the next level, by developing and demonstrating streamlined O&M strategies and procedures aimed at minimising downtime, maximising reliability and reducing the cost of energy for tidal power.

The SEASTAR Project will have a total installed capacity of 4 MW and involve the deployment of sixteen of Nova's 250kW M250-D turbines at Berth 7 in the Fall of Warness site at EMEC, Orkney Islands. The total number of devices deployed will not breach the limit in the overarching section 36 consent for Fall of Warness. An offshore electrical hub, intra-array cabling and a remote observation platform for environmental monitoring will also be installed for the duration of the SEASTAR Project. All SEASTAR offshore infrastructure will be installed at the Fall of Warness in 2026 and will be operated at the site for 20 years, following which decommissioning will take place in 2046.

1.4 SEASTAR Project and Fall of Warness project envelope

Table 1 details the key parameters of offshore technologies and associated infrastructure that may be deployed at the EMEC Fall of Warness site under the 10 MW and 50 MW site-wide consents. Parameters of the 10 MW consent are as stipulated in the site-wide licence issued by Marine Scotland (operational name) on behalf of Scottish Ministers under Section 36 of the Electricity Act 1989 for the Fall of Warness. The details for the 50 MW consent (not yet issued) are based on the project envelope assessed within the supporting Environmental Impact Assessment (EIA). The final column provides the parameters of the SEASTAR Project.

Table 1. Key parameters of 10 MW and 50 MW site-wide consents for the Fall of Warness. Final column provides project-specific values for the SEASTAR Project.

Parameter	10 MW consent	50 MW consent	SEASTAR Project
Maximum installed capacity	10 MW	50 MW	4 MW
Maximum number of devices	12	35	16
Maximum number of rotors	18	Not specified	16
Maximum rotor diameter	25 m	Not specified	7.5 m
Maximum swept area per device	Not specified	5000 m^2	44.2 m^2

Parameter	10 MW consent	50 MW consent	SEASTAR Project
Minimum depth surface clearance	2.5 m	2.5 m	15 m
Total materials deposited per device	Not specified	2000 tonnes concrete/densecrete 2000 tonnes steel/carbon steel 100 tonnes plastic/synthetic	23 tonnes steel 7 tonnes plastic/synthetic
Total materials deposited per substructure	Not specified	4000 tonnes concrete/densecrete 4000 tonnes steel/carbon steel	152 tonnes concrete 28 tonnes steel
Total seabed coverage per device	Not specified	750 m^2	203.5 m^2 (Direct contact = 3 m^2)
Maximum number of electrical hubs	Not specified	8	1
Maximum seabed coverage of hubs	Not specified	500 m^2	25 m^2
Total material deposited per hub	Not specified	500 tonnes concrete/ densecrete 1000 tonnes steel/carbon steel 100 tonnes Plastic/synthetic	60 tonnes concrete 100 tonnes steel 5 tonnes plastic/synthetic

Copyright © Nova Innovation 2023

The offshore infrastructure associated with the SEASTAR Project is within the envelope of parameters specified for the 50 MW Fall of Warness site-wide consent[4]. The 10 MW Section 36 consent allows for a maximum of 12 turbines. **EMEC and Nova will work together to manage installation of SEASTAR offshore infrastructure and associated activity to ensure that the project is installed and operates in accordance with site-wide consents for the Fall of Warness, both alone and in combination with other activities at the site. This includes ensuring that the total number of devices deployed (or any other parameter) does not breach any limits of the overarching section 36 consent for Fall of Warness.**

Table 2 details the key parameters of offshore works associated with activities at the Fall of Warness, as included in the 'worse case scenarios' assessed within the EIA for the 10 MW and 50 MW site-wide Section 36 licences. The final column provides the corresponding parameters for the SEASTAR Project.

Table 2. Key parameters of offshore works associated with activities carried out under 10 MW and 50 MW site-wide consents for the Fall of Warness. Final column provides project-specific values for the SEASTAR Project.

Parameter	10 MW consent	50 MW consent	SEASTAR Project
Pre-installation activities at Berth	Not specified	Up to 1 week	Up to 1 week
Installation activities	Not specified	Typical duration of up to 1 month per device (maximum of 7 days of drilling per device)	Typical duration of up to 6 days per device.
Inspection and maintenance activities	Not specified	Regular intervals over 3-12 months	Scheduled maintenance once every 5 years (all turbines in one operation). Unscheduled

[4] At the time of writing, a site-wide Environmental Impact Assessment (EIA) is underway to support an application for a 50 MW licence under Section 36 of the Electricity Act 1989 for the Fall of Warness.

