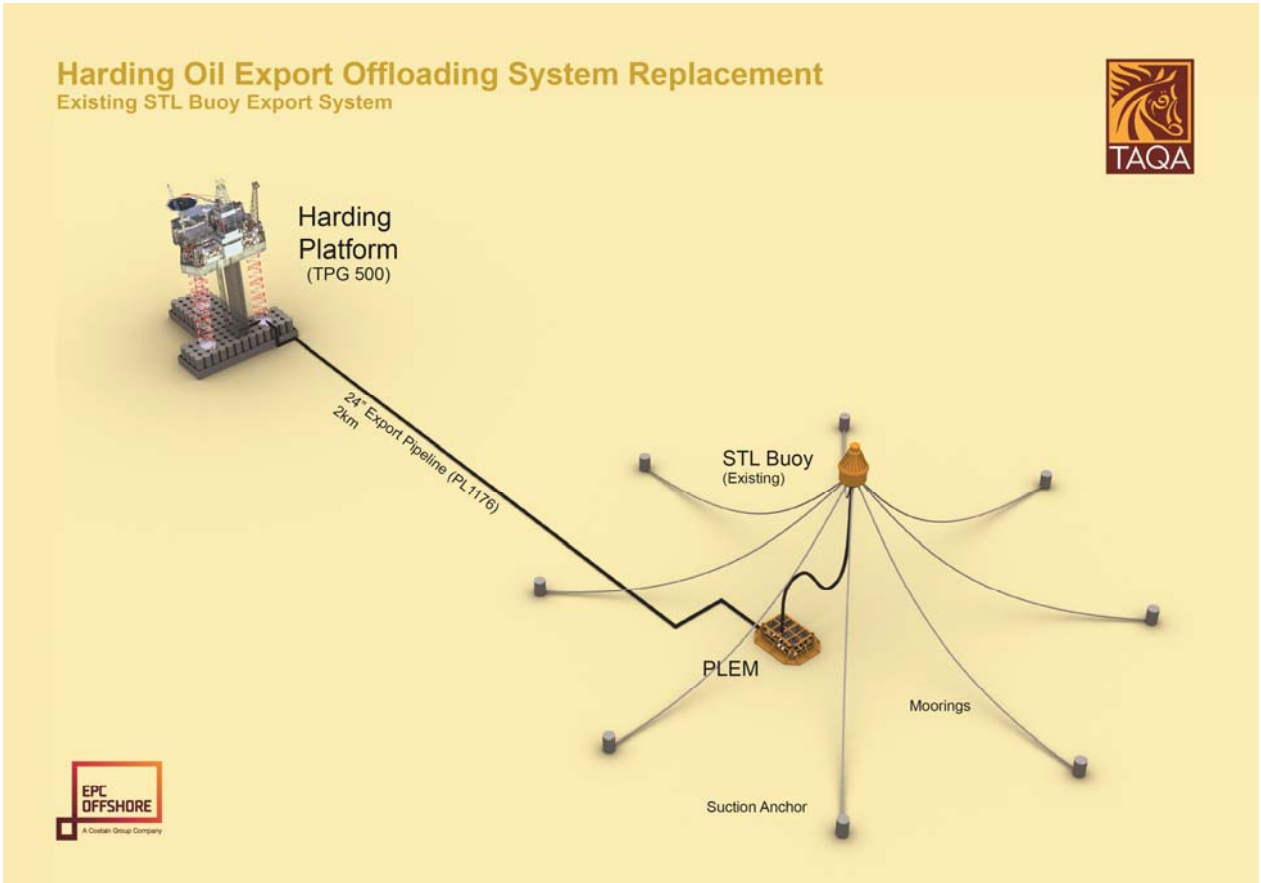
Decommissioning Programme

Harding Submerged Turret Loading System

HAR-01031-DEC-PM-ADP-0001-TAQ



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DECC revision summary			
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R1	Issued for internal comment.		16/01/2015
R2	Re-issued for internal comment.	Changes & comments from R1 issue included.	03/02/2015
R3	Issued pre-draft.	Changes & comments from R2 issue included.	06/02/2015
R4	Issued first draft.	Changes & comments from R3 issue included.	31/03/2015
R5	Issued second draft.	Changes & comments from R4 issue included. Updated anchor data after 2015 Survey; section 2.2. Added further information on suction anchor removal; section 3.3.8 and Appendix 2.	08/07/15
R6	Issued for Consultation	Changes & comments from R5 issue included	18/09/15
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R8	Issued for Approval	Figure 6.1 Updated Table 6.1 Updated	23/11/15
A1	Final Issue	Maersk letter of support included in section 8.	17/12/15

