Tocardo EMEC installation
Project Information Summary

For general information and application for consent

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1.0	First release	13-12-2016
1.1	Significant additional updates	12-1-2017

Contents

1. Company background

Tocardo International B.V. was founded in the Netherlands in 2008 as a commercial spin-off from the engineering company Teamwork Technology B.V. Founder and CEO of the company, Hans van Breugel has a long history in maritime and renewables sectors.

The founding team come from a long background in shipping, ship building and civil engineering. This bedrock of knowledge, experience and methodical approach to technology development has enabled the company to design and develop a turbine technology based on robust marine installation and operational principles. The turbines are simple, efficient and reliable.

Tocardo works with strong partners in project development, engineering, installation and maintenance to deliver turnkey turbine solutions to fit each project perfectly. The range of water turbines generate electricity at the lowest cost per kWh, through minimised maintenance and maximised power generation technology. Tocardo builds on the Netherlands' proud reputation for civil water engineering, with a proven track record of 12 successful years developing renewable hydro-power devices.

1.1 Technology background

Currently Tocardo has 9 turbines operational at four different demonstration sites ranging from 103 kW (single turbine) to 1.2 MW (5 turbines) installed capacity. Tocardo aims at providing low maintenance solutions and reliable technology. Turbines are sized according to the site characteristics regarding water flow conditions. This mainly concerns the blade rotor diameter.
Tocardo currently has three models available:

- T1 Bi-directional free flow turbine. Ranges from 42kW to 98kW
- R1 Uni-directional free flow (river). Ranges from 42kW to 98kW
- T2 Bi-directional free flow turbine. Ranges from 103kW to 372kW

Tocardo installed five T2 tidal turbines (totalling 1.2MW) in the Eastern Scheldt storm surge barrier. This installation is the largest tidal energy project in the Netherlands (www.tocardo.com/projects). The 50-meter-long and 20-meter-wide structure was transported over water. Taking into account the water levels, the tides and the weather and using the sides of the storm surge barrier, the tidal power plant was placed within a window of just two hours and with high precision. Tocardo is also currently working on the final pre-construction stage of a floating-array-project lined up for Canada which are to be installed in 2017-18.

The intended use of the turbine is to generate electrical power from bi-directional tidal flows, while being completely below the water surface. The turbine can be installed single or in an array on different types of foundations, both fixed and floating. The (economic) design life time of the turbines is 20 years.
The turbine is intended to be integrated in a tidal power plant that distributes the generated electrical power to a grid.

Tocardo has been developing an offshore tidal unit, the Universal Foundation Structure (UFS), which it now wishes to bring to the UK for sea trials at the EMEC tidal test facility in the Fall of Warness. However, in order to benefit sufficiently from the site and the connection to the electrical grid at Eday, Tocardo intend to carry out the project in two phases: the first utilizing the Temporary Foundation Structure (TFS) floating foundation which would enable a single T2 turbine to operate at the site and generate power to the grid. The intention is to install this first turbine prior to 31st March 2017. The second phase will transfer the first turbine from

the TFS foundation to Tocardo's UFS foundation which will hold a total of 5 T2 turbines and generate 1.4MW of electrical power.

1.2 Project background

The objective of the project at EMEC is to demonstrate the power generation and reliability of the Tocardo tidal technology in an offshore location along with its ability to operate passively with the surrounding environment with minimal/no impact to the biota. Peak power output at the typical 4 m/s tidal current flows at the site, is 275kW for the TFS unit and 1.4MW for the UFS unit.

In summary, the project will be built out in two phases:

Phase 1 (Duration max. 18 months) – Installation of the TFS Platform and a single 275kW turbine prior to 31st March 2017. This unit will be located at a temporary location within the Fall of Warness which will utilize ScotRenewables Tidal Power Ltd's existing SR250 cable. The Platform will be moored to the seabed using a 4-point mooring system. This unit will be operated and then decommissioned within the 18 month period.

Phase 2 (Duration max. 18.5 years) – Removal of the TFS foundation unit and turbine transferred to the UFS unit along with 4 additional turbines (the TFS unit will then be transported back to the Netherlands, minus the turbine). The UFS, including the 5 turbines, will then be installed at berth 6 at the Fall of Warness where the tidal flows are slightly higher and more suited to the 5 turbine foundation unit. The UFS will be anchored in place using 2 gravity anchors. This unit will remain on station for a further 18.5 years. All equipment will be removed from the site and decommissioned during the 18.5 year period.

Both Phase 1 and Phase 2 will involve the turbines being connected to the local electrical grid at EMEC's Eday substation. Tocardo will be utilizing the existing subsea cables at the Fall of Warness. Both foundation units will be connected to the subsea cables using dynamic umbilical cables.

The total duration for the project in its entirety will be 20 years, therefore the Marine Licence application for which this document is supporting, is for the full 20 years.

2. Project Description

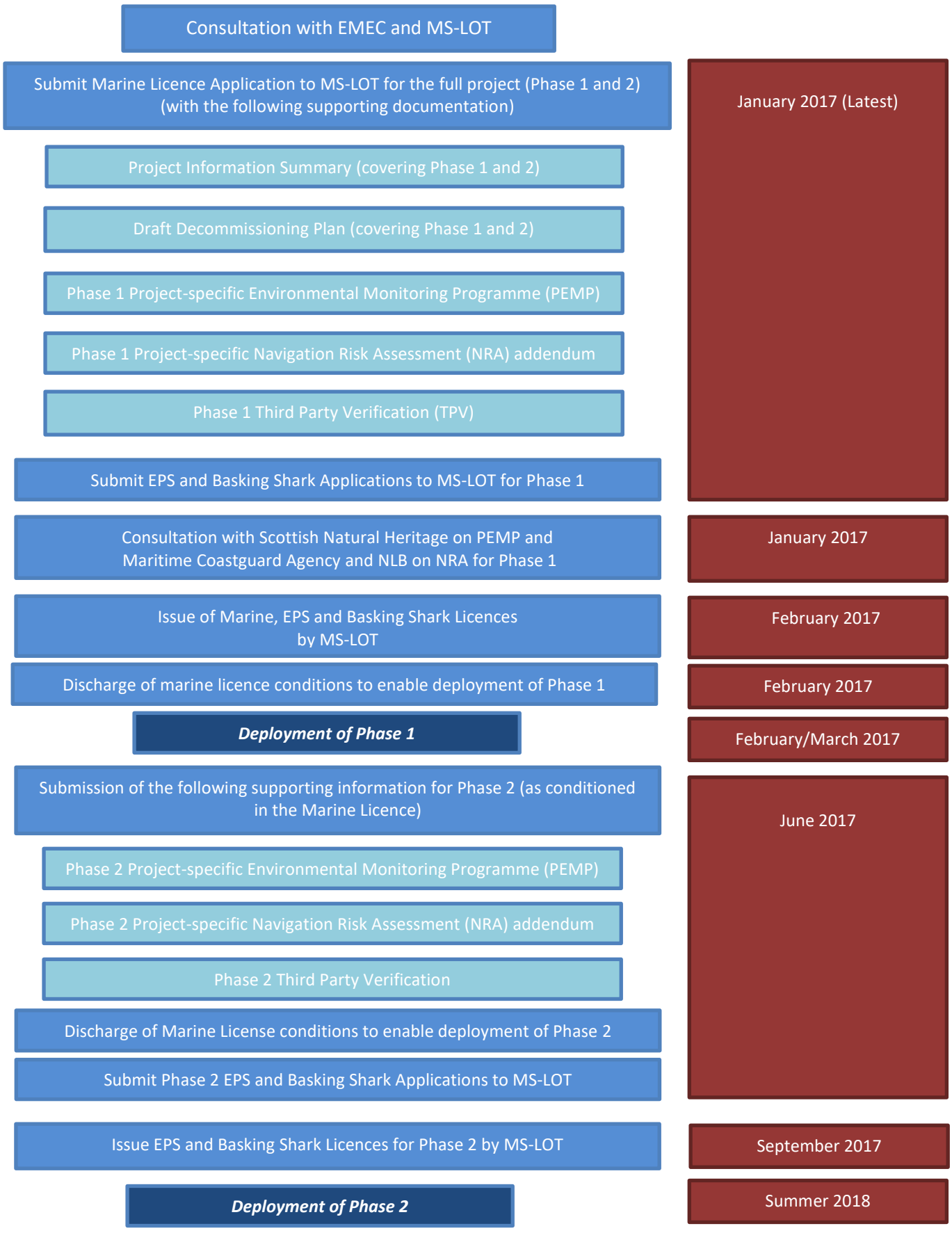
On 23nd of February 2016, Tocardo International B.V. and EMEC Ltd. signed a contract for the deployment and operation of its floating tidal stream technology within the Fall of Warness Tidal Test Site for a total duration of 20 years.