Parameter	10 MW consent	50 MW consent	SEASTAR Project
			maintenance up to 2-3 times per year (worst case scenario)
Temporary retrieval and redeployment of nacelle, gravity foundations, anchors or scientific equipment	Not specified	Typical duration of up to 1 month	Typical duration of up to 3 neap tides per turbine (allowing contingency)
Inspection, maintenance and replacement of cables and protection	Not specified	Typical duration of up to 1 week	Typical duration of up to 3 neap tides (allowing contingency)

Copyright © Nova Innovation 2023

The offshore works and activities associated with the SEASTAR Project are within the 10 MW and 50 MW consented envelopes for the Fall of Warness. **EMEC and Nova will work together to manage installation of SEASTAR offshore infrastructure and associated activity to ensure that the project is installed and operates in accordance with site-wide consents. Any interaction with Nova's OCEANSTAR Project will also be managed, as well as other developer activity at EMEC, to ensure that any limits of site-wide consents are not exceeded.**

2 Technology

2.1 Turbine technology background

Nova's seabed-based direct drive 250 kW tidal turbine (the M250-D) that will be deployed in the SEASTAR Project is the culmination of 12 years of technology development, demonstration and refinement. It has been designed by Nova for operation in tidal sites of depths from 15 m to 50 m with maximum spring tide flow speeds of up to 4.5 m/s. The device consists of a gravity moored base structure, with a detachable steel nacelle containing the drive train, and two bladed horizontal axis rotor, designed for bi-directional operation, eliminating the need for a yaw mechanism. The base consists of a steel structure with concrete/steel ballast positioned on three feet.

The SEASTAR Project and the M250-D turbines that will be deployed in the array builds on the work of Nova's operational tidal array in Shetland, our manufacturing capability, our R&D innovation and our deployment experience over the last 12 years, supported by private investors, international governments, and other sources.

Details of the M250-D turbines and associated offshore infrastructure for the SEASTAR Project, for which Nova is applying for a marine licence, are provided in the following sections.

2.2 Turbine description

The sixteen Nova M250-D turbines in the SEASTAR Project closely resemble the three Nova M100-D turbines currently deployed in the Shetland Tidal Array, Bluemull Sound, shown in Figure 1.

Figure 1: Nova's M100-D turbine with its substructure being prepared for deployment at the Shetland Tidal Array, Bluemull Sound. *Source: Copyright © Nova Innovation 2020*

The Nova M100-D turbines in the Shetland Tidal Array are configured to supply up to 100kW to the Shetland grid. However, with minor modifications (including shortening the blades), the same device is capable of generating up to 250kW at faster flowing tidal sites, such as the Fall of Warness. This slightly modified device, which will be deployed in the SEASTAR Project, has been rebranded the M250-D in recognition of its greater generation capability. Total project capacity will not exceed 4 MW and the total number of devices deployed will not breach the limit in the overarching section 36 consent for Fall of Warness.

Key differences between the Nova M100-D and the Nova M250-D turbines that will be deployed at the SEASTAR Project are highlighted in Table 2.

Table 2. Key differences between the Nova M100-D and M250-D turbines.

Turbine parameter	M100-D	M250-D
Rotor diameter	8.5 m	7.5 m
Rotor swept area	56.8 m^2	44.2 m^2
Rotor hub height	8.9 m	9 m
Blade tip height	13.2 m	12.5 m
Width of fully ballasted substructure	10.3 m	15 m
Power rating	100 kW	250 kW

Source: Copyright © Nova Innovation 2023

The M250-D turbine has a rotor diameter of 7.5 m, and a rotor hub height of 9 m The total height from the bottom of feet to the tip of the blades is 12.5 m. The devices will be located at depths that ensure that during operation all parts of the turbine are at least 15 m below lowest astronomical tide to allow ample draft clearance for shipping. Each device uses a ballasted gravity foundation and therefore requires no other mooring system.

Dimensions of the M250-D turbines are provided in Figure 2 and Table 3.

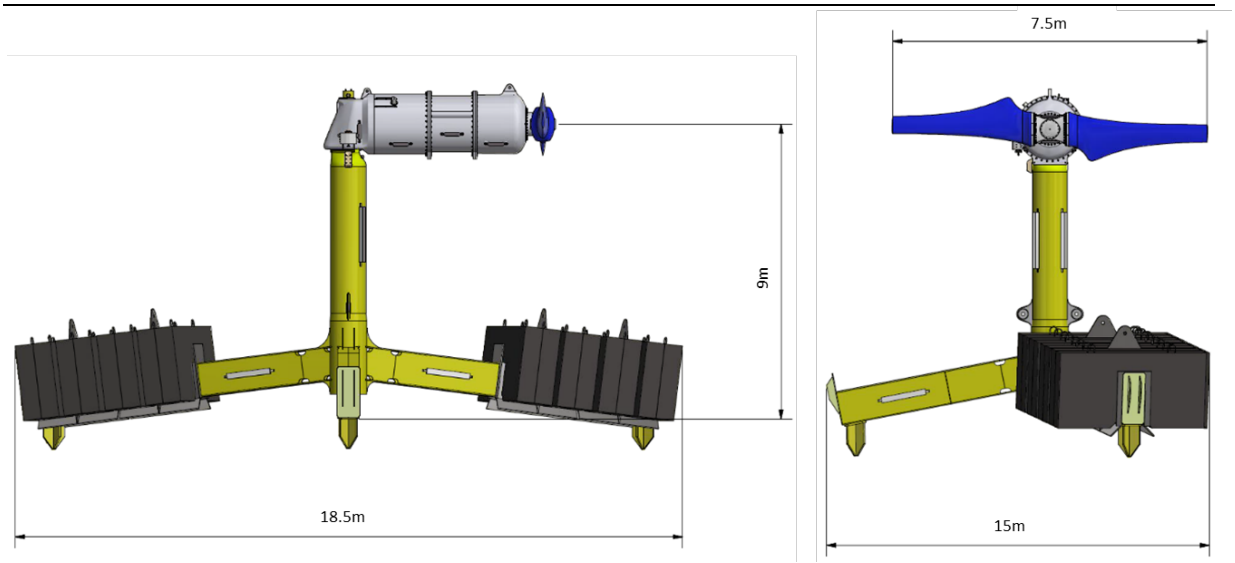


Figure 2. Dimensions of Nova M250-D turbine. *Source: Copyright © Nova Innovation 2023*

Table 3. Key dimensions and weights of Nova M250-D turbines.

