Construction and installation plan for the NSF#1 project

A	First Issue	14 Jul “23	Issued for permit application	
B	Second issue	13 Jan “24	Updated for HKZ location	
Revision	Description	Date	Status	Client Approval

Table of contents

Table of contents 2
Abbreviations and definitions 3
1 Introduction 4
1.1 Purpose and scope Of The North Sea Farm#1 Project 4
1.2 Scope of this document 4
1.3 Organisation 6
2 Equipment 7
2.1 Installation vessel 7
2.2 Vibratory hammer 8
2.3 Remote Operated Vehicle (ROV) 8
3 Workability 10
4 Installation plan seaweed cultivation systems 11
4.1 Onshore preparation harbour 11
4.2 Load-out items 11
4.3 Load-out operations 12
5 Vessel Mobilization 13
5.1 Vessel set up 13
5.2 Trial run in port 13
5.3 Pile installation 13
5.4 Seaweed cultivation system installation 15
5.5 Deployment of seeded nets 16
6 Contingencies 17
6.1 VLT breakdown 17
6.2 Crane breakdown 17
6.3 Spillage 17
6.4 Vessel breakdown 17
7 Demobilization 18
7.1 Load in equipment 18
7.2 VLT disassembly 18
7.3 Daily report 18
8 Health, safety, and environment 19
9 Attachments 20
Attachment1: Risk register for construction and installation works 20
Attachment2: Layout & coordinates 21

Abbreviations and definitions

DOG	Doggerland Offshore
HSE	Health, Safety and Environment
HSSMP	Health, Safety, Security Management Plan
ITP	Inspection and Test Plan
ITR	Inspection and Test Record
JSA	Job Safety Analysis
LMRA	Last Minute Risk Assessment
MS	Method Statement
MCC	Marine Coordination Center of the wind farm Hollandse Kust Zuid
NSF	North Sea Farmers
PPE	Personal Protective Equipment
PQP	Project Quality Plan
PRADA	Project Risk Assessment Database
PTW	Permit to Work
QA/QC	Quality Assurance / Quality Control
RA	Risk Assessment
RAT	Risk Assessment Tool
SBG	Simply Blue Group
SOC	Safety Observation Card
SWP	Safe Work Practice
VOMS	Van Oord Management System
RWS	Rijkswaterstaat
RVO	Raad van Ondernemend Nederland
VLT	Vibratory Lifting Tool
NSF	North Sea Farmers
NSF#1	The North Sea Farm 1 project

1 Introduction

This chapter provides a general project description and the scope of work covered under this method statement including the requirements.

1.1 Purpose and scope Of The North Sea Farm#1 Project

The purpose of the North Sea Farm#1 project is to boost the scale-up of the European seaweed sector and become a visible stakeholder in discussions about the future of the Dutch North Sea. The project aims to demonstrate the technical feasibility of seaweed farming between offshore wind turbines, showcasing safe and robust growing systems with high yields. The goal is to reduce offshore visits by developing sensors that allow remote monitoring of the farm. The project also aims to organize the young seaweed sector by showcasing various companies involved in the supply chain, from seedling providers to processing and distribution companies. Furthermore, the project seeks to confirm genuine interest from European markets in seaweed products by demonstrating the use of locally and sustainably cultivated seaweed in various applications, such as food ingredients, cosmetics, and agriculture. The availability of tangible samples can facilitate conversations and attract investment in the sector.

The goal of NSF#1 is ultimately to manage a large-scale seaweed farm within the Hollandse Kust Zuid wind farm. The first step in this process, and therefore also for this permit application, is:

- Developing and implementing the first multi-use seaweed farm in Europe within an offshore wind farm.
- 1 seaweed cultivation module.
- Type of seaweed: Saccharina Latissima.
- Expected harvest: 6 tons of wet weight seaweed (net weight).
- With a duration of one year:
    - Installation from May to October 2024.
    - Seeding in September-October 2024.
    - Harvest in May-June 2025.
    - Decommissioning in June-July 2025.
- Using the experience gained from this first step to optimize the processes towards the next step of scaling up.

1.2 Scope of this document

This document details the installation of the 1 seaweed cultivation system, including their seeding as listed above. In Figure 1 the layout of one seaweed module is depicted. In general, the eco-anchors will be installed first. Directly after, headrope with connected pipe floaters will be connected between anchors (4 pipes per set of anchors). Then the seeded nets will be attached to the head ropes.

