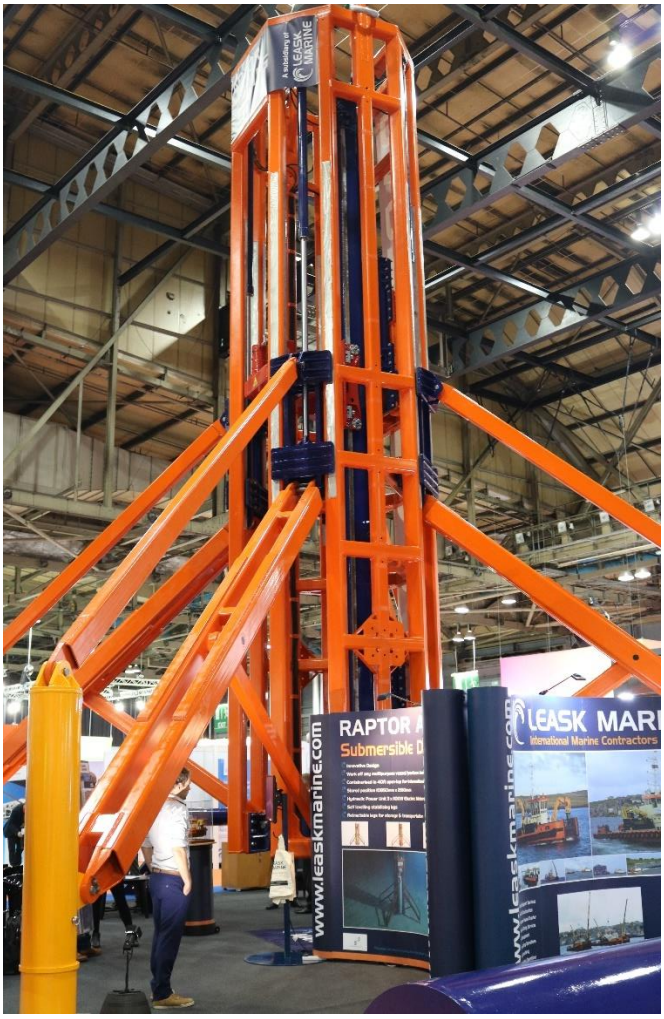
Leask Marine | Submersible Drill Rig Testing

Project Information Summary

July 2020



Purpose

This Project Information Summary gives a high-level view of the company, the device, and the proposed project. This document is the foreword to the project's marine licence application, and will feed into the rest of the application supporting documentation, including but not limited to the following documents:

- Project Environmental Monitoring Plan
- Decommissioning Programme

Document History

Revision	Date	Description	Originated by	Reviewed by	Approved by
0.1	24/06/20	Originate	EMEC		
1.0	13/07/20	Finalise		EMEC	

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Executive Summary

Leask Marine are proposing to test a submersible drilling rig (SDR) which offers a low-cost anchoring solution. The testing of the SDR and anchor installs are proposed to be located at both EMEC's Fall of Warness and Shapinsay Sound test sites. Rock anchors of up to 800mm diameter will be able to be installed using the SDR. The SDR will be winched from the vessel to the seabed using the vessel's onboard lifting and recovery system. Each drilling operation is expected to take between 2-3 hours before the SDR is recovered to the vessel. The SDR will be controlled using a single electrical line to the vessel; unlike other drilling systems all hydraulics will be mounted on the SDR. Different anchoring solutions will be tested with up to a maximum of 8 rock anchors installed across the two test sites. The anchoring solutions to be tested include:

- RAPTOR – Grouted Anchor Pile Tricone;
- RAPTOR – Grouted Anchor Pile Core;
- RAPTOR – Strataloc; and
- RAPTOR – Raptor.

The installation operation will be completed using a single multicat vessel and is expected to last a maximum of 4 days at each site, including vessel mooring installation and retrieval. EMEC plan to conduct acoustic surveys in order to characterise the noise signature of the SDR and anchor installation process.

It is proposed that the anchor installs will be completed during September 2020. There is currently no plan to use the anchors between installation and recovery. The recovery of the anchors is planned for September 2022 at the latest.

1 Introduction

1.1 Company background

Leask Marine Ltd was established in 1985 by Douglas Leask providing marine construction and diving services around Orkney and the rest of the UK. As a highly qualified commercial diver and vessel master, his talents were increasingly called upon for many marine construction repairs, and over the first 20 years Douglas built up a fleet of small & medium sized workboats and numerous commercial diving teams to satisfy this accumulating demand.

1.2 Technology background

Leask Marine Ltd have developed a submersible drilling rig (SDR) with which the company seeks to offer a new anchoring possibility to the market. A low cost drilled anchoring system will interest wave and tidal developers, floating wind developers, aquaculture and harbour maintenance markets.

1.2.1 The Opportunity

Currently there are a small number of subsea drill rigs, including one previously built by Leask Marine, which has the capability of drilling holes up to a diameter of 150mm, or others on the market which have the capability of drilling up to 220mm. Such small drill rigs have operational boundaries which may limit their use in the wave and tidal sector. In addition, the oil and gas industry have developed much larger drill rigs, however cost often places them out of reach of the renewables market. Therefore, Leask Marine have found an opportunity in the market to develop a mid-range seabed drill rig.