Parameter	Value
Nacelle weight	23 tonnes
Steel substructure weight (inc. cable attachment)	28 tonnes
Concrete ballast blocks (each)	9.5 tonnes (20 per turbine)
Total weight	241 tonnes
Rotor hub height	9 m
Rotor diameter	7.5 m
Blade tip height	12.5 m
Substructure plan view footprint	11m x 18.5m
Points of contact with seabed	3

Source: Copyright © Nova Innovation 2023

The M250-D Power Take-Off (PTO) consists of a highly efficient and reliable direct drive generator. This is an improvement on Nova's three original M100 turbines deployed at the Shetland Tidal Array from 2016/17 to 2023, which utilised a gearbox coupled to an induction generator.

The 90kNm direct drive PTO has been successfully demonstrated under the Horizon 2020 funded D2T2 project, which completed in March 2020. The results (validated by Wood) from onshore and offshore testing have confirmed that the direct drive PTO provides a substantial improvement in terms of cost and performance. Power electronic and transformer components are located in the turbine.

The first 90kNm direct drive unit was deployed in August 2020 as part of an M100-D turbine, the fourth turbine at the Shetland Tidal Array, and has since been generating impressively, proving its enhanced power generation performance and reliability. Two additional M100-D turbines (turbines 5 and 6 in the array) were successfully deployed in January 2023. At six devices, this was the greatest number of turbines ever deployed in a tidal stream array[5]. Turbines 5 and 6 are connected to the grid via a subsea hub, which is another world first and an essential enabling technology for future tidal arrays, by minimising the number of power export cables.

[5] In April 2023 the three original M100 turbines in the Shetland Tidal Array were decommissioned as part of the EU Enabling Future Arrays in Tidal (EnFAIT) project.

The device includes onboard power electronics, so can supply grid-compliant power directly to the grid. Connection voltage is 3.3 kV (at turbine) to 11 kV (shore voltage).

2.3 Third Party Verification

The SEASTAR Project builds on the work of Nova's operational tidal array in Shetland, our manufacturing capability, our R&D innovation and our deployment experience over the last 12 years, supported by private investors, international governments, and other sources.

The Nova M250-D seabed-based horizontal axis direct drive tidal turbine that will be deployed in the SEASTAR Project is the culmination of 12 years of technology development, demonstration and refinement. The 250 kW turbine has been designed by Nova for operation in tidal sites of depths from 15 m to 50 m with maximum spring tide flow speeds of up to 4.5 m/s.

Third Party Verification (TPV) of the M250-D turbine will be provided by Wood Group Plc. Wood is one of the world's leading consulting and engineering companies operating across Energy and Materials markets, with wide experience in TPV and marine warranty in the marine renewables sector. Wood sits on the UK working group for the International Electrotechnical Commission's (IEC) PEL/114 Marine energy (Wave, tidal and other water current converters) committee. This group, which provides the UK input into the IEC/TC114, is responsible for the development of Standards in the field of Wave and Tidal Energy Converters. Wood is therefore well-placed to provide the independent TPV of the M250-D.

Previously Wood provided TPV of Nova's M100-D turbine, three of which are currently operating in the Shetland Tidal Array, and which has also been fully licensed for deployment in the bay of Fundy, Canada.

2.4 Array layout

The sixteen turbines in the SEASTAR Project will be installed at Berth 7 at EMEC's Fall of Warness site west of Eday, Orkney Islands. The turbines will be aligned such that their rotors are perpendicular to the primary flow. The precise location and layout of the sixteen turbines in the array will be finalised during the project development phase. The total number of devices deployed will not breach the limit in the overarching section 36 consent for Fall of Warness. A preliminary sketch of the proposed layout at Berth 7 at the Fall of Warness is shown in Figure 3. The purple line shows the array boundary, with the proposed array layout of the M250-D turbines shown as two rows of 8 turbines, delineated by the red rectangle. Further details of the array area, including coordinates are provided in Section 3.1.