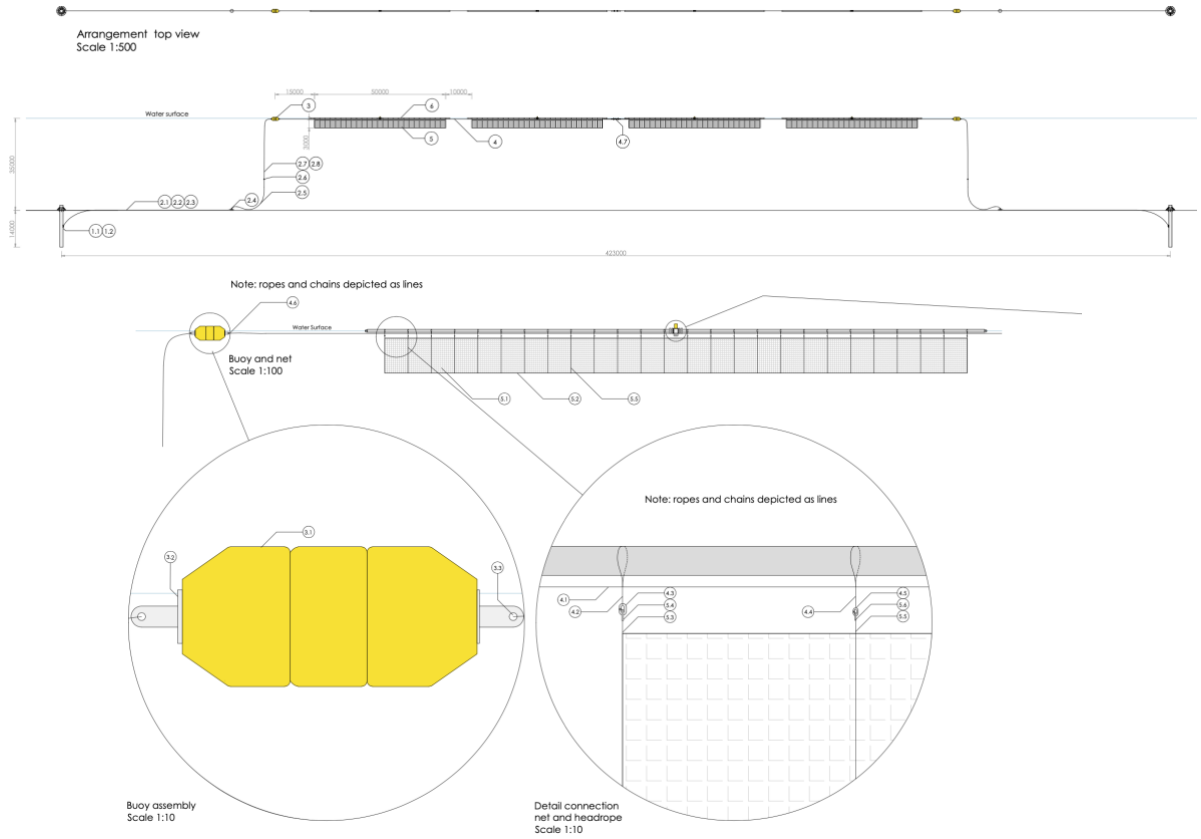


Figure 1 design layout seaweed module

1.3 Organisation

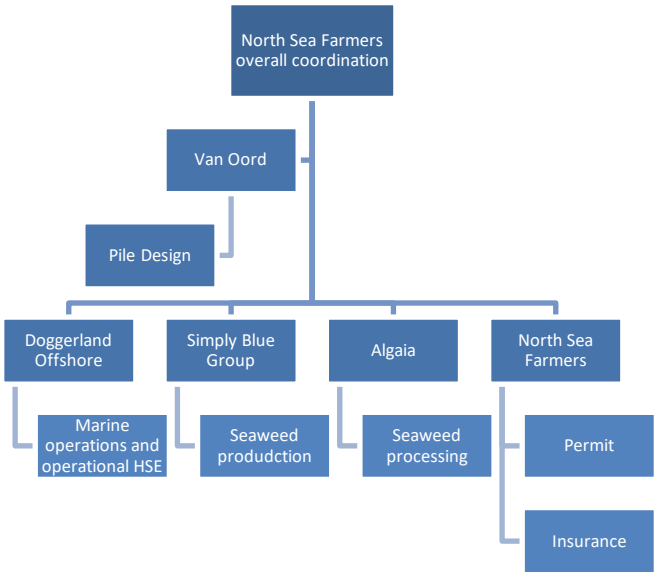


Figure 2: Roles & responsibilities in the NSF#1 Project

Table 1.1 Overview of the roles and responsibilities of the operational project team members