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GLOSSARY OF ABBREVIATIONS

BAP	Biodiversity Action Plan
Britoil	Britoil Limited
CA	Comparative Assessment
CNS	Central North Sea
DECC	Department of Energy and Climate Change
DP	Decommissioning Programme
DSV	Dive Support Vessel
ED50	European Datum 1950
EIA	Environmental Impact Assessment
EMS	Environmental Management System
ER	Environmental Report
ES	Environment Statement
FLTC	UK Fisheries Offshore Oil and Gas Legacy Trust Fund Limited
FPAL	First Point Assessment Limited
GBT	Gravity Base Tank
HSE	Health and Safety Executive
JNCC	Joint Nature Conservation Committee
km	kilometre
LSA	Low Specific Activity
m	metre
Maersk Oil	Maersk Oil North Sea UK Limited
MS	Marine Scotland
N/A	Not Applicable
NFFO	National Federation of Fishermen's Organisations
NIFPO	Northern Irish Fish Producers Organisation
NORM	Naturally Occurring Radioactive Material
OGUK	Oil & Gas UK
OLS	Offshore Loading System
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic

PDi	Project Development International Limited
PLEM	Pipe-Line End Manifold
PMF	Priority Marine Feature
PWA	Pipeline Works Authorisation
ROV	Remote Operated Vehicle
SFF	Scottish Fishermen's Federation
SIMOPs	Simultaneous Operations
STL	Submerged Turret Loading System
TAQA	TAQA Bratani Limited
Te	Tonne
UKCS	United Kingdom Continental Shelf

FIGURES AND TABLES

APPENDICES

1.0 EXECUTIVE SUMMARY

1.1 Decommissioning Programme

This document contains one Decommissioning Programme (DP), for one installation. It outlines the decommissioning intent for elements of the Harding field Submerged Turret Loading system (STL) - which is to be replaced due to obsolescence.

1.2 Requirement for Decommissioning Programme

Installation:

In accordance with the Petroleum Act 1998, TAQA Bratani Limited (TAQA), as the operator of the Harding field STL, and on behalf of the Section 29 holders (see Table 1.2), is applying to the Department of Energy and Climate Change (DECC), to obtain approval for decommissioning the installation detailed in Section 2.0 of this programme. Partner Letter of Support for this programme is included in Section 8.0.

In conjunction with public, stakeholder and regulatory consultation, this Decommissioning Programme is submitted in compliance with national and international regulations and DECC guidelines. The schedule (Figure 6.1) is for a 2 month decommissioning project, due to commence summer 2016.

1.3 Introduction

The Harding field is located in the UKCS Licence Block 9/23b in the Central North Sea, approximately 320 km north-east of Aberdeen (Figure 1.3). Water depth at the field is 110m. The field was discovered in January 1988 and first production was in April 1996. The field was operated by BP until June 2013, when TAQA purchased BP's field equity and took over the operatorship.

The field has one central production, drilling and accommodation platform located between the Central and South reservoir accumulations. The Harding platform is a large, heavy-duty jack-up rig fixed to a concrete gravity base structure containing oil storage tanks. The oil is exported from the storage tanks to shuttle tankers via the STL which is located approximately 2km to the east of the platform.

The STL is supported by a submerged mooring and loading interface buoy, which is anchored to the seabed via eight mooring lines and suction anchors. Due to obsolescence the STL will be replaced by a new Offshore Loading System (OLS).