Since signing this agreement Tocardo and EMEC have worked together to develop the plan and scheduling for the intended project. Due to the lack of Contracts for Difference (CfD), set by the Government, to replace the Renewable Obligation Certificates (ROC) scheme, it has been decided that Tocardo will need to undertake their intended project in the 2 phases as outlined in the previous section. **Phase 1** must be installed prior to 31st March 2017 in order to qualify for the ROCs scheme. Without this the project will not be financially viable and Tocardo will lose a significant opportunity to invest in the UK marine renewables market.

As previously stated, Tocardo wish to install the TFS unit for a duration of up to 18 months when it will be removed and then replaced with the UFS which will remain operating at the test site for a further 18.5 years. During this time Tocardo will remotely monitor the units through on-board sensors. A preventative maintenance schedule is being developed at present and will be made available at an appropriate time. It is not envisaged that the units will need to be removed from their berth during the lease period unless the units have encountered significant damage or significant component failure. All electrical/sensor maintenance and repair can be carried out on site without removal of the units.

2.1 Consenting Schedule

Due to Tocardo's requirement to secure consent for the development as a single project (which includes Phase 1 and Phase 2) as well as install and commission Phase 1 prior to the end of the ROC's regime (31st March 2017), Tocardo plan to apply for the full project within the one marine licence application. The intention is to install and commission Phase 1 prior to the end of the ROC's regime (31st March 2017). The proposed consenting schedule, along with supporting documentation, is detailed within the below flow chart. The approach outlined has been discussed with Marine Scotland's Licensing Operations Team (MS-LOT).



Proposed consent submission schedule

2.2 Project Location

The table below illustrates the intended licence boundaries of the proposed tidal project at EMEC's Fall of Warness.

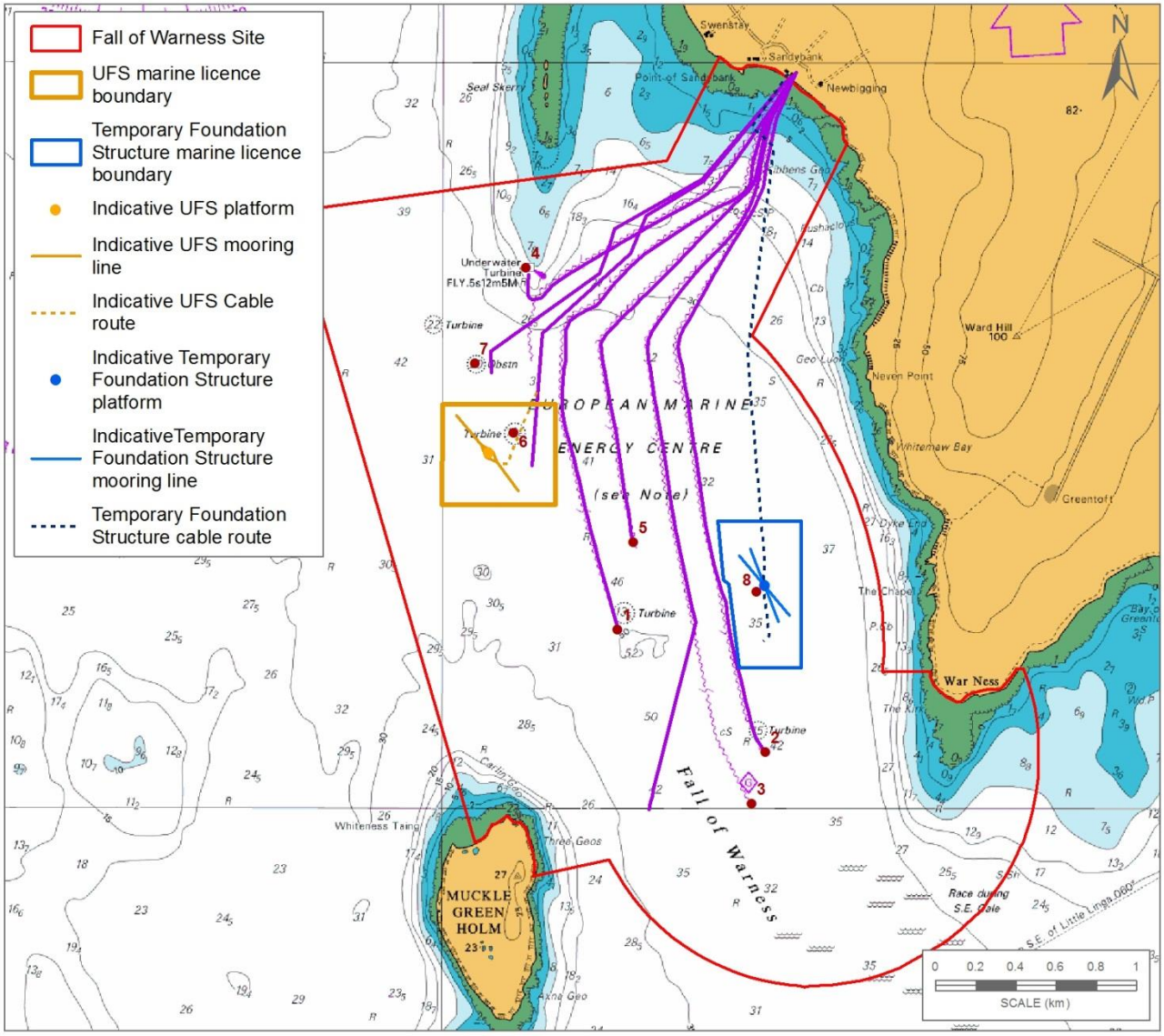
Phase	Latitude	Longitude
Phase 1 (TFS)	59° 8.771'N	2° 48.560'W
	59° 8.771'N	2° 48.125'W
	59° 8.378'N	2° 48.125'W
	59° 8.378'N	2° 48.447'W
	59° 8.600'N	2° 48.503'W
	59° 8.614'N	2° 48.532'W
Phase 2 (UFS)	59° 9.082'N	2° 49.998'W
	59° 9.083'N	2° 49.409'W
	59° 8.813'N	2° 50.000'W
	59° 8.814'N	2° 49.410'W

Coordinates of marine license boundary for Phase 1 and 2

Phase 1: The TFS has a sway circle with diameter of < 30m about the installed location. (The coordinates of the final installed location will be provided to Marine Scotland once deployed).
The mooring spread of the TFS is 190m each side, so 380m in total (end to end). The mooring lines of the TFS run to two gravity anchor points upstream, and two gravity anchor points downstream.

Phase 2: The UFS sway circle is < 50m maximum. The coordinates of the final installed location will be provided to Marine Scotland once deployed).
The mooring spread of the UFS is 250m each side, so 500m in total (end to end). The mooring lines of the UFS run to one gravity anchor point upstream, and one gravity anchor point downstream.