Role	Responsibility	Responsible party
Project Overall Coordination	Overall coordination and end-reponsible for the NSF#1 project, including HSE	North Sea Farmers
Project Manager (PM) Works	Project management and coordination with all partners relating to onshore and offshore operational activities, including HSE	Doggerland Offshore
Seaweed production	Seeding, inspection and harvesting of the seaweed, including logistics onshore. Falls under HSE regime of PM Works	Simply Blue Group
Seaweed processing	Processing of the seaweed in an onshore facility	Algaia
Structural design	Lead engineer on seaweed farm design	Van Oord

2 Equipment

The equipment expected to be used during the operation is stated in the table below. The items are further described in the following paragraphs.

Table 2.1

Item	Description
Vibratory hammer	Low noise emitting tool to install eco-anchors in the seabed
Sea fastening	Multiple sea fastenings are used onboard the vessel to support the eco anchor components and installation equipment during sailing and installation.
Rigging (shackles, slings, etc.)	The vessel is equipped with a variety of slings and shackles all suitable and certified for the operations.
Survey equipment	Sensors to determine the correct installation process during installation
Cranemaster dampening unit	Passive heave compensation unit
Survey ROV	ROV to guide the installation of the eco-anchors
Upending equipment	Crane hooks and other supports as required as part of the upending procedure
Installation vessel	Multi-cat or anchored barge suitable for installation of the eco-anchors, seaweed growing system and deployment of the seeded nets
Support vessels	Any vessel required for ancillary personnel or anchor handling

2.1 Installation vessel

For the installation a typical multicat vessel will be used that will have DP1 capabilities, see also Figure 3 below. This vessel will be equipped with the required tools for performing eco-anchor pile installation work.

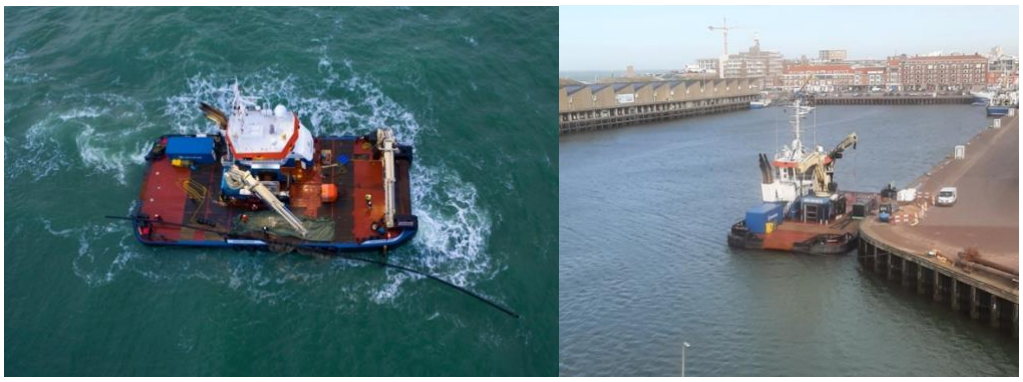


Figure 3 Vessel type to be used for installation works

In case such a vessel will not be available for the works, then a specifically fitted anchored barge could be used. Regardless of what vessel selection, alignment will be sought with the MCC of Hollandse Kust Zuid such that the vessel will meet all requirements as stipulated by the MCC.

2.2 Vibratory hammer

During pile driving, the vibratory hammer causes the pile to vibrate, which in turn vibrates the surrounding soil, significantly reducing the friction between the pile and surrounding soil.

The tool is equipped with inclination monitoring system to provide the operator with an indication of the pile inclination during pile driving. The Vibro Lifting Tool VLT is used to upend and install the Eco-anchor to the agreed penetration depth.

Figure 4: Vibratory hammer used to install eco-anchors offshore in 2022

2.3 Remote Operated Vehicle (ROV)

In the previous installation pilot in 2022 a ROV was used to guide the installation of the eco-anchor on the seabed. This ROV was equipped with a DeepBlue sonar system to enable work in low-visibility conditions. A similar or better equipped ROV will be used for this operation.