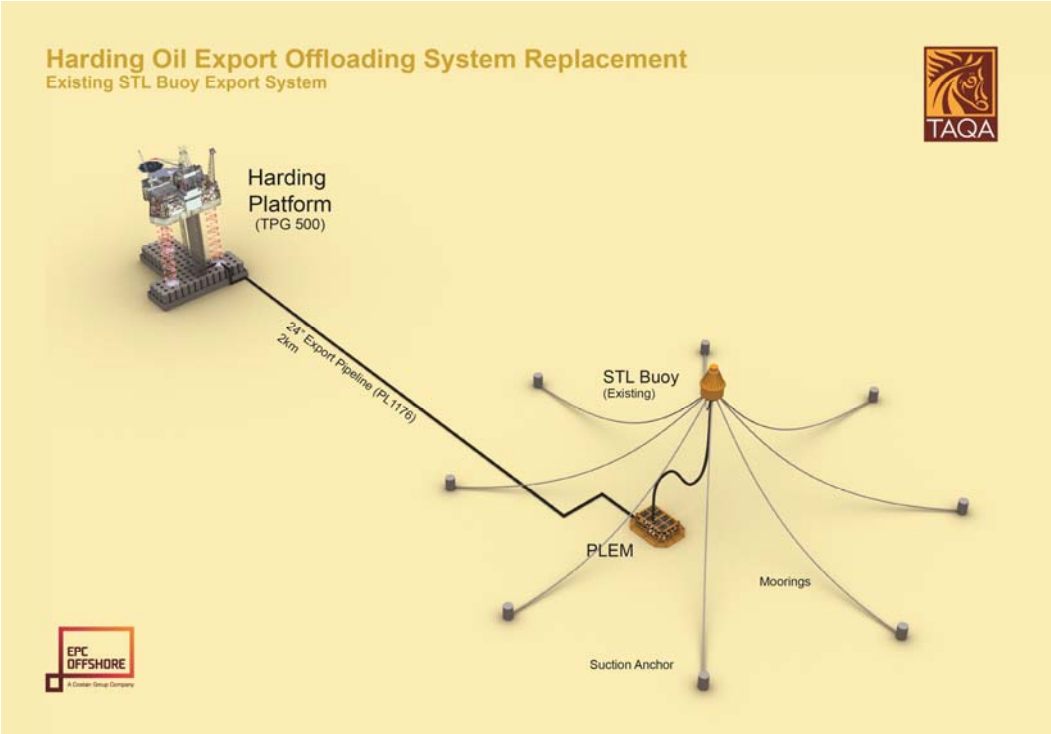


Figure 1.1 Existing STL Loading System

The following components of the original system are redundant and will be removed:

- Eight mooring lines and associated components
- Eight steel seabed suction anchors
- The shuttle tanker mooring and loading interface buoy and associated components
- The offloading riser *

It is intended that all redundant equipment will be removed for reuse or recycling. If it is not possible following reasonable endeavours to perform reverse installation of the individual suction anchors then it is intended, following liaison and agreement with DECC, to cover the suction anchor with rock dump and leave in situ. It is considered that the 'partial recovery' of an anchor, i.e. suction anchor not fully removed from seabed at failure of reverse installation, is, after detailed engineering and utilisation of optimal removal procedure, rated as very unlikely / very low risk.

Reference Section 3.3.8 and Appendix 2 for further details on suction anchor removal by reverse installation and suction anchor failure modes.

**The Harding oil export pipeline PL1176, inclusive of riser, is being modified. This will be defined in a variation to PWA 23/W/95; as a result the riser is not included in this Decommissioning Programme.*