The SDR has been designed to offer the following:

- A cost-effective subsea drilling solution.
- Provide a range of drilling heads available up to 600mm diameter drilling hole.
- Serviceable and easy to maintain due to the adapted and marinised key components.
- Appropriately sized SRD (under 18T) to work off a range of small workboats that are cost effective to charter and operate anywhere, reducing the need for large DP vessels or drill rigs to be chartered.
- Containerised and easily transportable within two containers.
- Easy to assemble, deploy and demobilise with selected personnel.
- Reliable and proven adapted equipment and technologies make up rig and operating components.
- Working depth capacity of drilling will be up to 90m, and drilling depth of holes to meet client requirements.
- Market potential across range of industries including wave, tidal and floating wind industries, aquaculture and inshore drilling pilling for pontoons and marinas.

1.3 Project background

Currently, the majority of floating and semi-submersible devices are anchored to the seabed using gravity-based anchors. Whilst this solution is cost effective for one or two devices, Leask Marine believe that there will be greater CAPEX savings by using a flexible and universal anchoring solution, suitable for the conditions experienced at most development sites.

During the testing programmes conducted across EMEC's wave and tidal test sites, both Leask Marine and EMEC are aware of a lack of options regarding anchoring solutions, particularly relating to floating and semi-submersible devices. In order to offer more options to technology developers, Leask Marine have been developing the SDR to offer a new anchoring

solution to both existing and future renewable developers that require an effective low-cost solution to anchor their devices.

The proposed anchoring solution will require much less materials and could possibly be shared by multiple devices.

2 SDR Technology

2.1 Description

The SDR (Figure 1) is composed of seven key elements which are highlighted below:

1. A rotary head in order to drill while casing;
2. A sliding drilling mast with a preferred stroke of 6m and a preloaded ground anchor that is able to move from horizontal to vertical position once the device is levelised under water;
3. A gravity base with bumper bar that protects that drilling mast, the drilling head and the hydraulic power unit (HPU) of the SDR. The base includes two lifting points that have been used before by Leask Marine as recovery units which allows for an easy launch and recovery of the device;
4. Four hydraulic reversible stabilising legs that will be synchronised with vessel telemetric system in order to get the most stable position for the anchoring operation;
5. A single umbilical that will run from the surface to the SDR connector box located in the back of the gravity base. This umbilical will contain the power and control cable of the HPU;
6. A deck mounted control system, combining all telemetry and control of the SDR;
7. A compact subsea HPU which three-pump design.

Figure 1. Leask Marine Submersible Drilling Rig (SDR)

2.2 Hydraulic stabilizing legs

One of the main characteristics of the SDR design (see Figure 2) is the use of proven technologies. In order to ensure a high-quality drilling operation, four independent hydraulic stabiliser legs have been integrated which ensure the device is level when on the seabed. With this advantage, the SDR is able to complete the installation of a ground anchor in a single deployment.

Figure 2. SDR design

The compact hydraulic power unit (HPU) is located on the drill rig and therefore on the seabed during drilling operations. Typical HPUs are controlled by a complex hydraulic umbilical from the surface to the seabed, however, the drill rig has been designed with only one electrical cable from the SDR to the vessel. This will reduce the likelihood of cable drag which can often prove troublesome to operators.

2.3 Control system

The complete control system for the drilling rig requires to remain on the deck of the vessel which operate the self-levelling and drilling components subsea. The subsystems of the SDR will be integrated into one single control panel that will be located on the deck of the vessel. The operator will be able to control all subsystems from a single point which will allow easy substitution of subsystems in case of malfunction or failure. This has been possible through the use of underwater plug board which minimises the number of cables and hoses for better performance of the SDR.

2.4 Corrosion mitigation

Salinity in the marine environment can cause an accelerated build-up of scale on all pipe and hose connections, therefore, all connectors will be fitted with protection. Due to corrosion in

the marine environment, the SDR will require cathodic protection by the use of sacrificial anodes on the systems to prevent the accelerated degradation of the metal structure.

3 Deployment and removal of the SDR

Prior to transit to site, the SDR will be secured on the deck of the multicat involved in the operation. The SDR has been designed to the deployed using a customised launch and recovery system (LARS) or if the vessel has the capacity through the vessel crane. The lifting points, located on the frame of the SDR, are designed and tested. The drilling unit is placed into its launch position over the bow of the vessel using the vessel's onboard crane and is then lowered by the vessel's winches. The umbilical is simultaneously paid out while the device is lowered to the seabed.

Once the SDR is free of interference with the vessel, the legs of the SDR are extended (see Figure 3). By extending the legs of the SDR during the descent to the seabed, this ensures the system experiences less water pressure and also proves less onerous on the hydraulic system. In the case of a malfunction, having the legs pre-extended also allows for an easier recovery to deck. There are cameras within the SDR to provide visual support for the operation.