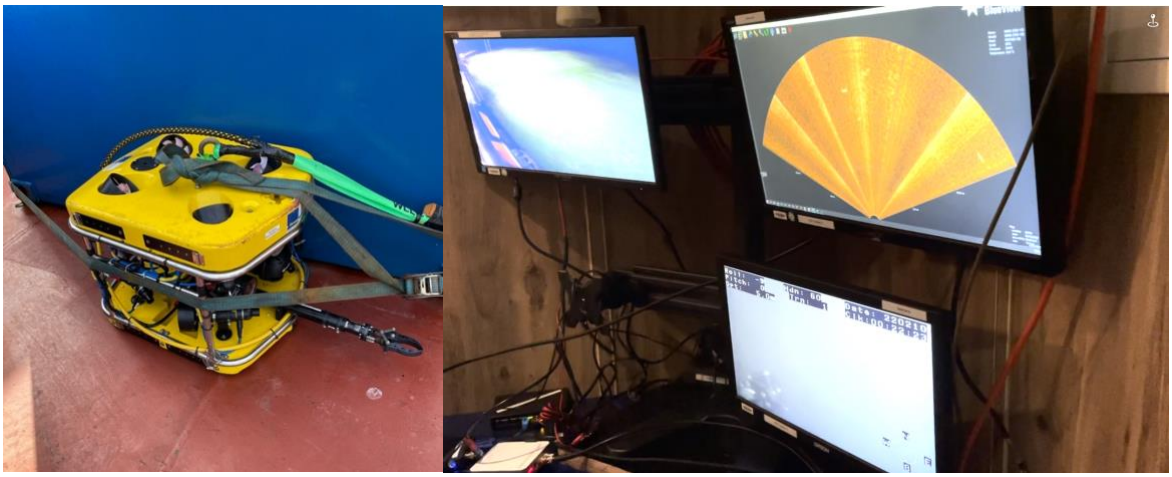


Figure 5: ROV equipped with camera and DeepBlue sonar system

3 Workability

Table 3.1 General workability

Operation	Duration	Required weather Window	Wind Speed	Surface current Speed	Significant wave height	Peak Wave Period
	D [h]	WW [h]	U10 10min average [m/s]	Uc [m/s]	Hs [m]	Tp [s]
Lifting with crane in port			<12m/s			
Transit to site			<12m/s		1.5m	TBD
DP position						
Lift VLT from sea fastening & Stab into pile			<12m/s		1.0m	TBD
Upend pile and position above water			<12m/s	<0.4m/s	1.0m	TBD
Vibrate the pile into the seabed				<0.4m/s	1.0m	TBD
Return VLT to sea fastening			<12m/s		1.5m	
Installation headrope & floater			<12m/s	<0.4m/s	1.0m	TBD
Installing seeded nets			<12m/s	<0.4m/s	1.0m	TBD
Transport back to port			<12m/s			

4 Installation plan seaweed cultivation systems

4.1 Onshore preparation harbour

Delivery of components and equipment will be at a temporary assembly yard in Vlissingen port. DOG superintend and client rep will supervise the correct assembly and subsequent load-out.

4.2 Load-out items

4.2.1 VLT assembly

The vibratory hammer supplier will transport the VLT assembly to the harbour. This will include the vibratory hammer, powerpack and ancillaries such as pressure hoses. It will also assemble the VLT assembly directly on the vessel. After assembling the VLT, the supplier tests all the functionalities of the VLT prior to departure and the dry-test. The following details apply:

- Vibratory Block Dieseko PVE M 150, comes with powerpack and hose package of 45 m.
    - To be requested a short grommet on the top side.
- Block weight: 20,000 kg. Height approximately 2,000 mm + 1,000 mm for grommet.

4.2.2 Cranemaster dampening device

- Cranemaster: Weight: 880 kg. Length retracted 4,010 mm. Extended 6,510 mm.

4.2.3 Pile dimensions

From pile desigh report Rev.05. Final data to be obtained from the lastest version of this document. 4 piles will have to be loaded. To be determined how many piles per trip will be loaded.