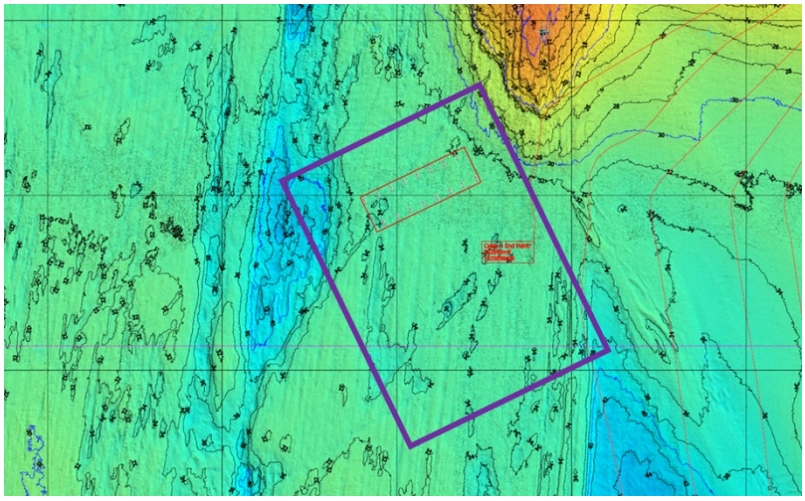
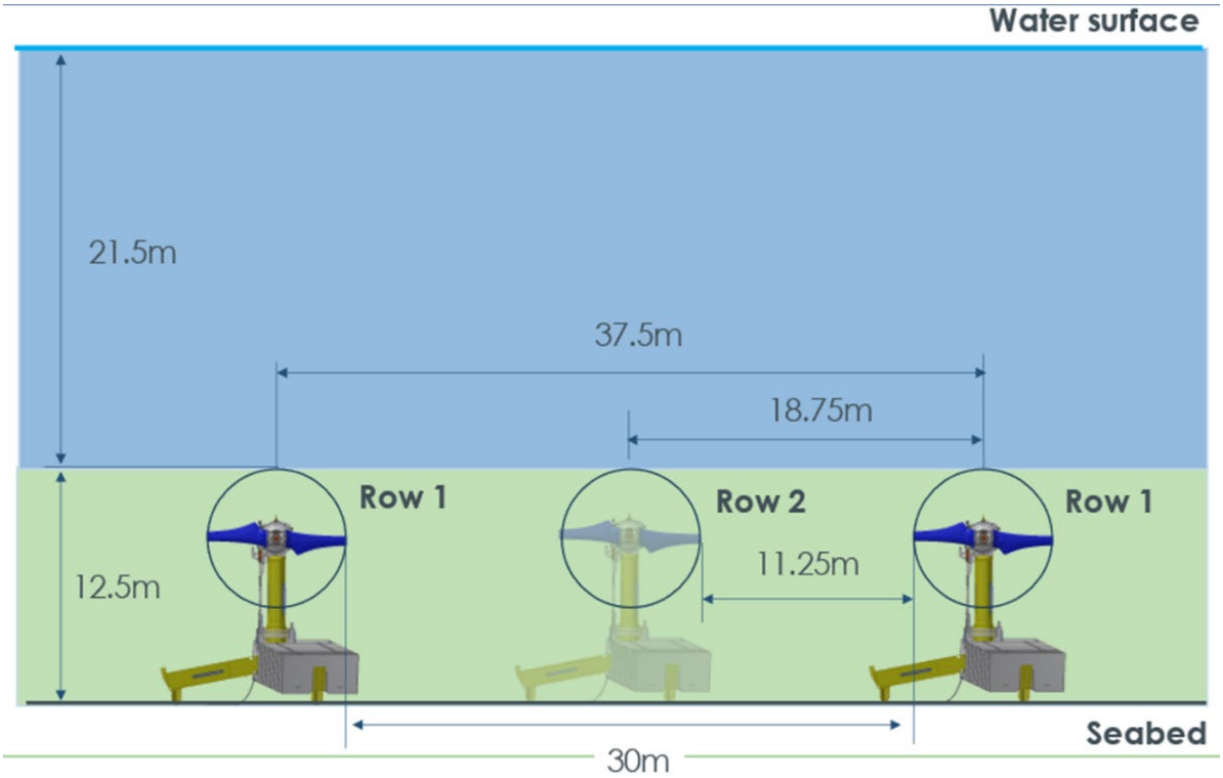


Figure 3. Proposed layout of turbines in the SEASTAR Project.
Source: EMEC and Nova Innovation 2023

Figure 4 shows the front elevation profile of the array, viewed from the north in the direction of flow. Turbines within each row will be spaced 37.5 m apart (between rotor centres). The two rows of 8



turbines will be separated by 70 m. The total array area will be approximately 325 m by 90 m. This proposed layout leaves ample room for navigation by vessels above the array – just as vessels have passed over Nova's turbines in Bluemull Sound since 2014 without incident. This means there is no risk of interaction between the array turbines and navigation, including during poor weather when inter-island ferries may use this area. A full Navigation Risk Assessment for the SEASTAR Project is provided in a separate document.

Figure 4. Front elevation profile of the array, viewed from the north.
Source: Copyright © Nova Innovation 2023

2.5 Offshore electrical hub

An offshore electrical hub will be utilised in the SEASTAR Project to enable a single export cable to shore. The hub will be located within the existing EMEC site boundary in a suitable site that complies with EMEC's site-wide Navigation Risk Assessment for the Fall of Warness. If the hub is a floating structure, it will likely be sited in a sheltered location, agreed with EMEC and identified as being suitable for surface piercing devices. Careful micro-siting will be used for all project infrastructure, informed by discussions with navigational stakeholders, including Orkney Ferries, to ensure safe navigable channels.