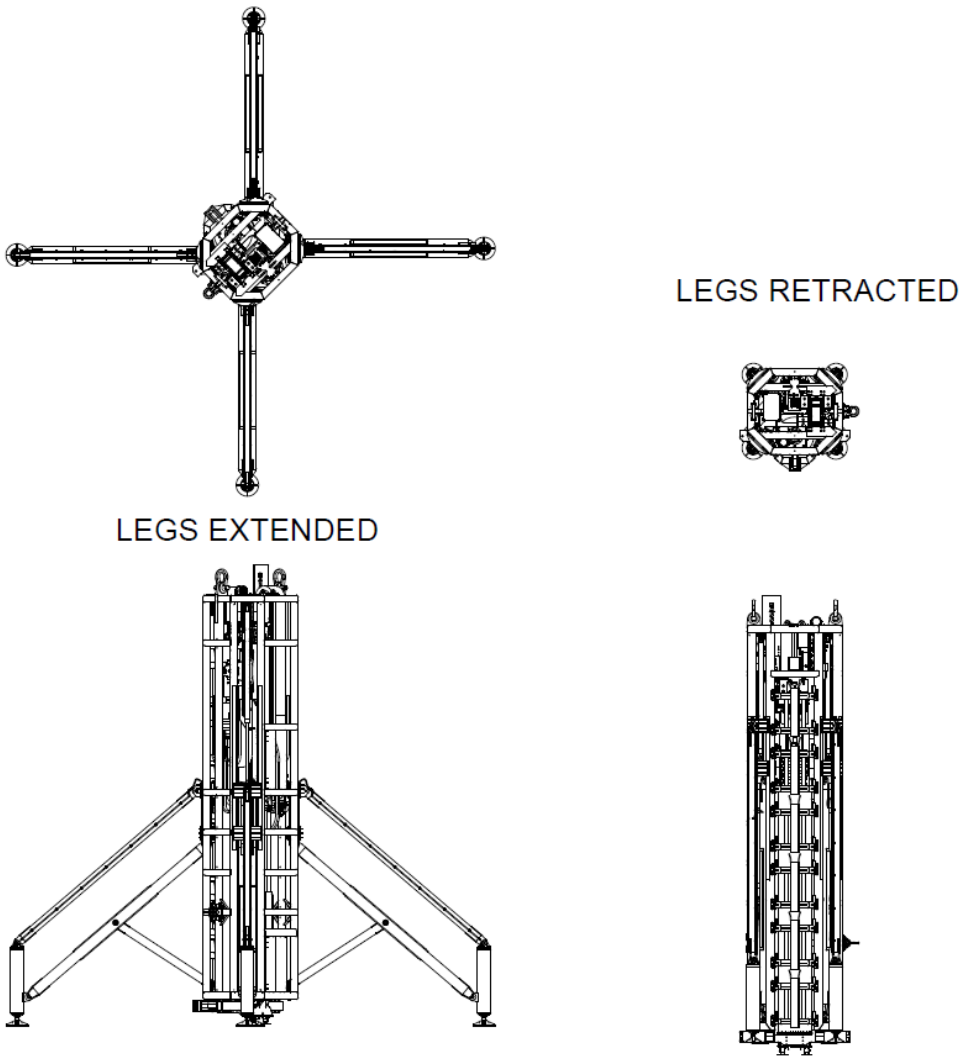

Figure 3. SDR legs extended and retracted

When the SDR reaches the seabed, the onboard telemetry provides the surface control unit with tilt angle information of the rig, which allows the operator to use the four independent hydraulic legs to level the unit and ensure the ground anchor is drilling into the seabed in a vertical position.

When the SDR is located in position and has been levelised, the operator will activate one of the hydraulic rams located on the cavity of the gravity base. By doing so the hydraulic ram will push the lifting ram that is connected to the support spine (welded to the back of drilling mast). The support spine has two sets of pad eyes that attach the drilling mast to the gravity base of the SDR. The higher pad eye is the connection between the spine with the lifting hydraulic ram that position the mast into the drilling position and a lower pad eye is the rotating and the attachment point of drilling mast with the base. When the SDR is on position and has been levelised the mast can be moved from horizontal to vertical position to start the operation.

The following storyboard provides an indication of the deployment and readying operation for the SDR, see Figure 4.

The lifting lines would remain attached to the SDR throughout the drilling operation. Each drilling operation is expected to take between 2-3 hours to complete.

Once the anchor installation operation has been completed, the SDR would be recovered to the surface in a reverse method to the deployment. The SDR would be lifted towards the vessel and prior to the potential interference with the vessel, the hydraulics extending legs would be retracted. The SDR would be lifted to breach the water surface and then mounted and secured on the vessel's deck before being returned to shore.