Pile weight	[kg]	9727
Pile length	[m]	16
Pile diameter	[mm] [inch]	1219 48
Pile wall thickness	[mm]	20
Eco-structure height/ stick-out	[m]	2.0
Pad-eye depth (measured from nominal seabed)	[m]	-6.0
Eye diameter*	[mm]	112
Material pile	[-]	S355J0H/J2H**
Material	[-]	S355J2G3 or S355NL0**
*Oval pin LTM anchor shackle type D has section 1.9xD and 1.1xD. Chain diameter is Ø58. Hole diameter pad-eye Ø110.2mm ** Material in consultation with production company. From structural point S355 is required		

Figure 6: Eco-anchor dimensions from pile design report

4.3 Load-out operations

Load-out will be done directly from the quayside using the ships cranes and in accordance with the layout plan to be agreed between vessel operator and DOG superintendent

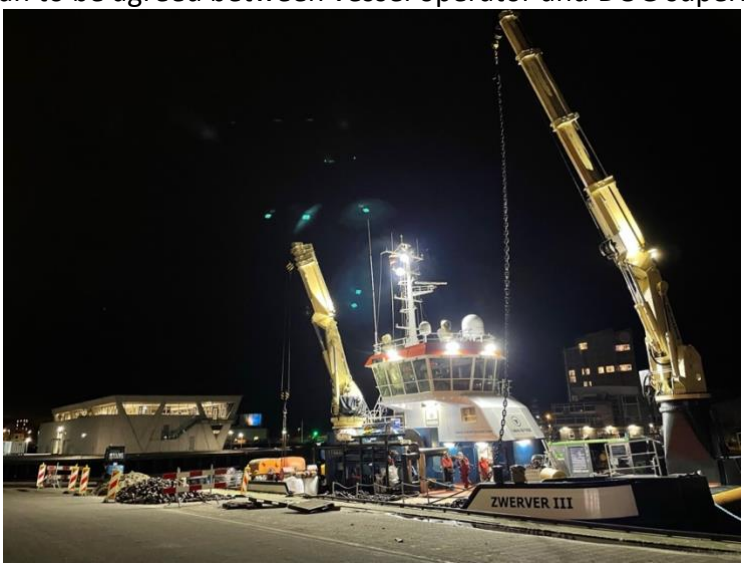


Figure 7: Load-out of eco-anchors in 2022

5 Vessel Mobilization

This chapter briefly describes all the mobilization activities to be executed before sailing out.

5.1 Vessel set up

Vessel will be setup in accordance with the layout plan to be agreed with the vessel operator. This includes install sea fastening for cradles for eco-anchors and sea fastening for the VLT equipment. See also diagrams below

5.2 Trial run in port

The total installation assembly will be trialled and tested in the harbour after load-out.

Figure 8: Testing the upending procedure and equipment validation prior to offshore operations

5.3 Pile installation

This section describes the works to be undertaken for the installation of the pile using the multicat vessel

Generally, the pile installation is performed in the following sequencew:

- Vessel in the correct position, at the installation coordinates
- Connecting VLT and cranemaster
- Upending and lifting in horizontal position;
- Lifting pile over board
- Upending of the pile
- Testing of VLT equipment
- Lowering of the pile onto the seabed

- Positioning of the pile;
- Pile vibration operations with aid of ROV and sensors on VLT
- Installation of the pile to target depth;
- Disconnecting VLT
- Lifting VLT and ROV back on deck

Communication is key during all these work activities. Supervisors of all parties must be able to communicate at all times with each other to align during the works. During all the lifting works, all the people not directly involved have to be in the designated areas.