The hub will consist of multiple cable terminations (from the intra-array cables) which feed into the transformer via circuit breakers. A cable termination and short jumper cable will then attach to the export cable end-connection.

The hub will consist of a steel hull-structure, with copper, iron and a limited quantity of oil in securely sealed subsystems. The hub will be designed for either permanent or temporary flotation. It will be marked appropriately using buoys/markers and lights. A full Navigation Risk Assessment for the

SEASTAR Project and any corresponding mitigation measures, including for the offshore hub, is provided in a separate document[6].

2.6 Intra-array cables

Intra-array cables will be used to connect the sixteen turbines with the offshore electrical hub, which will then connect to the existing EMEC export cable. They will carry both power and communication. All cables will consist of a number of copper conductors and optical fibres, protected by a double armour layer and HDPE sheath. An indicative cross section is shown in Figure 5. The intra-array cables will be laid directly on the seabed, without the need for any additional protection (e.g., concrete mattresses). They are sufficiently heavy to remain in position without additional securing. The same cable specification has been successfully used at Bluemull Sound.

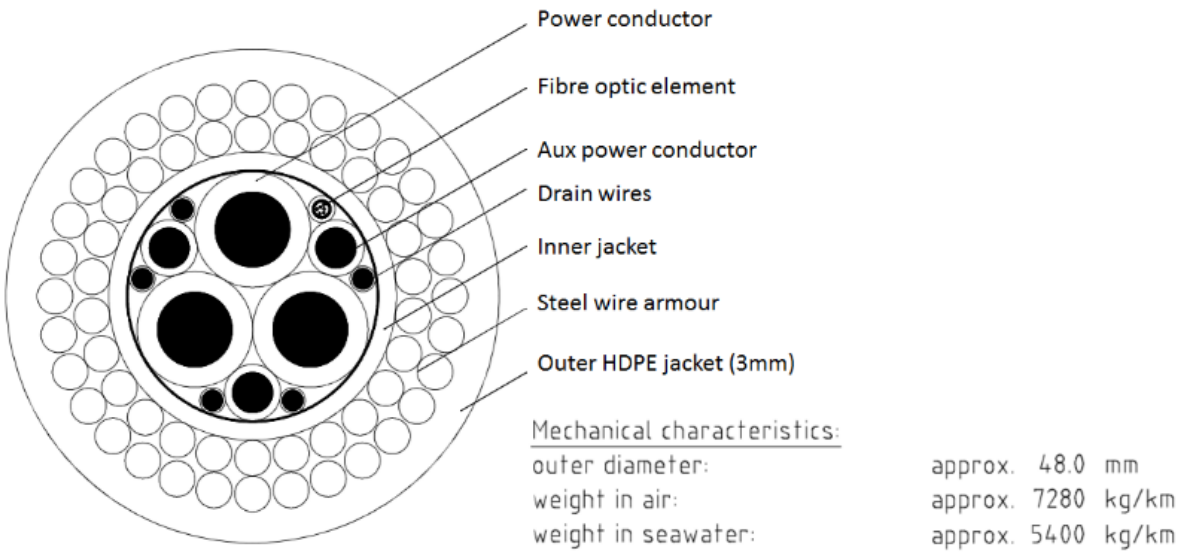


Figure 5. Intra-array cable cross section.

2.7 Export cable

The export cable will be provided by EMEC. The existing 11kV cables are capable of exporting 4 MW.

2.8 Materials used

Table 4 provides details of the materials to be used in the construction of the SEASTAR Project.

Table 4. List of materials to be used in the SEASTAR Project.

Components	Type of Deposit	Nature of Deposit	Deposit Quantity	Contingency Allowance
Turbine + rotor x 16 total	Steel nacelle containing shaft (steel), generator (steel + copper), power converter (electronic components) & transformer (iron, copper, small quantity of biodegradable oil). Rotor consists of hub (steel) & blades (composite outer with steel core).	Permanent	23 tonnes steel each 7 tonnes plastic/ synthetics each	20%

[6] SEASTAR Project, EMEC Fall of Warness. Navigational Risk Assessment Addendum. December 2023. pp24.

Components	Type of Deposit	Nature of Deposit	Deposit Quantity	Contingency Allowance
Substructure + cable backpack x 16 total	Steel	Permanent	28 tonnes each	20%
Ballast block and cages x 320 total	Concrete & steel reinforcement, 20 blocks per device.	Permanent	9.5 tonnes each	20%
Cables (intra-array)	Copper, HDPE, glass fibre, steel armour	Permanent	10.5 kg/m 24 km total	20%
Cable (to shore)	Copper, HDPE, glass fibre, steel armour	Existing	n/a	n/a
Offshore electrical hub x 1 total	Hub: steel Transformer: iron, copper, small quantity of biodegradable oil, plastic/synthetics	Permanent	100 tonnes steel and 5 tonnes plastic/ synthetics	20%
Hub/hub mooring ballast	Concrete	Permanent	60 tonne	20%

Source: Copyright © Nova Innovation 2023

3 Project Description

Key elements of the SEASTAR Project are as follows:

- 16 turbine nacelles.
- 16 gravity-base steel sub-structures and concrete ballast.
- An offshore electrical hub (either floating or seabed based, to be determined).
- Intra-array cabling.