The following image shows the proposed Marine Licence boundary for each phase of the entire project. The anchor locations shown are indicative and the final installed coordinates will be provided via the FEP5, to Marine Scotland following deployment.



Location of berth 6 and Temporary siting station (8), with associated marine licence boundary.

3. Device Descriptions

In this chapter, a high-level overview of the intended tidal power plant installation is given. As previously mentioned, Tocardo wish to install two different floating foundations at the tidal site in a 2 phase project. **Phase 1** will see the TFS unit with a single T2 turbine installed which will be operated and generating power to the grid at Eday for up to 18 months. This unit (including turbine) will then be removed prior to **Phase 2** commencing with the installation of the UFS unit which will include the initial T2 turbine alongside 4 more, giving a total of 5 turbines on the UFS. Although the foundations themselves are different, the turbine technology will be consistent, using the T2 turbine as described below.

3.1 Hardware items

The main hardware device items of the intended installation are:

Phase 1

- TFS moored floating foundation
- 1 x T2 turbine design series on the TFS
- 4 x mooring lines with associated gravity anchors.

- Dynamic and static intra-berth subsea cable. The dynamic subsea cable is connected between the foundation and the subsea connection hub. The dynamic subsea cable will be fitted with protection systems.
- Navigational aids, in line with requirements by the MCA and NLB, will be installed on the TFS platform. This will also include an AIS tracking system.

Phase 2

- UFS moored floating foundation
- 5 x T2 turbine design series
- 2 x mooring lines and 2 gravity anchors.
- Subsea connection hub
- Dynamic and static intra-berth subsea cable. The dynamic subsea cable is connected between the foundation and the subsea connection hub. The dynamic subsea cable will be fitted with protection systems.
- Navigational aids, in line with requirements by the MCA and NLB, will be installed on the UFS platform. This will also include an AIS tracking system.

3.2 Turbine specifications

Tocardo intends to use turbines of their series type T2, rated for speeds from 2.0 m/s to 4.5m/s. During survival mode, the turbine brakes kick in and prevent the rotor from turning. Blade rotor sizing depends on the site flow characteristics and is currently being analysed. Preliminary sizing of the turbine for the EMEC project has resulted in the following specifications:

TECHNICAL SPECIFICATIONS

GENERAL

Technical name:	DD1002HT+ cQP-2.4
Max power output:	280 kW
Rotor diameter:	9.85m (max)
Turbine principle:	Gearless, variable speed, fixed pitch

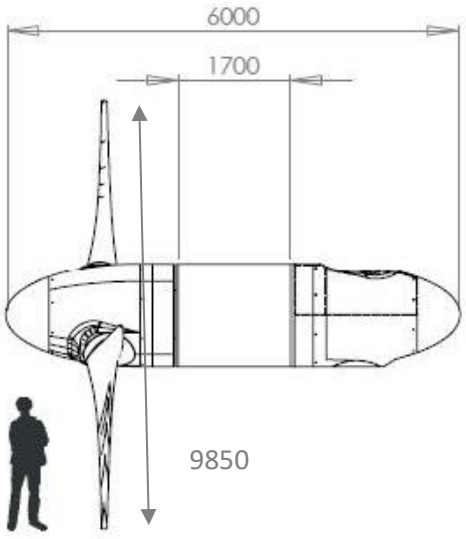
ROTOR

Type:	Bi-directional, fixed pitch
No. of blades:	2
Swept area:	45.8 m^2
Rotational speed:	Variable, 22 – 86.5 rpm
Blade material:	Composite

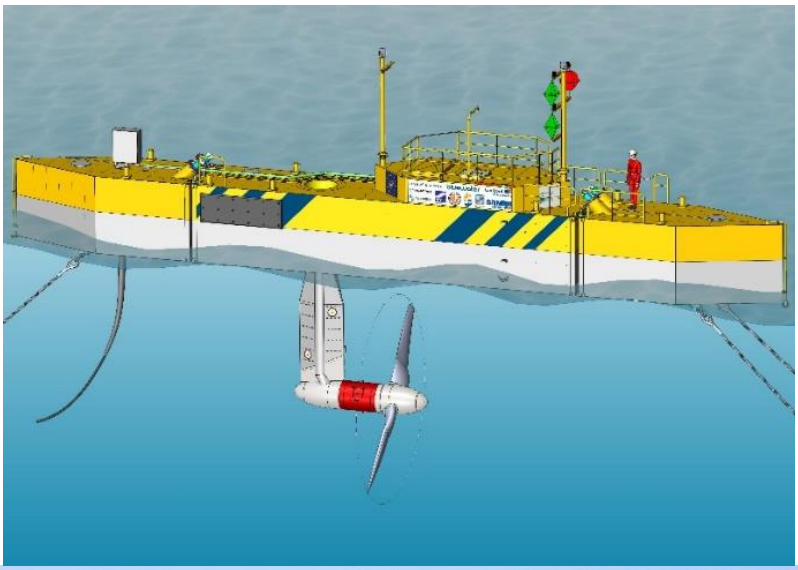
DIMENSIONS

GENERAL

Nacelle diameter (minus rotors):	1.34 m
Length (nose-tail):	6.00 m
Weight (dry):	13.5 tons