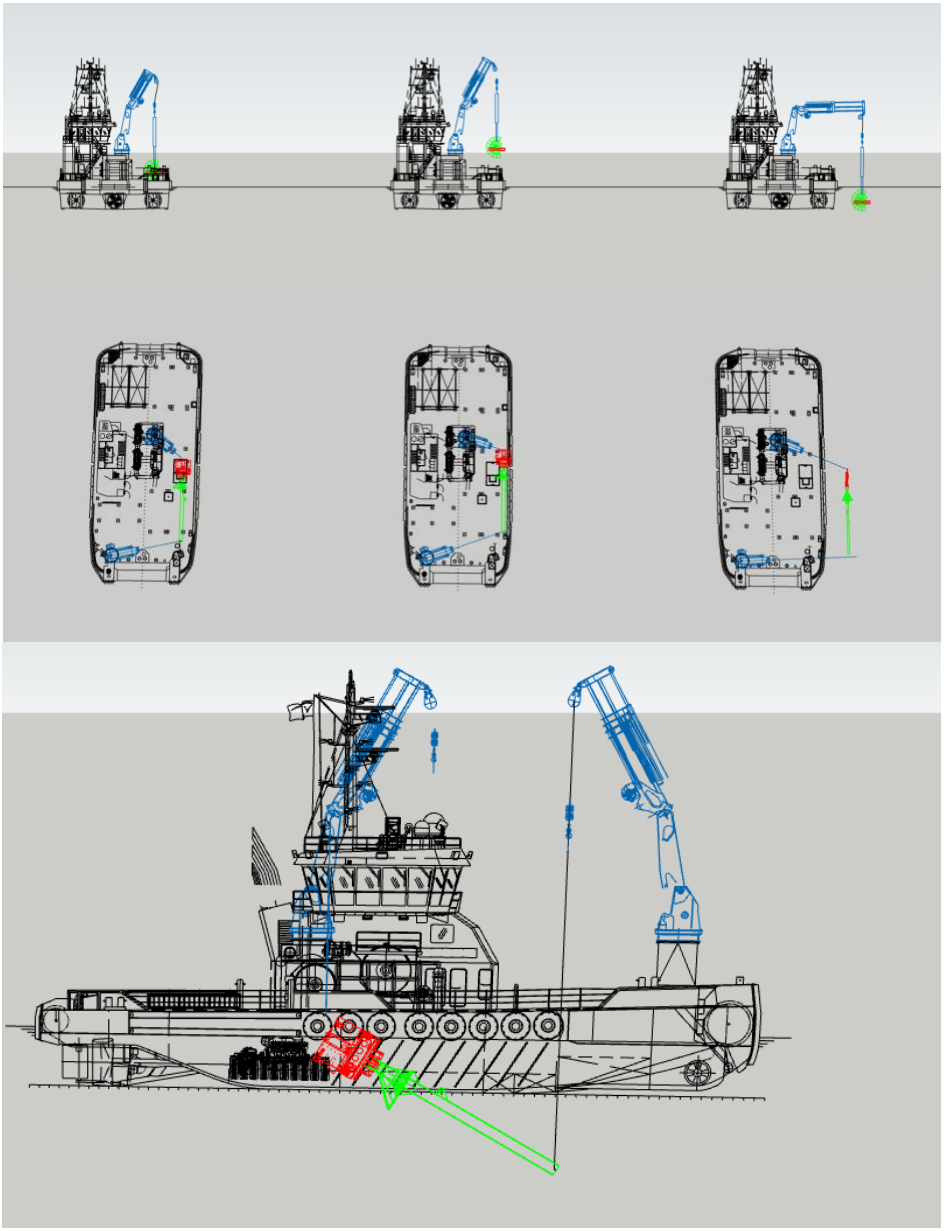


Figure 9: Deck layout, lifting and upending procedure

This pile installation will be guided with aid of a ROV. Anticipated ROV is a small observation class ROV OceanModulus M-500: https://youtu.be/0O5ccZ3PTBg

5.3.1 Installation tolerances of the eco-anchor

The positioning of the piles can be done by on-board GPS measurement on the installation vessel. As the installation will be done with a DP-vessel or anchored barge, i.e. the position can be maintained during vibration. The vibratory hammer includes sensors to determine the performance of the vibratory hammer. The tilt and the penetration depth of the eco-anchor will be monitored with an inclinometer and a pressure sensor where possible. Alternatively, this have to be monitored by the ROV with sonar capabilities.

Table 2: Installation tolerances from document "20230712 NSF#1 part specification"

Installation tolerances			
Accuracy position	Recommendation	[m]	2 (radius)
Max axial deviation (installation depth)	Recommendation	[m]	±0.1
Max rotational misalignment (direction pad-eye)	Recommendation	[deg]	±2.5
Max misalignment with vertical	Recommendation	[deg]	±1

5.4 Seaweed cultivation system installation

After installation of the eco-anchors, including the chain, concrete block, chain, rope and buoy (items 2.1 till 3 in Figure 10 below). The seaweed cultivation systems will be installed.