See Section 2 for details and diagrams.

3.1 Offshore location

The sixteen turbines in the SEASTAR Project will be installed at Berth 7 at EMEC's Fall of Warness site west of Eday, Orkney Islands. Table 5 provides coordinates for the location of the turbine array. The precise location and layout of the sixteen turbines in the array will be finalised during the project development phase, with a preliminary sketch of the proposed layout provided in Section 2.4. The total number of devices deployed will not breach the limit in the overarching section 36 consent for Fall of Warness.

Table 5. Location of SEASTAR Project turbine array.

Location Description	Latitude and longitude (WGS 84)	UTM Eastings	UTM Northings
Array centre point	59° 09' 08.188" N 2° 49' 47.354" W	509734	6557021
Array boundary points	59° 08' 51.758" N 2° 49' 54.483" W	509622	6556512
	59° 09' 15.711" N 2° 50' 16.647" W	509268	6557252
	59° 09' 24.846" N 2° 49' 40.976" W	509834	6557536
	59° 09' 00.438" N 2° 49' 17.309" W	510212	6556782

Source: Nova Innovation 2023

Figure 6 shows the location of berths at the Fall of Warness site, including Berth 7 where the SEASTAR Project will be located.

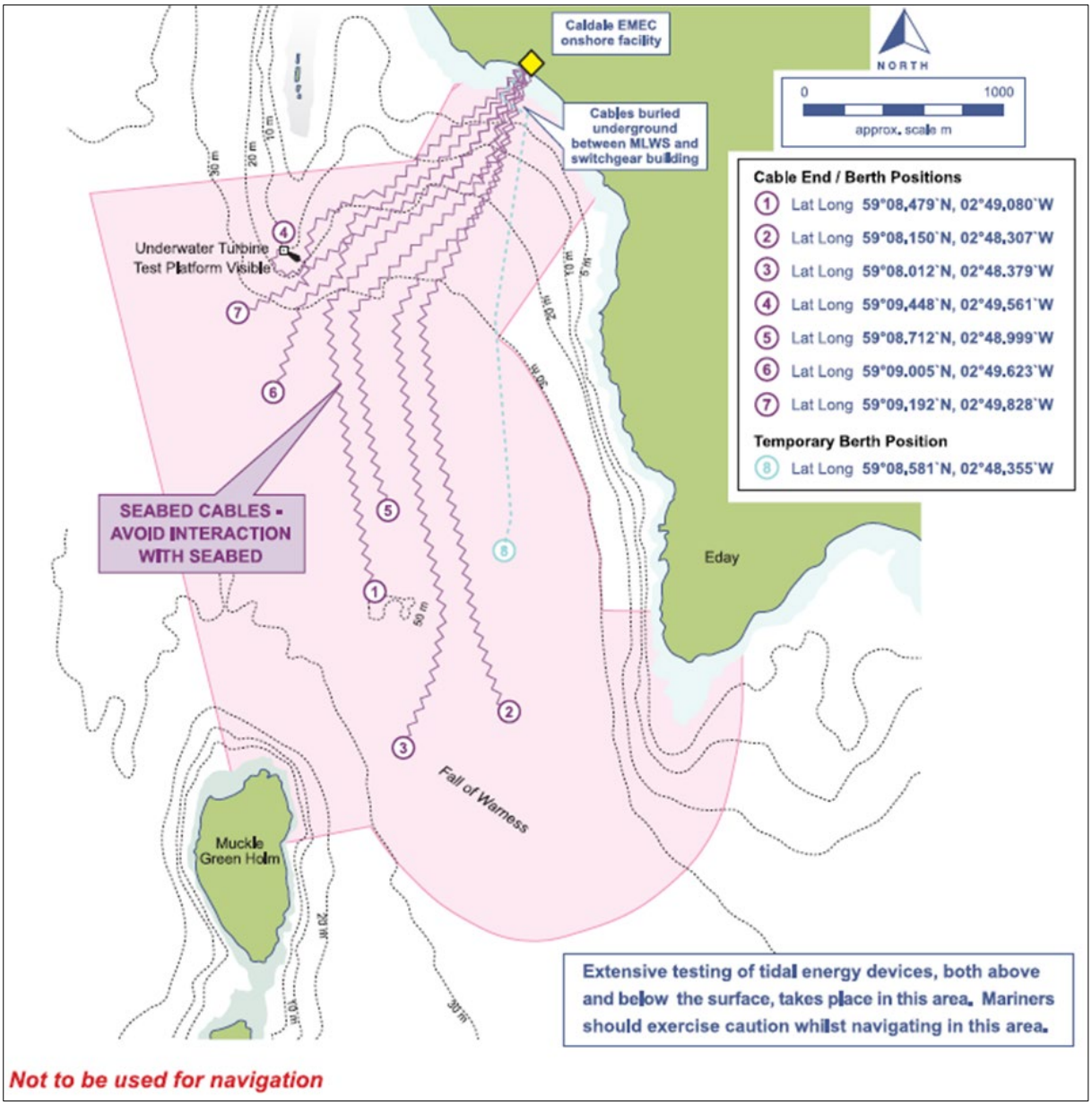


Figure 6. EMEC Fall of Warness site. *Source: EMEC 2022*

3.2 Site preparation

Site preparation will be minimal, consisting of existing cable inspection, and seabed and tidal current (ADCP) surveys.