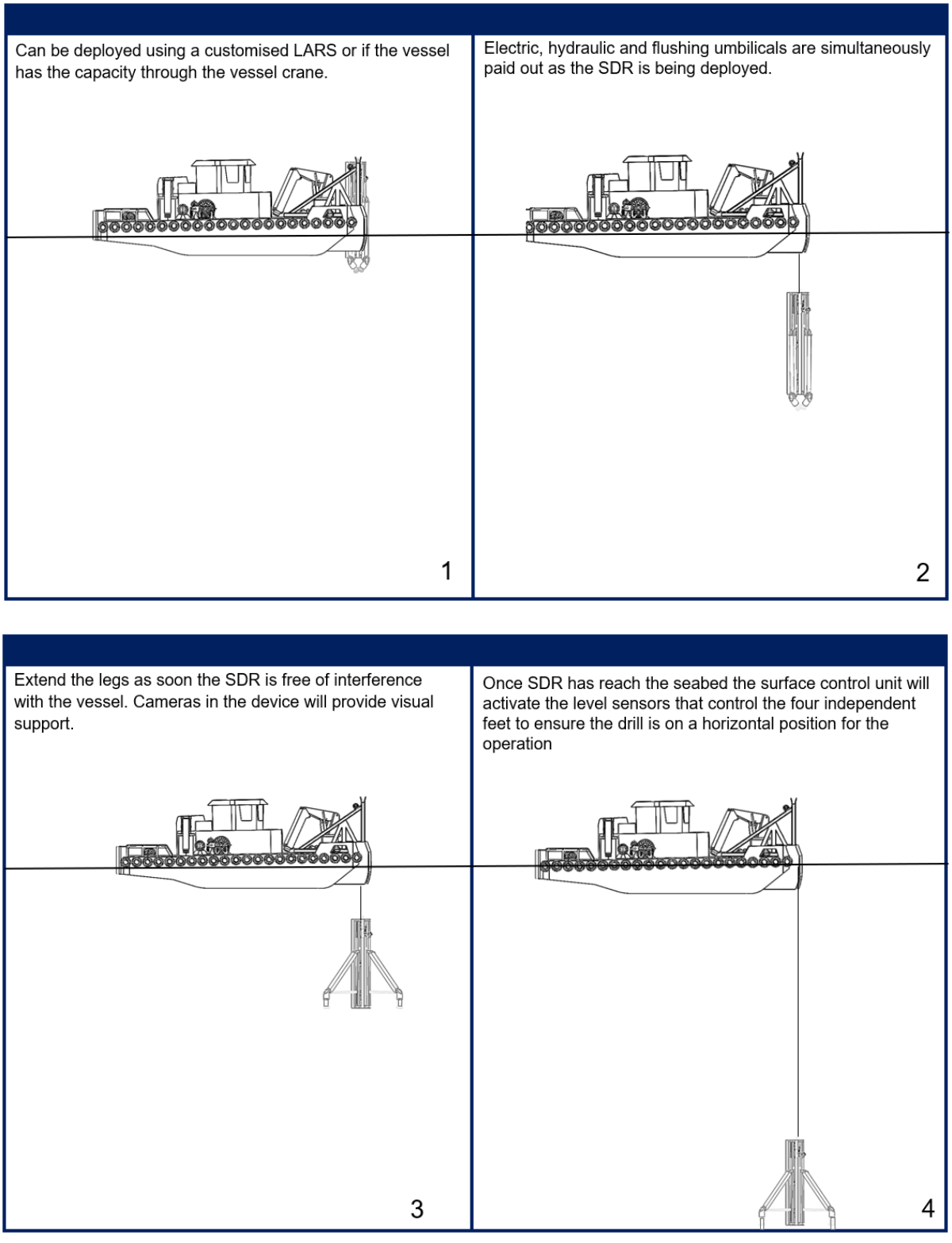

Figure 4. Installation operation storyboard

4 Anchor concepts

4.1 Background

The preferred test location for the SDR will be EMEC's Shapinsay Sound and Fall of Warness test sites. The characteristics of the soil at the planned test trial within Shapinsay Sound test site are mudstone/siltstone and sandstone composed of pebbles, cobbles, boulders with slabs of flags. A summary of the geotechnical parameters for the Shapinsay Sound site are summarised in the below table.

Table 1. Typical geotechnical parameters for intact Old Red Sandstone

Unit	Rock Type	RQD (%)	UCS Range (MPa)	Density (Tonnes/m^3)
Old Red Sandstone	Mudstone/ siltstone	<10 (very poor to poor)	30-50	2.30
	Sandstone	65 (fair)	80-110	2.71

The bearing capacity of the rock has been evaluated for the anchors to be installed. A safety factor of 3 has been utilised during the design and specification of the anchors, due to unknown fractures that might be present on the seabed.

A total of three different anchoring solutions will be tested with up to 8 rock anchors installed across the two test sites. The anchoring solutions to be tested include:

- RAPTOR – Grouted anchor pile tricone
- RAPTOR – Grouted anchor pile core
- RAPTOR – Strataloc
- RAPTOR – Raptor

The anchors vary between 100-800mm with a length of 6m, which can be extended if required for the grouted anchor pile. The top of each anchor can be customised to meet the necessary requirements, for instance a padeye with high grade shackle can be mounted or a subsea ball-grab can be fitted.

The weight of each anchor depends on its diameter and other physical properties. The heaviest anchor is around 5t while the lightest is around 2t, therefore overall an absolute maximum of 40t of steel/iron will be deposited.

Further details regarding the four anchoring solutions employed are outlined in the following sections.

4.2 Raptor G.A.P Tricone Anchor

The Raptor Grouted Anchor Pile (GAP) is composed of a sacrificial drill bit that is connected to an outside casing sleeve that works as a driving shaft. Once the anchor has been drilled in place, the gap between the casing sleeve will be filled with grout. This increases the stiffness of the anchor and allows a higher resistance of lateral loads. The SDR can accommodate Raptor Tricone anchors from sizes 200-800mm.