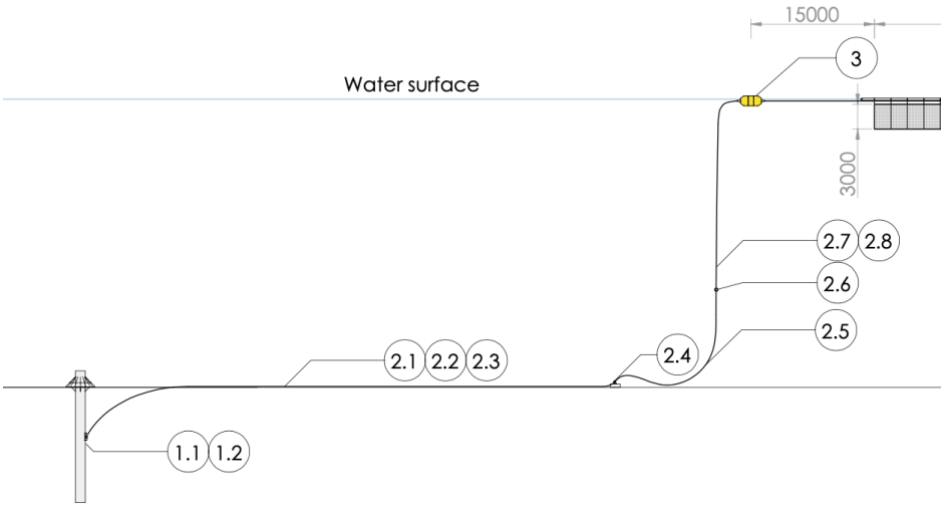


Figure 10: Items installed as part of the eco-anchor installation

In case of a DP capable vessel, the 4 pipe-headrope assemblies will be connected to floater (3) and paid-out from the vessel deck towards upstream and connected to the opposite floater connected to the eco-anchor on the other side.

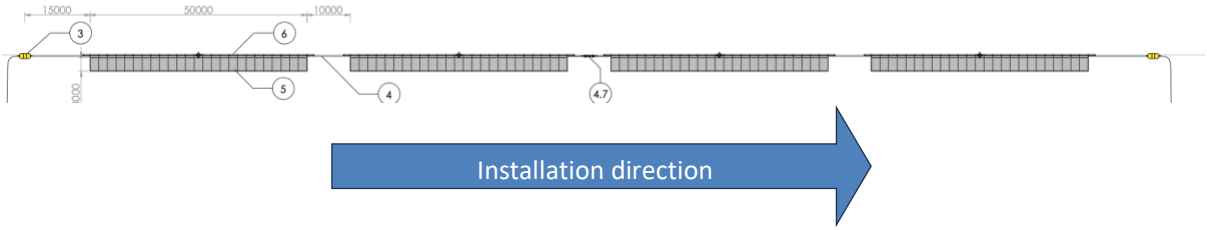
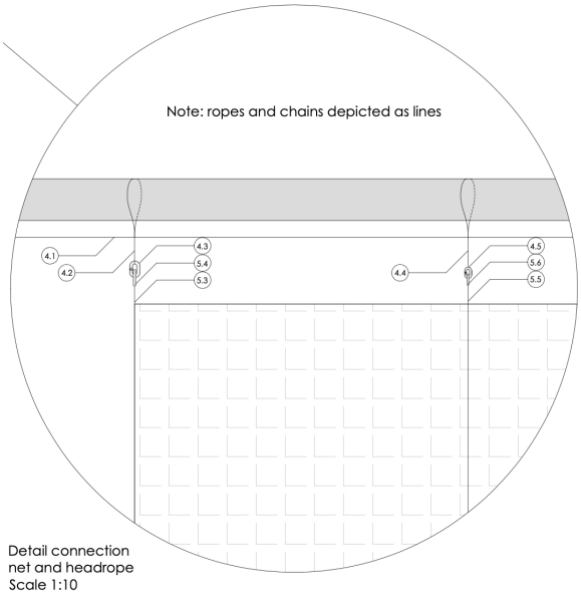


Figure 11: Installing the seaweed cultivation system between 2 eco-anchors

5.5 Deployment of seeded nets

Finally, the seeded nets will be connected to the head rope. The nets will be seeded in an onshore facility close to the harbour. The seeded nets will then be transported to the seaweed farm, most likely with a DP capable ship such as the above mentioned installation vessel, and connected to the head rope with special shackles. To this end the floater will be lifted onto the deck to avoid unnecessary risks for involved personnel. After this operation has been completed for both seaweed cultivaiotn systems the installation and seeding operation will have been completed for the NSF#1 project.



6 Contingencies

This project is not without risk. Based on the risk assessment the following contingencies are taken into account. All operations are carried out in accordance with all applicable nautical laws and regulations.

6.1 VLT breakdown

In the event of VLT equipment failure or breakdown, the decision whether to repair or replace a piece of equipment immediately or to commence a temporary repair will be taken by the hammer supervisor.