3.3 Installation method

Tidal turbines and offshore infrastructure associated with the SEASTAR Project will be installed using methodologies developed, refined and demonstrated by Nova in the successful deployment of six devices in the Shetland Tidal Array. As with operations conducted by Nova in Shetland, a Multicat vessel will be used, with either a 4-point mooring or dynamic positioning system for positioning when required.

A detailed Construction Method Statement will be supplied post- consent, but all installation methods will be within the project envelope specified for the Section 36 licence for the Fall of Warness.

Offshore infrastructure installation will take place in the following sequence:

1. **Load-out turbine substructure and ballast.**
   The turbine substructure and concrete ballast units will be assembled at a nearby facility or barged to load-out location. A crane will transfer the steel substructure into the water.

2. **Ballast turbine substructure.**
   The substructure will be picked up with a Multicat and transported to a sheltered local position near to the deployment site. The Multicat will pick up the ballast units and lower them onto the relevant locations on the turbine substructure.

3. **Deploy turbine substructure.**
   The ballasted substructure will be picked up and transited the short distance to the deployment location. Once on site, the ballasted substructure will be lowered to the seabed with equipment used to control the position and orientation of this once deployed. Remaining ballast will be deployed on-site, as demonstrated at the Shetland Tidal Array.

4. **Deploy offshore electrical hub and carry out shore cable connection.**
   The offshore electrical hub will be transported by Multicat vessel from Kirkwall harbour. The Multicat will recover EMEC's pre-deployed (existing) export cable and connect it to the offshore hub. The hub will be made secure at its final location and marked using buoys and lights as required.

5. **Deploy intra-array cables.**
   Intra-array cables will be installed using a Multicat vessel from a nearby pier. Using 4-point mooring or DP control, the Multicat will lower the turbine-end of each cable (known as a backpack) onto the corresponding substructure. The cable will then be laid until clear of the substructure area. Once released from the moorings (if used), the cable will be laid along a predetermined course (avoiding other array components) to the offshore hub, where it will be connected. This process will be repeated for all intra-array cables. No additional deposits are expected to be required to secure the cables.

6. **Deploy nacelle.**
   The Multicat vessel will collect the turbine nacelle from Kirkwall Harbour and carry it to the installation location. The nacelle will be lowered from the vessel to the substructure, to which it will be mechanically locked. The electrical connection is made by a remotely actuated wet-mate connector.

Nova does not plan to use any ROVs or divers during operations throughout the SEASTAR Project. Operations are designed not to require divers or ROVs and have been conducted accordingly, several times by Nova at the Shetland Tidal Array. Equipment deployment and recoveries will be carried out using a combination of the main vessel winch and the vessel HIAB crane, plus vertically lowered and surface-actuated recovery tools.

3.4 Removal method (maintenance)

Scheduled maintenance will take place in summer every 5 years, with each turbine being recovered to Kirkwall for maintenance before being redeployed at the site. All turbines will be serviced in a single operation every 5 years. Unscheduled turbine maintenance is anticipated to be required up to 2-3 times per year. The stages involved in this process are set out below.

1. **Nacelle retrieval.**
   A release mechanism is activated by the service vessel using a Launch and Recovery System (LARS) recovery tool which is lowered vertically. This releases the nacelle from the base from where it is lifted to the surface, secured to the vessel and removed to Kirkwall for servicing. Temporary marker buoys may be used.

2. **Redeployment.**
   On completion of servicing, the nacelle is returned to the site; the device is lowered onto the base using the LARS and the structural connection is completed. The LARS is then recovered.

At the end of the project life all offshore infrastructure will be completely removed from the site. Device removal is carried out using the same method as deployment (in reverse), as has been demonstrated at Shetland Tidal Array. Once the devices and all associated equipment have been removed, the seabed and surrounding locality will return to their natural state with no permanent impact from the devices.

Full details are set out in a separate Decommissioning Programme for the SEASTAR Project[7].

3.5 Vessels

The small scale and modularity of Nova's turbines mean that only one multicat workboat vessel is required to carry out offshore works. Typical workboats or multicat workboats such as MV C-Odyssey as shown in Figure 7 or similar, with lengths no greater than 28m and draught up to 4m will be used.

Figure 7. Representative turbine deployment and retrieval vessel (Leask Marine C-Odyssey).
Source: Leask Marine

The vessels to be used for offshore operations will be determined in advance of the operation depending on availability. Only vessels on EMEC's approved list of operators will be used for offshore operations.

The size and operational capability of vessels will be as follows:

1. Surveying: small local boat or Multicat vessel (see above).

2. Deployment and retrieval: Multicat vessel.

Offshore operations will be carried out during appropriately slack tides with suitable wave and weather conditions. The installation will be managed by Nova Innovation staff who will be resident

[7] SEASTAR Project, EMEC Fall of Warness. Decommissioning Programme. December 2023. pp16.

in Orkney for the project. All work will be accompanied by the relevant notifications, as set out in the Navigational Risk Assessment for the SEASTAR Project.