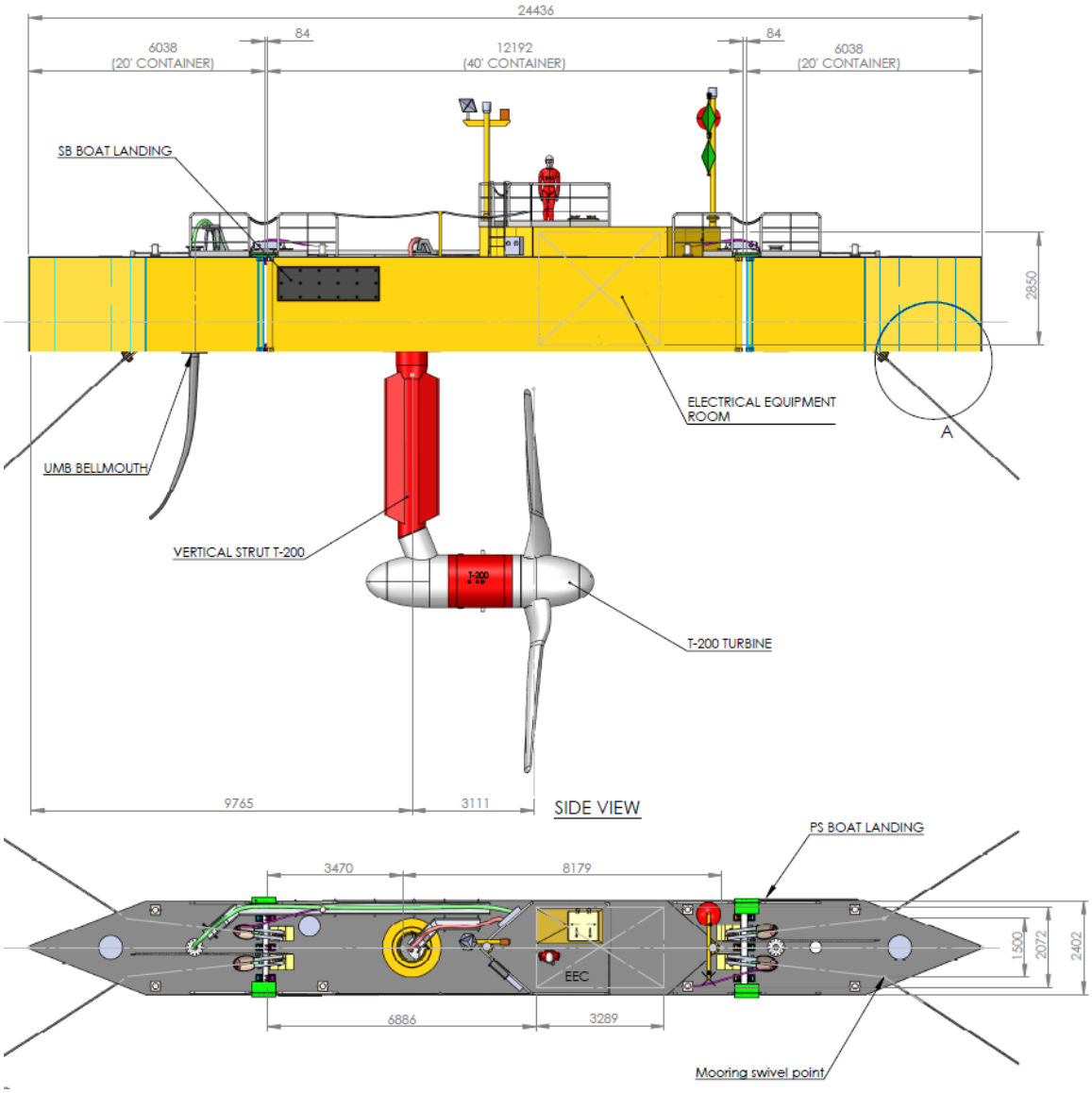
3.2.1 *Phase 1 – TFS Device*

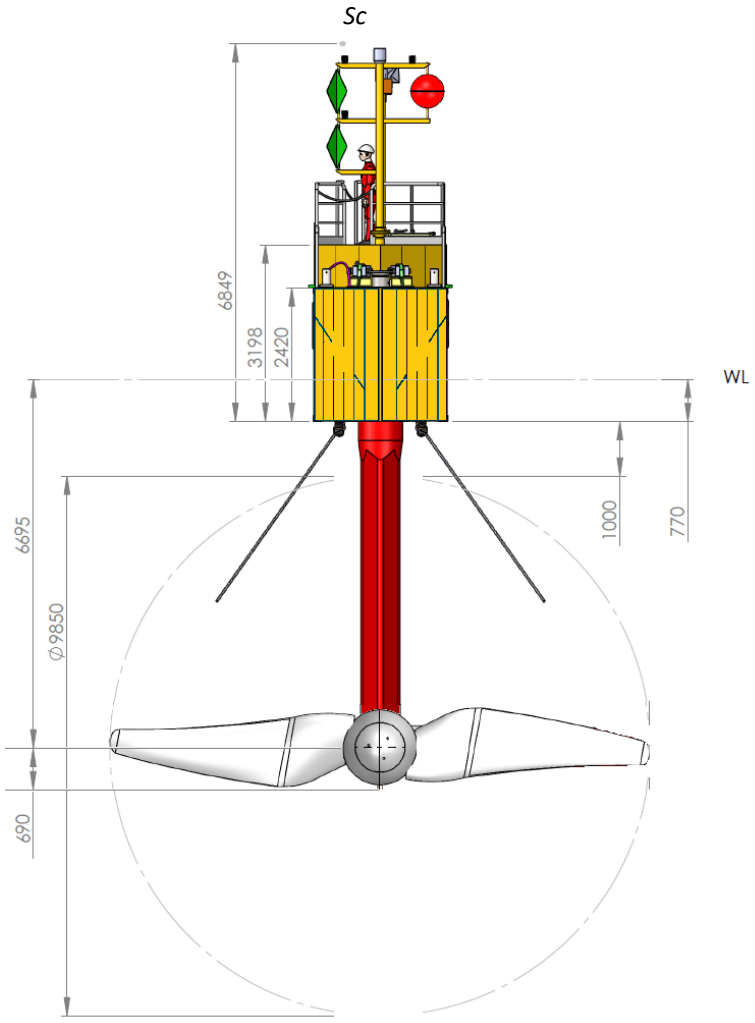


Deployed picture and 3D picture of TFS with T2 turbine as deployed recently in the Netherlands

The Temporary Foundation Structure (TFS) is based on the existing BlueTec device that was installed at Texel, The Netherlands. The deployment will be for a duration of 12 months, with a maximum of 18 months whilst the final foundation system, the UFS, is being constructed. The TFS will incorporate a Tocardo T2 tidal turbine as shown below.

After 12 months the UFS will replace the TFS. The turbine and electrical system of the TFS will be transferred to the UFS unit during Phase 2 of the project. The UFS will be installed at berth 6.


24436
6038
(20' CONTAINER)
84
12192
(40' CONTAINER)
84
6038
(20' CONTAINER)
SB BOAT LANDING
2850
ELECTRICAL EQUIPMENT
ROOM
A
UMB BELLMOUTH
VERTICAL STRUT T-200
T-200 TURBINE
9765
3111
SIDE VIEW
PS BOAT LANDING
3470
8179
1500
2072
2402
EEC
6886
3289
Mooring swivel point



Schematic of TFS unit with Tocardo T2 turbine attached. For illustrative purposes only.

The BlueTec floating foundation has been operating successfully in waters off the shore at Texel in the Netherlands since June 2015. The floating tidal turbine foundation was developed by Bluewater and the demonstration project was realized by a consortium of partners. Tocardo was part of this consortium. Following this project in the Netherlands, Tocardo are now looking to clean and refurbish this device and transport it to EMEC in order to demonstrate its capability in a higher current flow regime as experienced in the Fall of Warness.

The TFS will be held on station using 4 taut mooring lines consisting of nylon rope, steel chain, a steel anchor base frame with further chain loaded on top to form the gravity base clump anchor. Being a surface floating platform, which is directly accessible with a boat, it offers relatively good, easy access to the on-board turbine power system for O&M.

3.3 Phase 2 – Universal Foundation Structure (UFS)

For the second phase of the project Tocardo will install its Universal Foundation Structure (UFS). This unit is designed to support five Tocardo T2 turbines using a semi-submersible structure which is stabilised by its low centre of gravity and the mooring system (see following pictures). The semi-sub is a low-wave motion floating device. Inside the watertight hull, all low-voltage and medium voltage power systems are fitted and accessible for commissioning and maintenance.