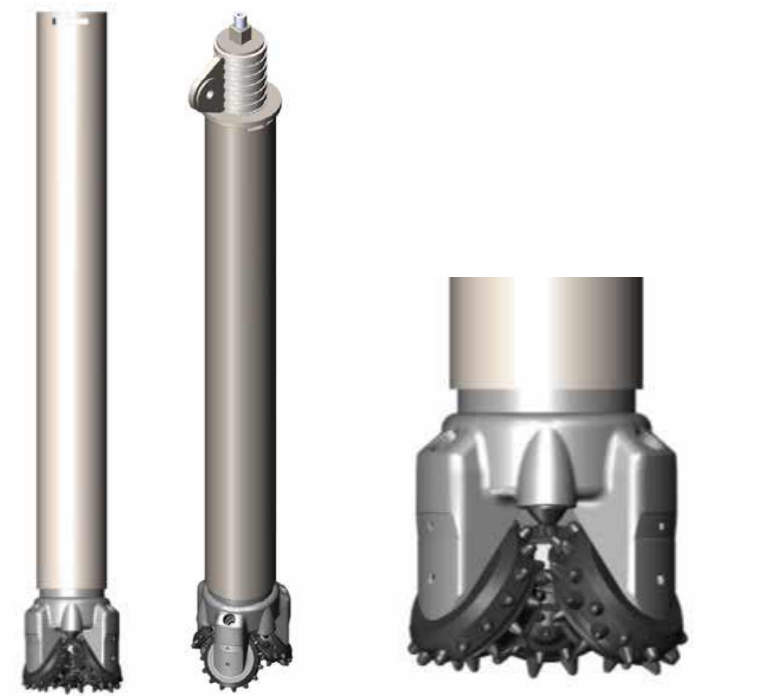

Figure 5. Raptor G.A.P Tricone Anchor

4.3 Raptor G.A.P Core Anchor

GAP anchors are steel piles that are drilled into bed rock and grouted. The Raptor GAP Core anchor has a custom cutting head which is made up from tungsten cutters and specifically designed for site and client requirements. Top anchor attachments can be customised as required. The SDR can install Raptor GAP Core anchors from sizes 200mm – 800mm.

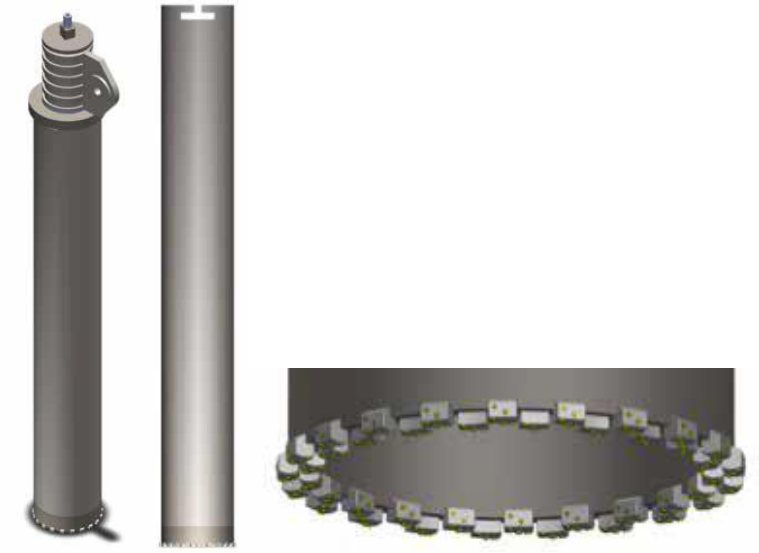

Figure 6. Raptor G.A.P Core Anchor

4.4 Raptor Strataloc Anchor

Raptor Strataloc anchor is a double sleeve anchor that is drilled into the bedrock. Once the anchor is completely drilled, the inner stem stops rotating. The outer stem continues rotating, reaming the upper taper into the rock. The cutting fingers are simultaneously forced over the lower cone, reaming the lower taper into the rock. With this process the cutting fingers are

expanded and secure the anchor. Top anchor attachments can be customised as required. The Strataloc anchor can be removed if required using a customised recovery unit. The SDR can install Raptor Strataloc anchors from sizes 200mm – 800mm.