Operations will typically take place during neap tides and, when possible, will be scheduled during the summer months for improved weather and daylight conditions, however Nova has experience in Shetland deploying, recovering and decommissioning devices in all seasons and during neap and spring tides.

Deployment of substructures and nacelles will take place over a period of 28 weeks covering 14 neap tides during the summer of 2026.

Scheduled maintenance will take place in summer every 5 years, with each turbine being recovered to Kirkwall for maintenance before being redeployed at the site. The full scheduled maintenance operation will take place over 4 weeks during 3 neap tides.

Unscheduled maintenance will be conducted as required, with the recovery of affected turbines to Kirkwall for maintenance before being redeployed at the site. Each recovery/redeployment operation will take approximately 1 day. Nova anticipates up to 2-3 unscheduled maintenance events each year.

Decommissioning is scheduled to take place over 28 weeks during 14 neap tides in the summer of 2046.

Only one vessel will be on any work-site at any given time during the SEASTAR Project. A maximum of two vessels may be present in the project area, but they will be working in different areas e.g. the temporary ballast zone and the final deployment zone. The equipment deployment and recovery tasks to be carried out are of the same type that Nova has been carrying out routinely in Shetland since 2014. The local harbour master and other vessels that frequent the Fall of Warness site are familiar with these or similar operations, as are the identified vessel providers. No special vessel management arrangements are required, beyond the standard EMEC protocols.

The harbour master, Orkney Islands Council Harbour Authority and Shetland CGOC (which covers both Orkney and Shetland) will be advised in advance of all operations. All quayside and harbour works will be undertaken in compliance with the direction of the harbour master.

All vessels involved in the installation, maintenance and decommissioning of the device will comply with all aspects of the International Regulations for Preventing Collisions at Sea (COLREGS). All vessels used will carry all equipment as required under the vessels' registration, e.g. the Code of practice for the safety of small workboats and pilot boats.

Notices to Mariners will be used to inform stakeholders of offshore operations. During all offshore operations we will adhere to the good practice guidelines associated with the Scottish Marine Wildlife Watching Code, hard copies of which are kept in Nova's offices and onboard all vessels engaged in operations.

A full Navigation Risk Assessment for the SEASTAR Project and any corresponding mitigation measures is provided in a separate document[8].

3.6 Device monitoring systems

Following successful commissioning, performance monitoring of the devices will be undertaken remotely via a fibre optic cable. This will allow the devices to be monitored either from the shore or remotely via a secure internet connection in the EMEC substation on Eday.

[8] SEASTAR Project, EMEC Fall of Warness. Navigational Risk Assessment Addendum. December 2023. pp24.

The fibre optic cable is embedded in the power cables for each turbine and can be accessed by a secure ISDN/broadband communications link, allowing each individual turbine to be accessed remotely over the internet. It is also therefore possible to control and monitor the turbines locally and remotely from Nova's Edinburgh office.

All important or emergency signals are sent automatically via internet and SMS to Nova engineers who can log on and monitor the devices.

A SEASTAR Project-specific Emergency Response and Cooperation Plan (ERCOP) will be developed in agreement with MCGA, with a copies stored in EMEC's office, in Nova's office, and with another brought aboard any vessel by the Nova Representative overseeing any offshore operations.

3.7 Environmental monitoring systems

A programme to monitor the presence and behaviour of marine wildlife around the operational turbines has been developed following a review of the potential for the project and associated activities to result in adverse environmental impacts.

Nearfield wildlife monitoring around the turbine will use turbine-mounted optical cameras and a seabed-based remote observation platform that will house optical cameras and a multibeam sonar. Full details are provided in the SEASTAR Project Environmental Monitoring and Mitigation Plan[9].

4 Project schedule

Prior to any installation works commencing, site investigations and preparation to inform SEASTAR Project development will be carried out. All SEASTAR offshore infrastructure will be installed at the Fall of Warness in 2026. The proposed SEASTAR Project schedule is outlined in Table 6.

Table 6. Proposed SEASTAR Project schedule.

STAGE	Year										
	2023	2024	2025	2026	2027	2028	…	2043	2044	2045	2046
DEVELOPMENT											
DEVICE INSTALLATION											
OPERATIONAL											
DECOMMISSIONING											

Copyright © Nova Innovation 2023

Following the installation and commissioning phase of approximately 12 months, the SEASTAR Project will be operated for a long-term project of up to 20 years to end 2046. Following this, the SEASTAR Project will be fully decommissioned, in line with the methodologies in the approved Decommissioning Programme. Decommissioning is scheduled to take place over 28 weeks during 14 neap tides in the summer of 2046.

EMEC and Nova will work together to manage installation of SEASTAR Project offshore infrastructure and associated activity to ensure that the project is installed and operates in

[9] SEASTAR Project, EMEC Fall of Warness. Project Environmental Monitoring and Mitigation Plan. December 2023. pp27.

accordance with site-wide consents for the Fall of Warness, both alone and in combination with other activities at the site. The total number of devices deployed (or any other parameter) does not breach any limit in the overarching section 36 consent for Fall of Warness.