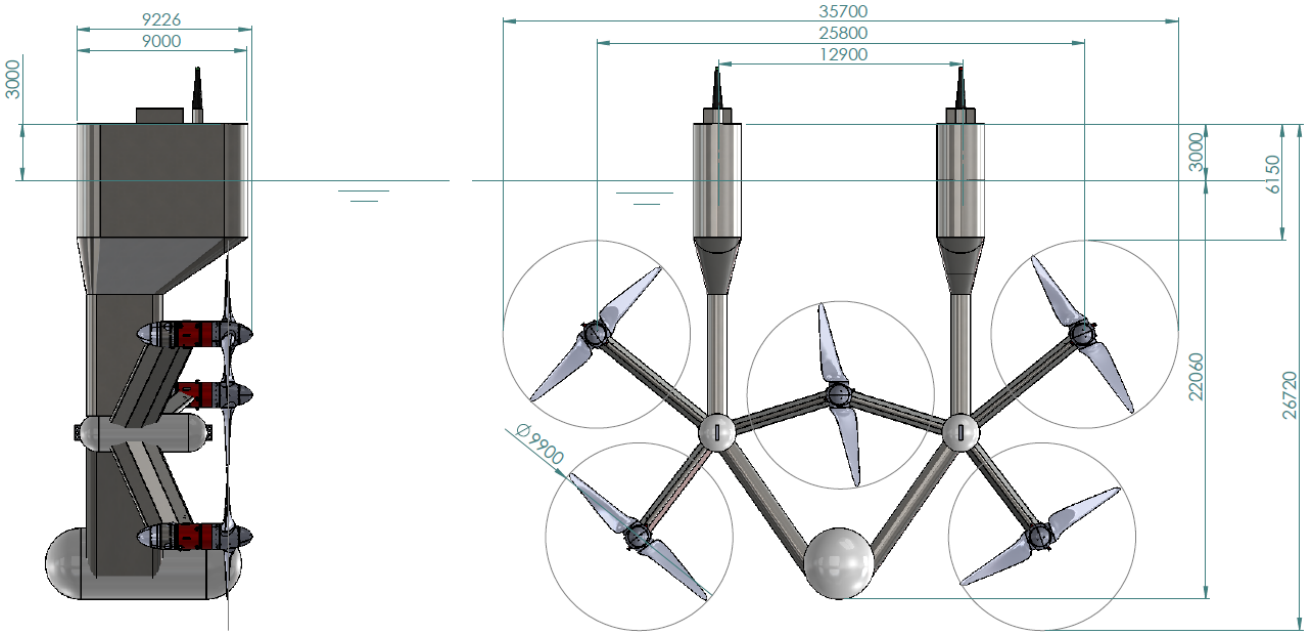
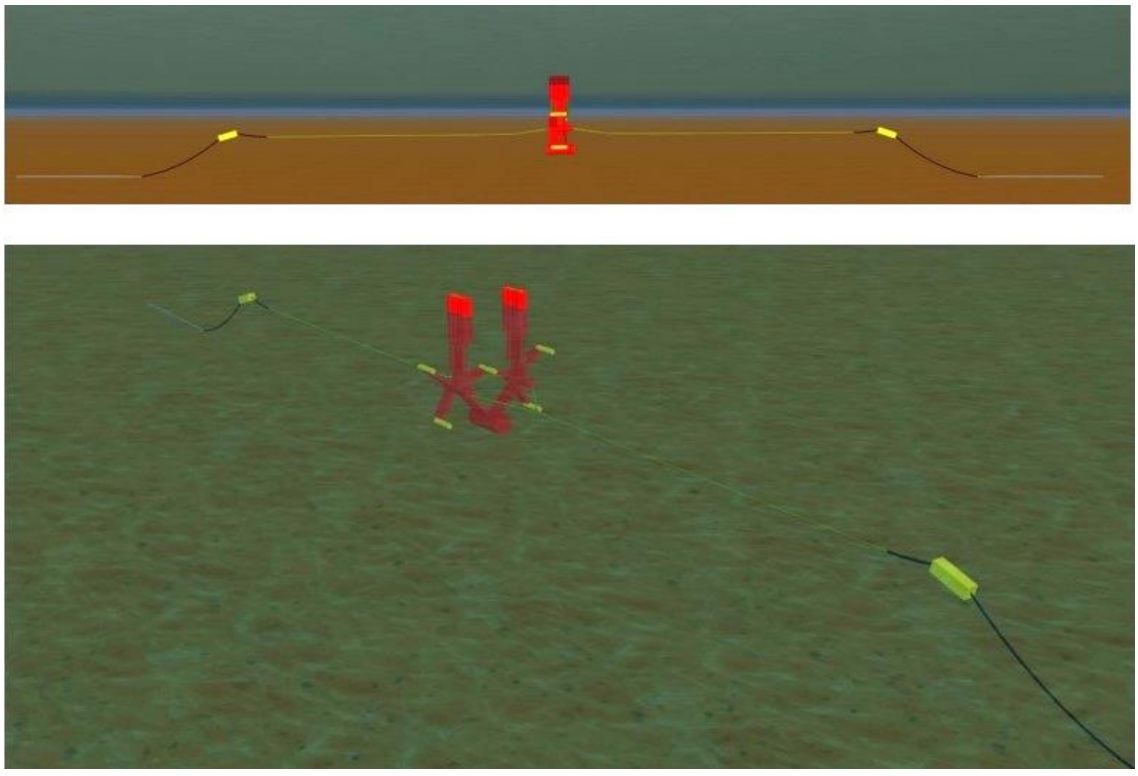


Illustration of UFS with 5 T2 turbines



3D image of UFS unit moored in position

When in normal operation, the U-shaped body is largely submerged. Only the two turrets are visible at the surface of the water.

The design is aimed at safe and easy access using small vessels. Also, deployment and installation of the device is done with small vessels of the multi-cat type. The device can be towed from the deployment harbour to the offshore installation site. At the site the mooring system will be pre-installed and there will only be a quick hook-up operation required of connection mooring lines and subsea cable.

Servicing requirements of the turbines themselves should be very limited during its life time. This will only occur due to unforeseen damage or unforeseen breakdown. All underwater parts are designed for 20 years maintenance free. Most servicing actions are expected to be on the electronics of the power and control systems that are inside the hull of the floating foundation and can be easily accessed using a small vessel.

TECHNICAL SPECIFICATIONS

GENERAL	
Technical name:	UFS5T
Weight operational:	490t
Dry weight:	410t
Number of turbines	5
Total power output	1,4MW
DIMENSIONS	
Depth below water surface:	23,7m
Piercing height above water level:	3m
Width between center verticals	12,9m
Width with turbines	35,7m
length	10m

Still, it is expected that during its 18.5 year operational life time inspection and repairs are required on the turbines. For this Tocardo is developing safe and low-risk marine operations. For some repairs it will be required to remove the platform from its mooring system and tow it back to the harbour. Any required repairs on the turbines may be executed offshore by lifting the turbines above water using special tools. Tilting the UFS can be done at a nearby, more sheltered area. This can be near the pier of Eday or at the Shapinsay test berth of EMEC. No deposits will be made on the seabed during this operation. Details of the operation and location will be worked out in an O&M manual.

3.4 Cables

At both berths, a subsea cable is already present. The cable works in this project will involve connection of cable tails to this existing cable.

Phase 1: The cable of the temporary siting station (Scotrenewables SR250 berth) is capable of transporting the power of one T2 turbine to EMEC's shore station at Eday. After hoisting up the end of the cable, a cable connector will be fitted. On the other side of the connector a tail-cable is connected that will form the 'dynamic' cable between existing cable end on seabed, up to the TFS. The tail cable will have rubber bend restrictors over it that stiffen the cable. The cable is then protected against chafing against parts of the TFS and against bending of the cable.

The tail cable is aligned in the direction of the current to minimize sideways loading. Enough space will be available to install and de-install the cable and/or mooring lines without interference between them.

Phase 2: The cable at berth 6 is the standard installed export cable from EMEC. A recent study indicated that the current status is good. At the end of this cable a connector is attached. A tail cable with protection likely to be similar to that described for the TFS, will be installed from the connector to the UFS. The exact type of protection is currently being investigated by a specialist company. The assumption is that Split Shells from iron will be used.