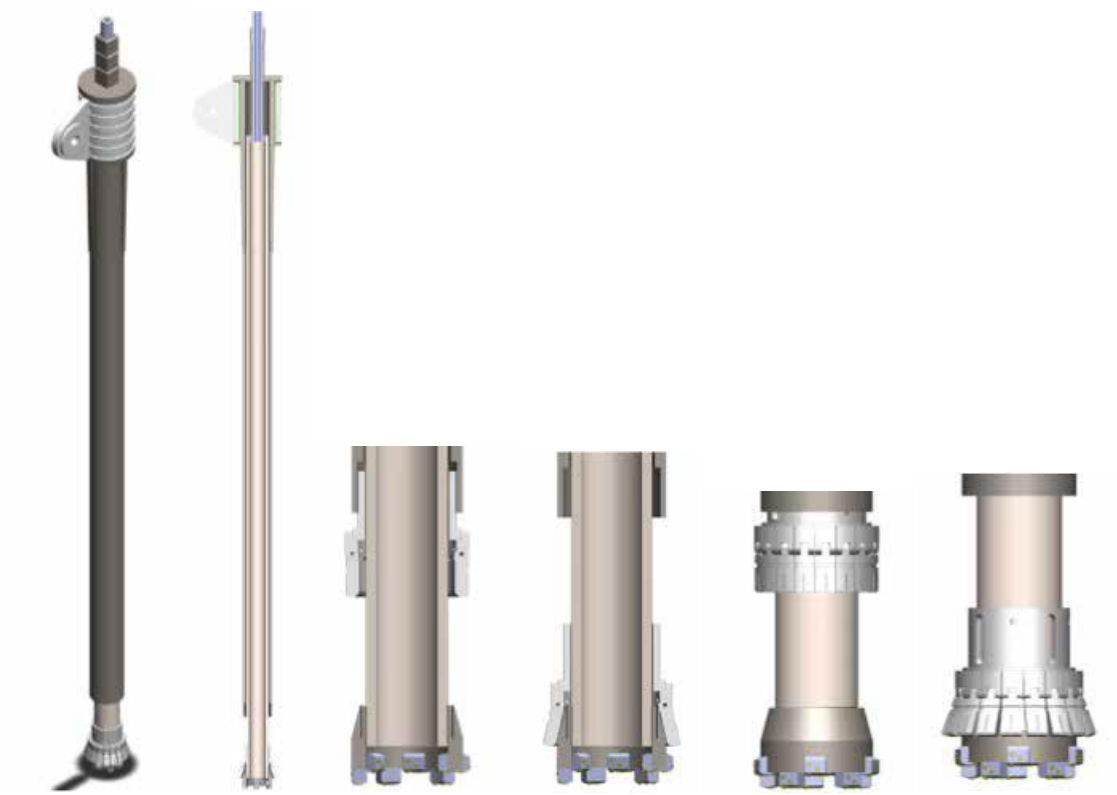

Figure 7. Raptor Strataloc Anchor

5 Acoustic characterisation

In order to capture the noise signature produced during the installation of the anchors, both drifting and static hydrophone surveys will be conducted in close vicinity to SDR. It is proposed to conduct a drifting acoustic survey at varying distances away from SDR deployment location during the operation. The drifting survey will be conducted when the vessels are onsite. If possible, vessels involved in the anchor operation will be requested to switch engines off during the drilling operation in order to gather the signature without being masked by vessel noise.

Further details regarding the acoustic characterisation survey are available from the method statement which is available on request from EMEC.

6 Deposit quantities

The following table summaries the proposed materials to be deposited as part of the works.

Table 2. Proposed list of materials to be used

Components	Type of Deposit*	Nature of Deposit (P = Permanent, T = Temporary)	Deposit Quantity (tonnes, m^3, etc.)	Contingency Allowance
Anchors	Steel	Permanent (removed by Sept 2022)	5 tonne per anchor 40 tonne for all eight anchors	20% contingency 8 tonne across all eight anchors
Submersible drill rig	Steel (with small quantities of other materials)	Temporary (only deposited during installation works)	30 tonne	0% contingency
Vessel moorings	Steel (with small quantities of other materials)	Temporary (only deployed when vessels are mobilised and retrieved prior to demobilisation)	24 tonne per clump mooring 96 tonnes for four moorings	0% contingency

*Types of deposits to consider: Steel/Iron; Timber; Plastic/Synthetic; Composite; GRP; Concrete; Silt; Sand; Stone/Rock/Gravel; Concrete Bags/Mattresses; and, Cable.

It should be noted that it will not be possible to remove two the anchors types completely from the seabed and therefore partial decommission at the end of the project will be necessary. It is expected that a worst-case scenario of 550mm of anchor will protrude from the seabed following the decommissioning process.

7 Vessel spread and traffic

Leask Marine vessels will be used to install, operate and remove the SDR at both the Shapinsay Sound and Fall of Warness test sites. A single multicat vessel is required for the operation. Vessel moorings will be installed the day prior to operations and removed shortly after work has been completed. It is expected that a maximum of 4 days at each site will be required in order to conduct the work. This estimate includes the time required to install and recover the vessel moorings.

One of the multicat vessels, specified in Table 3, Figure 8 and Figure 9, operated by Leask Marine will be utilised for the work.

Table 3. Vessel information

Vessel Name	MV C-Fenna	MV C-Odyssey
Type of vessel	Neptune Eurocarrier 2611	Multiworker Twenty6
Flag state	UK	UK
Port of registration	Kirkwall	Kirkwall
Year built	2013	2011
Vessel International Maritime Organisation Number (IMO)	9675963	9636307
Official number	922340	917987
Call sign	MBAH3	2ETW7
Vessel Owner	Leask Marine	Leask Marine
Operating Company	Leask Marine	Leask Marine
Length	26.48 m	26 m
Beam	11 m	10.5 m

Depth	3.5 m	3.5 m
Draught	2.61 m	2.5 m

Figure 8. MV C-Fenna

Figure 9. MV C-Odyssey

A RIB vessel will be used for the drifting hydrophone surveys which are expected to be conducted for two days at each site. Either the 'SULA' or 'Reggie', operated by Northerly Marine Services, will be used to deploy and retrieve the drifting hydrophones.

Once installed, it is not expected that any maintenance work will be required for the anchors.

Anchor retrieval is expected to utilise a similar vessel spread and require five days at each site. The vessel spread used for the retrieval operation will be confirmed following installation.

8 Deployment location

As described, Leask Marine are proposing to install up to 8 anchors across EMEC's two test sites, Shapinsay Sound and Fall of Warness. At this stage, it is not certain how many anchors

will be installed at each site. Following a review of geophysical and geotechnical data for both sites, two locations have been identified for the anchor install.