6.2 Crane breakdown

In the unlikely event that the crane breaks down, the following procedure is followed [to be included in work method statement and risk assessment prior to operations]

6.3 Spillage

In the unlikely event of an oil spillage, the emergency response procedure will be followed. If there's an opportunity for corrective action then the following procedure is followed [to be included in work method statement and risk assessment prior to operations]. As mitigation measure, the VLT equipment is filled with biodegradable oil.

6.4 Vessel breakdown

In the unlikely event of a vessel breakdown, the following procedure is followed [to be included in work method statement and risk assessment prior to operations]

7 Demobilization

7.1 Load in equipment

All equipment will be lifted from deck to quay in the following order:

- VLT
- VLT power pack
- Upending equipment (if applicable)

7.2 VLT disassembly

The hammer supplier disassembles the VLT on quay site. Quality
This chapter describes all quality aspects directly related to the scope of work covered under this method statement.

As part of this method statement an Inspection and Test Record (ITR) has been prepared. The ITR provides a checklist on the inspection and testing of the equipment before going offshore as well as before each installation of a pile. The ITR will be carefully followed step by step until it is completed and signed by each responsible person.

In addition, it is mandatory to stay within the scope of the permit, which is required to conduct these tests offshore. Therefore, the operation will stay within the limits of what has been permitted by RWS and RVO.

7.3 Daily report

A daily report will be made which summarises the operations throughout the day. This includes personnel and equipment status. This document shall be signed by a NSF representative and Work Instruction in the appendices and/or the JSA prepared prior to the start of the work.

8 Health, safety, and environment

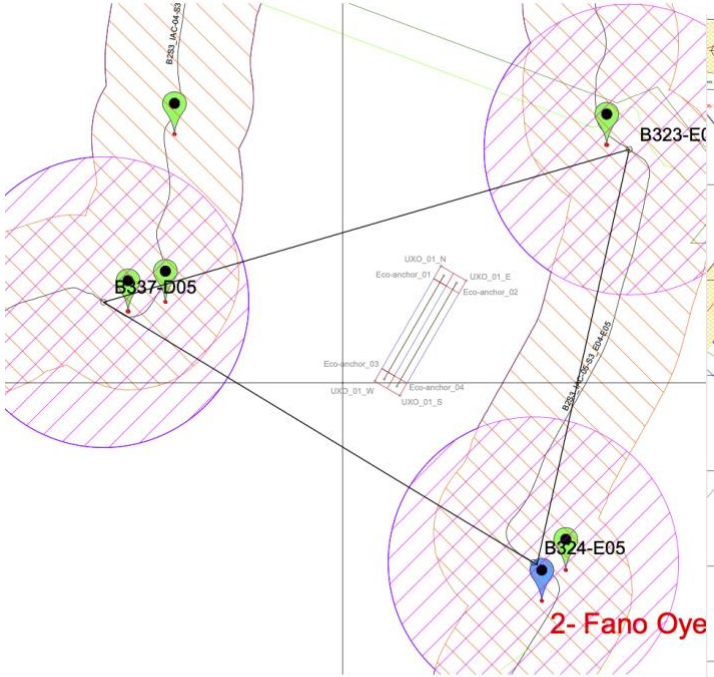
To ensure a safe working environment, a Safety Management Plan has been developed to describe how the NSF#1 projects manages the Health, Safety and Security matters. In addition, a Project Emergency Plan is in place providing guidance and advice on the duties to be performed by the project team members and workers who have been allocated specific roles in the event of an emergency.

9 Attachments

Attachment1: Risk register for construction and installation works

Will be included as part of detailed work method statement, following the guidelines in the NSF#1 Safety Management Plan

Attachment2: Layout & coordinates



	UXO_01_N	UXO_01_E	UXO_01_W	UXO_01_S	Eco-anchor_01	Eco-anchor_02	Eco-anchor_03	Eco-anchor_04
UTM E	500338.959	500425.562	500110.498	500198.008	500347.817	500425.562	500111.406	500188.938
UTM N	5720401.424	5720351.424	5720005.717	5719956.625	5720367.846	5720351.424	5720006.625	5719991.580
Lat Degree	51.634625°	51.634175°	51.631067°	51.630625°	51.634323°	51.634175°	51.631075°	51.63094°
Lon Degree	3.004898°	3.006149°	3.001596°	3.002861°	3.005026°	3.006149°	3.00161°	3.00273°