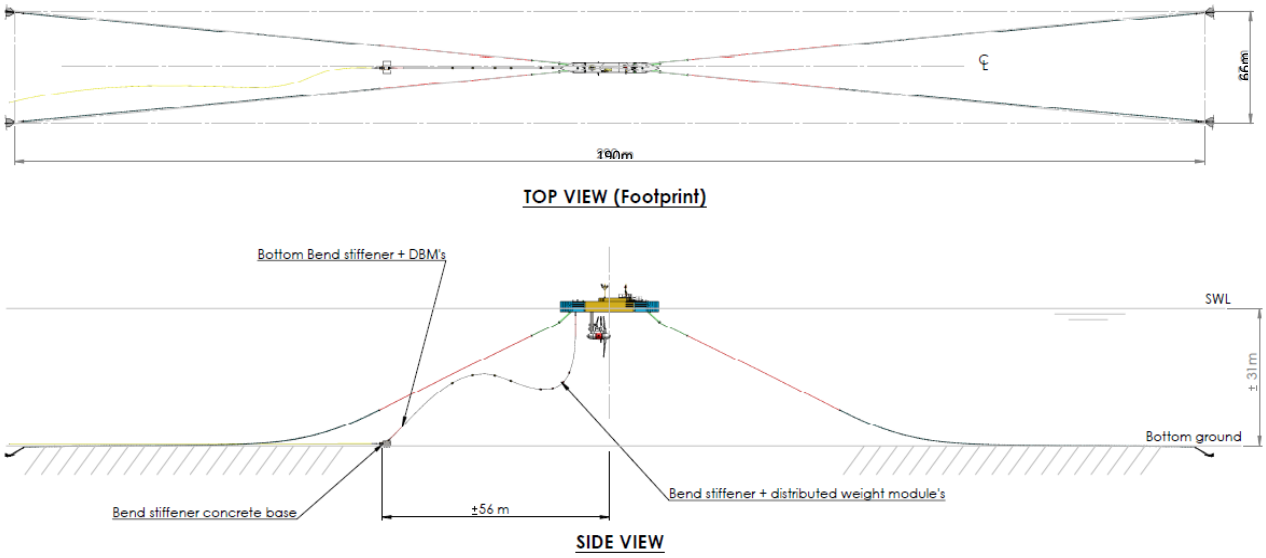
3.5 Mooring Principles

The TFS will be installed at a temporary siting station that will utilise the cable currently owned and maintained by Scotrenewables. Discussions have been held with the company and an agreement has been reached for Tocardo to be able use this cable on a temporary basis for 12 months whilst the UFS unit is being constructed for deployment at EMEC's berth 6. Once the UFS is ready for installation, the TFS will be removed prior to the UFS installation.

3.5.1 Phase 1 TFS Device

Tocardo intend to use a mooring system consisting of four anchor points holding the TFS in line. Depending on the final site positioning at a temporary siting station, all anchor points will be located at a water depth of approximately 37m.

The mooring system will consist of nylon lines that run to ground chain which in turn attach to an anchor. The mooring spread of the TFS is approximately 380m total from end to end. Each mooring line will therefore be around 190m. As drilled anchors are not preferred due to the temporary character of phase 1, gravity (box) anchors are the best available option. The anchor will consist of a stiff welded, open box, max 8m x 8m, containing 73mm link mooring chains up to 100t per box. The area that will be in contact with the seabed will therefore be 256m^2.

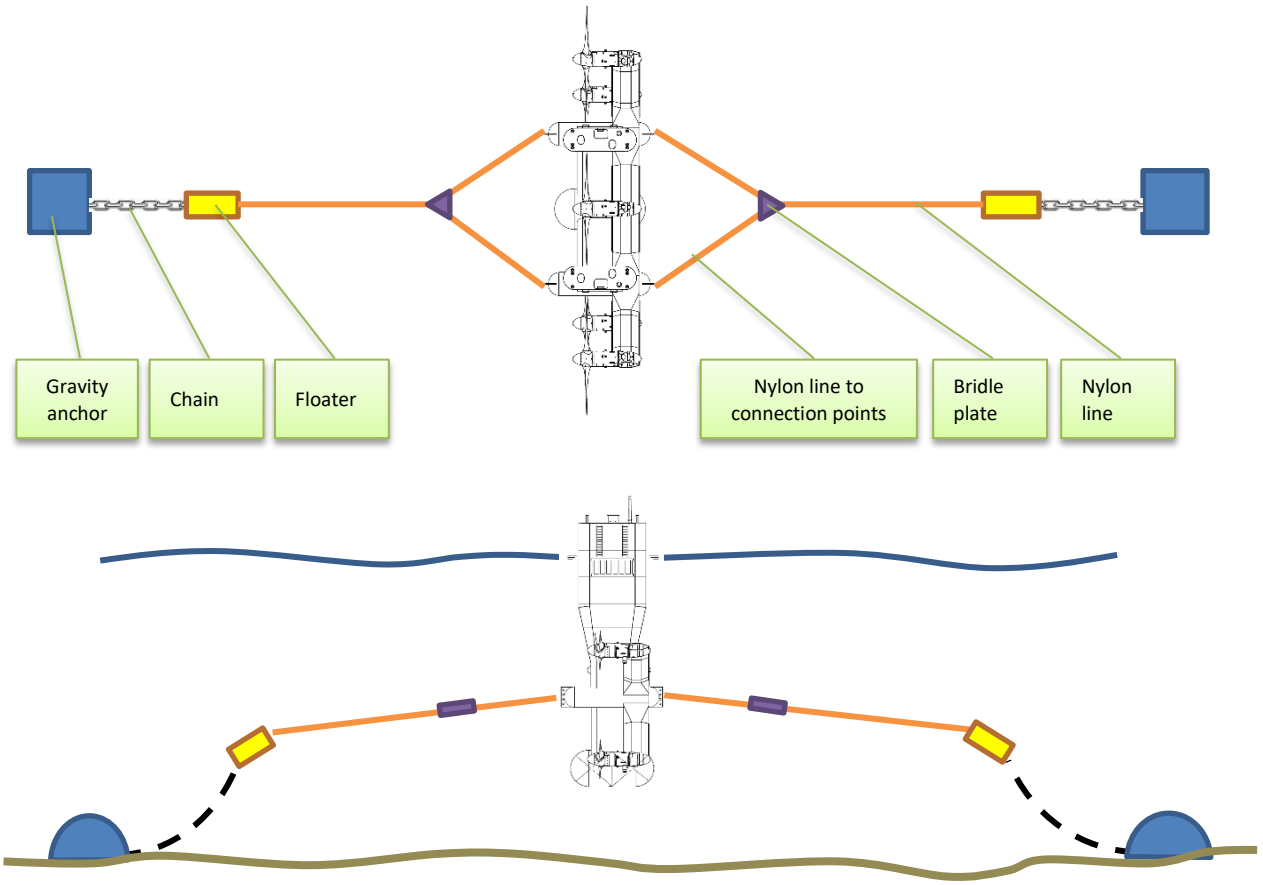


Indicative mooring view of TFS (not to scale). Gravity anchors not shown here but will be used.

3.5.2 Phase 2 UFS Device

For the future phase 2, Tocardo intend to use a mooring system consisting of a similar principle as the TFS (and where feasible using components of the TFS system). It will consist of two anchor points holding the UFS in line. The mooring spread of the UFS is approximately 500m total. The length of the mooring lines will therefore be 250m. The anchor points will be located in water depths at approximately 34m.

Different from the TFS, the mooring lines of the UFS will run to a bridle first, and from the bridle to a floater. From the floater, chains run to the anchor point.



Sketch of UFS unit moored in position

The UFS will be anchored in position using 2 anchor points each consisting of 500t steel chain contained within a steel frame of 12m x 12m. The height is low (up to 2m) as it is only the weight of the chain resting on the steel frame that will create the holding capacity. From the anchor, a chain is connected to a mid-column floater. The floater connects to a nylon mooring line. 40 Meters in front of the UFS, the nylon line ends in a bridle plate and then two mooring lines go to each side of the UFS. This set-up can handle extreme load cases with relative ease due to the elastic nature of the nylon and the mid column floater that keeps the necessary tension in the lines.

The volume of the mooring line floater is: 15t
The distance between UFS and the floater is: 100m
The depth of the mooring line floater is: 15m

The gravity anchor consists of a stiff low profile, open box similar to that utilised for the TFS. In the box, heavy chain is lowered. The chain can be lowered controllably and results in enough weight to keep the anchor in place. The required weight of the clump chain is 500t per anchor.

This set-up is tested for different sea conditions, not only for EMEC, but also for the other known sites. The simulation was run in Orcaflex®. A recent model tank test confirmed the model and the ability to handle the extreme load cases.

3.6 Materials used

Below are two tables containing the lists of materials used for installation of the devices.

Table A – TFS Device

All below mentioned materials are calculated with the current status of the design.