Rather than specifying the exact location, in order to allow for micro-siting, a deployment area at each site has been identified. The boundary points for each deployment location are marked for Shapinsay Sound test site in Table 4 and Figure 10 and for the Fall of Warness test site in Table 5 and Figure 11. Following installation, the deployment location will be confirmed with Marine Scotland.

Table 4. Location within Shapinsay Sound test site

Location Description	Latitude and longitude (WGS 84)	UTM (Eastings and Northings)
Point A	58° 59.8535' N, 002° 52.4384' W	507241, 6539787
Point B	58° 59.9316' N, 002° 52.9384' W	506762, 6539931
Point C	59° 00.1632' N, 002° 52.2566' W	507414, 6540362
Point D	59° 00.2407' N, 002° 52.7566' W	506935, 6540505

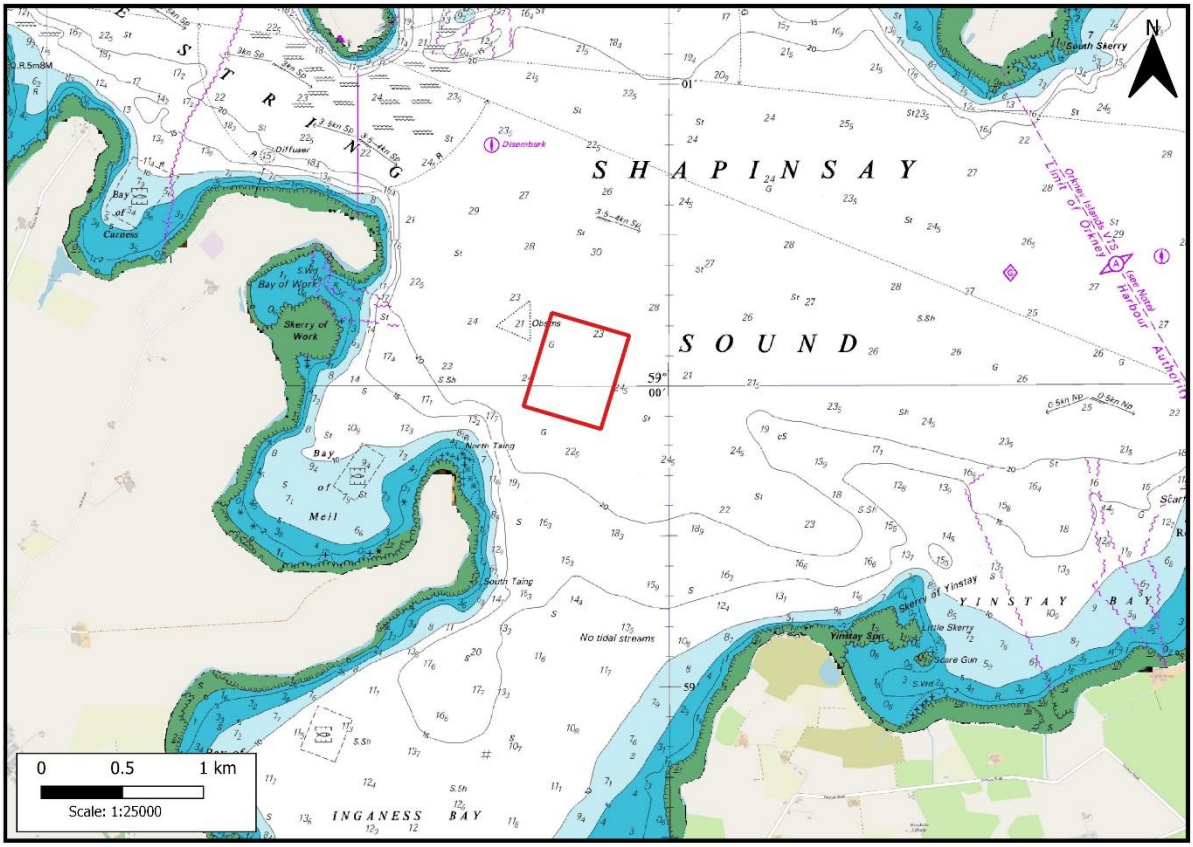

Figure 10. Shapinsay Sound deployment location (within red boundary)

Table 5. Location within Fall of Warness test site

Location Description	Latitude and longitude (WGS 84)	UTM (Eastings and Northings)
Point E	59°09.634'N, 2°48.283'W	511344, 6557941
Point F	59°09.629'N, 2°48.098'W	511330, 6557677
Point G	59°09.487'N, 2°48.113'W	511153, 6557684
Point H	59°09.491'N, 2°48.299'W	511167, 6557949