Type of Deposit	Nature of Deposit (P = Permanent for 12 months, T = Temporary)	Deposit Quantity (tonnes, m^3, etc.) Maximum quantities stated
Steel/Iron	P	35t chains (4x 70m)
	P	400t (4 x 100t) chain as clump weight anchors including box.
	P	55t steel structure (TFS)
	T	2t Installation vessel anchor (drag)
	P	1t cable connector
Plastic/Synthetic	P	10t Nylon mooring lines (4 x 40m)
	T	1t Mooring lines installation vessel
Cable	P	100m tail cable. The existing cable is already installed.
Turbine	P	1 x 16t

No other types of deposits (composites, plastics, timber, stone, gravel, sand, silt, rock, other metals than steel) are foreseen.

Table B – UFS Device

All below mentioned materials are calculated with the current status of the design.

Type of Deposit	Nature of Deposit (P = Permanent for 18.5 years, T = Temporary)	Deposit Quantity (tonnes, m^3, etc) Maximum quantities stated
Steel/Iron	P	1300 t chains for anchors including box anchors
	P	450t chain between box anchor and floater
	P	2 x 60t mid-column floater
	P	390t steel UFS
	T	2t Installation vessel anchor (drag)
	P	5t cable connector as per spec EMEC
Plastic/Synthetic	P	20t Nylon mooring lines (2 x 100m + 4 x 40m = 360m)
	T	1t Mooring lines installation vessel
Cable	P	600m tail cable
Turbines	P	16t per turbine, 80t total
Titanium/Aluminium	P	Active sonar. 32cm x 15cm (Dimension) 12kg (Weight)
stainless steel and plastic with lead weights, or concrete	P	Gravity mounts for ADCP sonar equipment above

No other types of deposits (composites, plastics, timber, stone, gravel, sand, silt, rock, other metals than steel) are foreseen.

No materials installed as part of Tocardo's proposed project will be left on the seabed at the berths following decommissioning of the project.

3.7 Mounting scientific equipment

Further details of monitoring equipment are found within the Phase 1 Project-specific Environmental Monitoring Programme (PEMP) issued with the Marine Licence application.

It is planned to install and operate one or two Acoustic Doppler Current Profilers (ADCPs) similar to that shown in Figure 2.5 of the Project-specific Environmental Monitoring Programme (PEMP) if required for Phase 2. The ADCPs will be installed on the TFS device and mounted in a horizontal position. This allows Tocardo to examine the effects on water currents up and downstream of the device. No seabed mounting is required for the TFS.

For Phase 2 deployment, it is planned that scientific equipment (including ADCPs) will be deployed on stand-alone gravity mounts located on the seafloor 30 - 45m in front of and behind the UFS device. The PEMP for Phase 2 will be developed in consultation with Marine Scotland and Scottish Natural Heritage (SNH) and submitted at least 3 months prior to construction.

4. Installation method

Both the TFS and UFS are floating devices which makes installation relatively simple and can be undertaken using smaller workboat type vessels such as multi-cats and tugs.

Installation of both devices respectively, at the EMEC site will be undertaken in key stages beginning with the installation of the anchors. An installation plan is currently being developed in cooperation with EMEC and Leask Marine such that it will fit within the consent envelope and within the agreed dates. Further detail can be seen in the project Construction Method Statement which will be submitted with the Marine Licence Application.

4.1 Phase 1:

Hatston Pier is the preferred location for assembling and launch of the TFS unit due to the water depth at the pier and proximity in relation to the actual site at the Fall of Warness. Assembly and launch of the TFS at the pier will likely take a week or two after which it will be towed into position at EMEC's test site, in the selected deployment location.
The following activities are proposed:

- Construction and installation
    - Installation of vessel moorings (expected duration 2 days)
    - Installation of anchor frames, chain and attach moorings to anchors; (expected duration 4 days)
    - Connection of TFS to moorings; (expected duration 0.5 day)
    - Connection of tail cable to Scotrenewables subsea cable; (expected duration 0.5 day)
    - Commissioning; (expected duration 2 days)
- Operation and maintenance (see Navigational Risk Assessment document and Project Environmental Monitoring Programme for further detail)
- Removal of TFS platform, umbilical cable, moorings and anchors; (expected duration 3 days)

4.2 Phase 2:

The UFS will be pre-fabricated, most likely in mainland Scotland (Nigg Yard) and will be transported fully assembled minus 1 turbine to Orkney. The UFS will be moored alongside Hatston Pier for assembly of the turbine and until safe installation can be undertaken.

- Construction and installation
    - Installation of vessel moorings. This may require the use of either a multicat workboat or an Anchor Handling Vessel (AHV) (expected duration 2 days)
    - Installation of anchor frames, chain and attach moorings to anchors; (expected duration 3 days)
    - Connection of UFS to moorings; (expected duration 1 day)
    - Connection of umbilical cable to EMEC's subsea cable; (expected duration 1 day)
    - Commissioning (expected duration 5 days)
- Operation and maintenance (Onboard inspection: once per 2 years, component replacement: once 10 year)
- Decommissioning of UFS device and equipment; (expected duration 3 days)

Tocardo aims to use minimal vessels and vessel movements.

4.3 Anticipated Vessel traffic to site

Installation of each device will take several days (further detail on this can be found in the accompanying Construction Method Statement (CMS) submitted with the Marine licence application). Actions are planned such, that a minimum of vessels (movements) is needed. Despite the difference in size, both devices are deployed with the same method and the same fleet. It is expected that all installation phase durations are

very equal. The UFS has more weight per anchor to install, but only requires 2 anchors. Connection subsea connectors and TFS or UFS require the same handling procedures.

It is likely that the loadout of the devices and their respective moorings will take place from Hatston Pier, Kirkwall (Orkney) which is already well established as a loadout and O&M base for other tidal energy developers who have used the Fall of Warness test site. A transit route map for the vessel's route options will be submitted with the Project Environmental Monitoring Programme (PEMP). The optimal route to the test site, which is also currently used by other developers, passes to the south of Shapinsay.

Currently, the multicats of Leask Marine are incorporated in the installation plan. These are the MV C-Odyssey and the MV C-Chariot. Please see Appendix A for specifications. However, depending on the final weight of the Phase 2 UFS anchors, an Anchoring Handling Vessel (AHV) may be required to install these anchors. This will be confirmed within the next 6 months but for the purpose of this licence application, Tocardo wish to include the AHV as a potential vessel to be used.

4.4 Device Monitoring Control and Maintenance System

The complete TFS (and subsequent UFS) system with its sub-systems and their performances, are monitored online from Tocardo headquarters in Den Oever, The Netherlands. By analyzing the data, the performance of the systems is checked and in case of failure, these are identified. Changes in control strategies can be uploaded by Tocardo remotely. The EMEC control station at Eday will also be used to monitor the status and the performance of both the TFS during Phase 1 and then the UFS system in its entirety during Phase 2.

The mooring lines for both units are designed for a single failure event, but in case of failure of a mooring line, an automatic alarm will be triggered enabling that appropriate emergency response to be actioned. The Emergency Response Plan (ERP) for Phase 1 has been developed and is submitted with the Marine Licence application. This Plan will be thoroughly communicated with EMEC, relevant stakeholders and involved third parties prior to deployment and installation. The ERP for Phase 2 is in draft and will be submitted prior to the commencement of Phase 2.

Onsite maintenance for Phase 1 and the subsequent Phase 2, can be undertaken from a small workboat capable of enabling at least 2 personnel to be transferred to the unit for onboard inspection. During the maintenance visits, the systems will be visually checked for any inconsistencies. Re-calibration actions and check-up measurements will guarantee the performance of the system and its monitoring devices.

4.5 Decommissioning Method

Tocardo will provide a decommissioning plan set-up with a marine operations specialist. Tocardo will comply with site regulations and requirements regarding removal of the device and equipment on the seabed. For decommissioning of the system, the followings items can be considered:

1. The tail cable on TFS is disconnected
2. The subsea connector and tail cable are hoisted up.
3. The connector and cables are disconnected from the export cable
4. The export cable is properly capped and lowered down. The location of the end-cap is reported.
5. The TFS is disconnected from its mooring lines and tugged to a harbor for dismantling.
6. The mooring lines are disconnected from their anchor points and removed from site.
7. Removal of gravity anchors, and installed at berth 6.

A draft decommissioning plan will be submitted to BEIS prior to construction of Phase 1 of this project.

4.6 Environmental and Navigational Risk Considerations

EMEC has developed Navigational Risk Assessment and Environmental Appraisal for the Fall of Warness test site and together with their project team, Tocardo has developed Phase 1 and Phase 2 project specific annexes to these assessments. Key factors that Tocardo are aware of are proximity to the local ferry routes, fishing vessels operating in the area and other developers undertaking operations at the test site.
Lessons are learned from the navigational risk assessment of ScotRenewables who installed their floating SR250 device (same size as TFS), at the same location as the TFS.

4.6.1 Environmental Risks

A Project-specific Environmental Monitoring Programme (PEMP) for Phase 1, has been developed by Aquatera Ltd and will be submitted with the Marine Licence application. A separate PEMP will be prepared for Phase 2 in consultation with Marine Scotland and SNH. This document will be submitted and agreed with MS-LOT and SNH at least 3 months prior to installation of the Phase 2 UFS unit.

4.6.2 Navigational Risks

Tocardo is providing an addendum to EMEC's existing Navigational Risk Assessment for the Fall of Warness site. The Phase 1 project specific NRA will be submitted along with the Marine Licence application and will follow the EMEC guidance code. The Phase 2 NRA is being drafted and will be submitted prior to commencement of Phase 2.

Both Phase 1 TFS unit and the Phase 2 UFS unit are floating, moored structures. Risks associated with loss of station, under keel clearance and collision will be fully considered in the NRA addendums.

4.7 Project timeline milestones

Table of (proposed) milestones:

Contractual date [ref]	Project date (information)		
X		Effective date *	23 February 2016
[3.7]	PHASE 1	Mobilisation date *	1 February 2017
[4.1.4]		Installation date **	28th February 2017
[4.1.5]		Cable Connection date **	10 March 2017
	X	First floating system producing	31 March 2017
	PHASE 2	Decommissioning of TFS followed by installation of UFS	Summer 2018 Allow 3 months for works to be completed (includes weather windows etc.)
[4.1.6]		Disconnection date **	1 April 2037
[4.1.7]		Decommissioning start date**	1 April 2037
[4.1.7]		Decommissioning end date**	31 May 2037
[4.1.8]		Demobilization date (= Mobilization date + 20 years) *	1 February 2037

* Fixed
** Proposal

APPENDIX A

LEASK MARINE

MV C-Odyssey

Specifications

General

Type of vessel	Multiworker Twenty6
Year built	2011
Category	MCA Cat 1 Up to 150 miles (from safe haven)
Passengers	12 plus crew
Flag state	UK
Port of registry	Kirkwall
MMSI No.	235088132
IMO No.	9636307
Call Sign	2ETW7
Official Number	917987

Dimensions

Length	26m
Beam	10.5m
Depth	3.5m
Draught	2.5m
Air draught – mast up	13.8m
Air draught – mast down	8.2m
Gross tonnage	150t
Free Deck Space	120m²

Deck Equipment

Towing winch		60 t
Anchor handling		60 t
(Combined lift)		120 t
Tugger winch	3 x	15 t
Towing hook	SWL	25 t
Capstan		5 t
Bow roller	3m SWL	120 t
Aft roller	3m SWL	60 t
Deck carrying capacity		100 t
Deck crane	Hs 185t/m 5530kg @	18.5m
Deck crane (aft)	Hs 60t/m 4630kg @	10m

Hydraulics towing pins/stopper

Pins	
SWL	50 t
Design load	105 t
Hub	400 mm
Stopper	
SWL	75 t
Design load	150 t
Hub	400 mm

Tank Capabilities

Fuel/oil	100m³
Black/grey water	9m³
Fresh water	45m³
Dirty oil	0.9m³
Ballast water	88m³

Accommodation

Cabins	2 off twin berth 2 off single berth
Large mess room	
Galley and laundry	

Generators

1 off 75 KVA
1 off 35 KVA
K.W. 1790

Propulsion System

Main engines	2 x caterpillar C32
Total power	2,400bhp at 1,800 rpm
Propulsion	2x fixed pitch propellers Nozzles 1,500mm

Performance

Bollard pull	27 t
Speed	10 knots

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LEASK MARINE

MV C-Chariot

Specifications

General

Type of vessel	Multi Work Boat
Year built	2014
Category	MCA Cat 1 Up to 150miles (from safe haven)
Passengers	12 plus crew
Flag state	UK
Port of registry	Kirkwall
Classification	B.V.
IMO	9756783
Call Sign	2UH2

Dimensions

Length	23.83m
Beam	9.60m
Depth	3.2m
Draught Min	1.8m
Draught Max	2.25m
Free Deck Space	130m²
Maximum Deck load	10t/m²
Gross tonnage	143t

Tank Capabilities

Fuel Oil Cargo	91m³
Fuel Oil Own Use	13.40m³
Fresh Water Cargo	56.40m³
Fresh Water Own	17.10m³
Black/grey water	13.50m³
Fresh water	56.40m³
Lub Oil	2m³
Hydraulic Oil	2.20m³
Dirty oil	1.90m³

Propulsion System

Main engines	2 x YANMAR 6AYM-WET. TIER II
Total Output	1658bhp
Gearboxes	Reintjes WAF 364L, i: 92:1
Propulsion	2off 3" Ø 1630mm

THRUSTERS

Bow thruster	2x65Kw Ø 500mm
Aft thruster	2x65Kw Ø 650mm

Nautical Equipment

1 x Radar FURUNO FR-8122 + ARPA
1 x Radar FURUNO FR-8062 + ARPA
1 x VHF dsc Class A SAILOR mod. 6222
1 x VHF brand SAILOR model 6248
1 x Fleet Broadband SAILOR model FB150
1 x Navigation Sounder FURUNO FCV 587
1 x Receiver GPS FURUNO DGPS-150, DIFF, IMO
1 x AIS Class FURUNO FA-150
1 x Auto-Pilot SIMRAD AP80
1 x Receiver Navtex FURUNO NX-700 B
1 x Video Plotter FURUNO Mod GD-1920 C BB
1 x Satellite Compass FURUNO SC-50
1 x Beacon Board JOTRON model TRON 60S + FB-60
1 x Transponder radar JOTRON TRON SART20
1 x Ultrasonic weather-station FURUNO WX-100
1 x Organising Data FURUNO RD-33
1 x GNAVAS FURUNO BR-500
Phones BLU-MF/HF SAILOR 6310
GMDSS dsc Class 1 15W
Radiotelephones portable VHF GMDSS ENTEL HT-849

Deck Equipment

Towing winch
600m x Ø 38mm, 35t pull
65te pull Anchor handling winch

Tugger winches	3no.	16te pull
Towing Hook Fore	SWL	15 t
Towing Hook Aft	SWL	30 t
Guide Pins Fore 2 x Hydraulic	SWL	75 t
Guide Pins Aft 2 x Hydraulic	SWL	75 t
Bow roller	425Øx1200mm	
Stern roller	150Øx700mm	
Deck carrying capacity		130 t
Deck Crane Fore HEILA HLRM 120-4S	7 ton @14.32m	
Deck Crane AFT HEILA HLRM 90-6S	4 ton @16.53m	
Moon pool		Ø 900mm

Accommodation

Cabins: 3 off twin berth cabins
Galley, Lounge, Dining Room, Heating, Air conditioning

Auxiliary Systems

Generator Sets	2x99Kw John Deere
Hydraulic Power	John Deere 6135AFM75/278Kw / 1500r.p.m.
Transfer Pumps	Fuel Transfer 35m³/h, Fresh Water 35m³/h

Performance

Bollard pull	23.8 t
Speed	11 knots

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