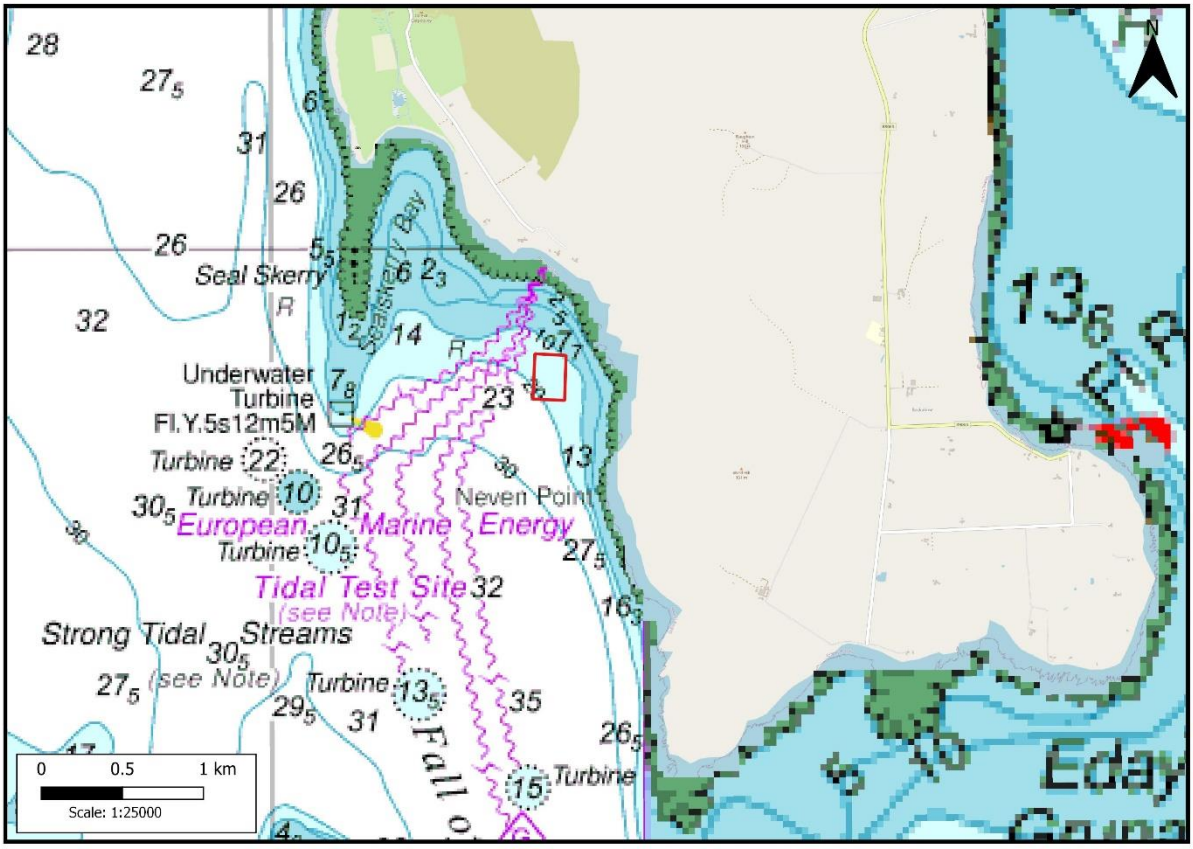

Figure 11. Fall of Warness deployment location (within red boundary)

9 Proposed Schedule

The following figure provides an overview of the proposed schedule for the project. A window of several months has been specified for installing the rock anchors to allow any learning and required changes to the SDR to be implemented between installation at each site. It is planned that the installation period at each site will be a maximum of 4 days including 2 days of drifting acoustic survey. A two-month window has been specified for decommissioning to allow for vessel availability. It is expected that decommissioning will be completed within a period of 5 days at each site. A review of the decommissioning schedule will be completed with Marine Scotland closer to the time of decommissioning.

At this stage, there are no plans to use the anchors between installation and decommissioning.

Table 6. Project schedule Gantt

Project Stage	M1	M2	M3	M4	M5	M6	M7		M1	M2	M3	M4	M5
Installation Planning													
Installation Window													
Installation Contingency													
Deployment								September 2020 – June 2022					
Decommissioning Planning													
Decommissioning window													
Decommissioning contingency													

10 Navigational Risk Assessment (NRA)

10.1 Shapinsay Sound

10.1.1 Vessel routing

Shipment vessels currently transiting nearby the site should be aware of deployments across the site via the Notice to Mariners system.

10.1.2 Contact / allision risk

Few vessels navigate within the sites 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 and periodic updates.

10.1.3 Effects of tide / tidal streams and weather

The rock anchors will have no influence on tidal regimes and will not be at risk from conditions at the site.

10.1.4 Under keel clearance

Due to the nature of the infrastructure there will be enough depth as to not cause concern for vessels transiting the site.

10.1.5 Collision risk and visual navigation

Due to the scale and nature of the assets there is no expected effect on visual navigation and no risk of potential collisions.

10.1.6 Communication, radar and positioning system

Due to the scale and nature of the assets there is no expected risk associated with electronic communication or positioning systems.

10.1.7 Station keeping

Due to the nature of the anchors, the possibility of the assets becoming detached from the seabed are negligible. In addition, as the asset is not buoyant there is a negligible chance that detachment from the seabed will result in collision.

10.1.8 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.

10.1.9 Recreational activity

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

10.1.10 Subsea cables

No cables are associated with the assets and there is no evidence of anchoring or gear snagging at Shapinsay Sound historically.

10.1.11 Search and rescue

Due to the scale and nature of the assets there is no risk of impacting search and rescue efforts.

10.2 Fall of Warness

10.2.1 Vessel routing

The Fall of Warness test site is clear of major shipping routes and vessels currently transiting the site appear to be aware of the deployments across the site.

10.2.2 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 and periodic updates.

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