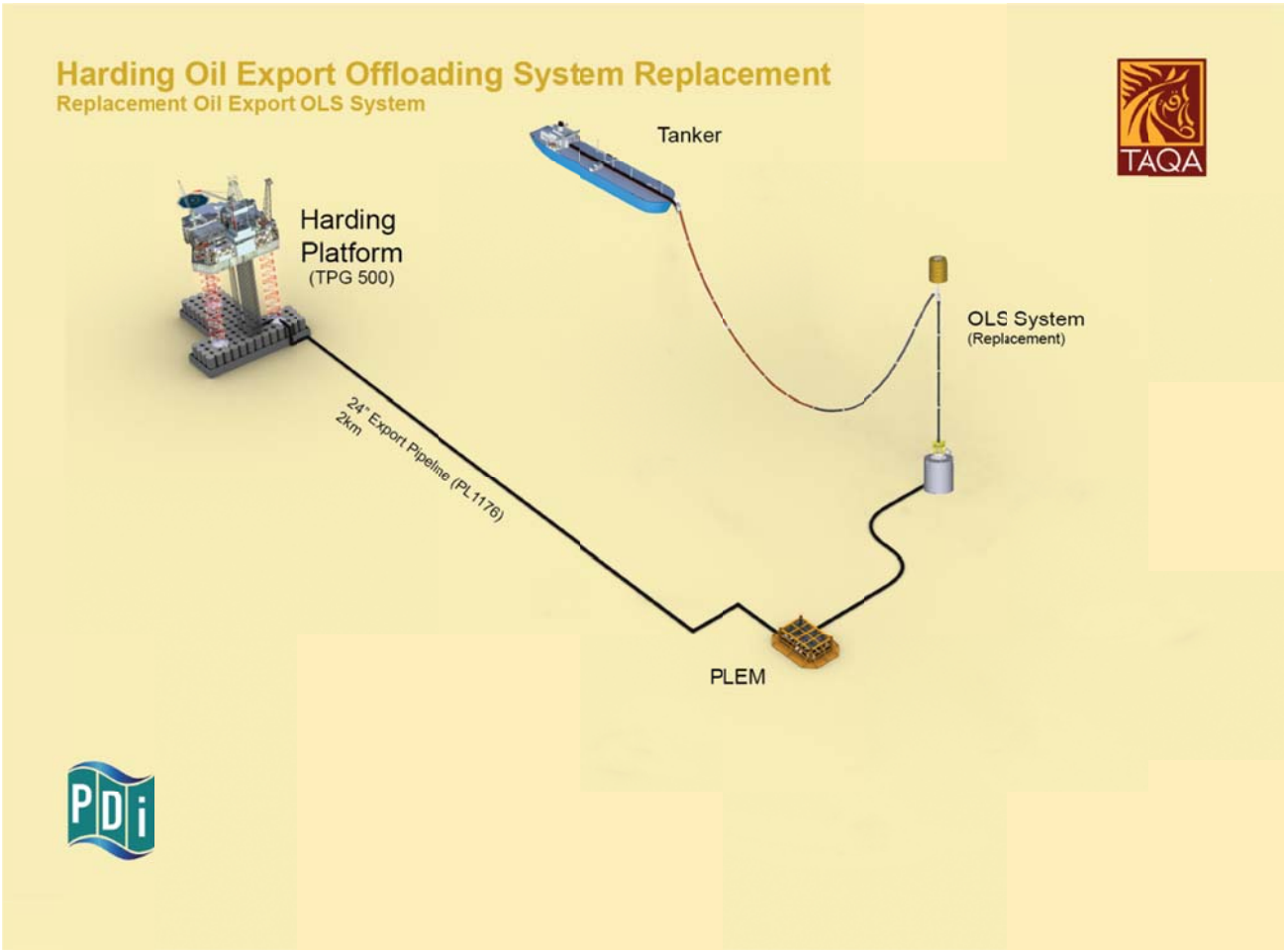


Figure 1.2 Replacement OLS System Schematic

1.4 Overview of Installation Being Decommissioned

1.4.1 Installation

Table 1.1: Installation Being Decommissioned			
Field name		**Quad/Block/Location**	
Harding STL		9/23b	
		WGS84	59° 16.586' 01° 33.025'
Subsea Installation			
Total Number		**Type**	
1		STL = Shuttle tanker mooring and loading interface buoy, and mooring facility	
Production type *(Oil/Gas/Condensate)*	**Water Depth (m)**	**Distance from nearest UK coastline (km)**	**Distance to median Line (km) (if less than 5km)**
Oil	110 meters	168km	N/A

Table 1.2: Installation Section 29 Notice Holders Details		
Section 29 notice holder	**Registration Number**	**Equity Interest (%)**
TAQA Bratani Limited	Reg. No. 05975475	70%
Maersk Oil North Sea UK Limited	Reg. No. 03682299	30%
Britoil Limited	Reg. No. SC077750	0%

1.5 Summary of Proposed Decommissioning Programme

Table 1.3: Summary of Decommissioning Programme		
Selected option	**Reason for selection**	**Proposed decommissioning solution**
Topsides		
N/A	N/A	N/A
Jacket(s) / Floating Facility (FPSO)		
N/A	N/A	N/A
Subsea Installation		
The STL: • Shuttle tanker mooring & Loading interface Buoy • Eight mooring lines • Eight seabed suction anchors • Riser* Option Selected: • Shuttle tanker mooring & Loading interface Buoy returned to owner. • Mooring lines, suction anchors and associated elements, removed by reverse installation method. • Riser* as per PWA 23/W/95 variation. **The Harding oil export pipeline PL1176 inclusive of riser, is being modified. This will be defined in a variation to PWA 23/W/95; as a result the riser is not included in this Decommissioning Programme.*	• Meets DECC guidelines on removal of seabed structures to leave a clean seabed. • Minimal seabed disturbance. • Reduced risk to personnel engaged in activity. • Removal of risk to 'other users of the sea' and consequent risk in perpetuity to section 29 holders.	• Decommissioning of the STL facilities highlighted will be by means of reverse installation process. This will be followed by disposal via an onshore accredited recycling/waste management facility. • The Shuttle tanker mooring and loading interface buoy is the property of the shuttle tanker agent, and as such, shall be returned to the owner. • Post activity 'as-left' survey and, where required, an over-trawl exercise will be conducted.
5. Wells		
N/A	N/A	N/A
6. Drill Cuttings		
N/A	N/A	N/A
7. Interdependencies		
N/A	N/A	N/A

1.6 Field Location including Field Layout and Facilities

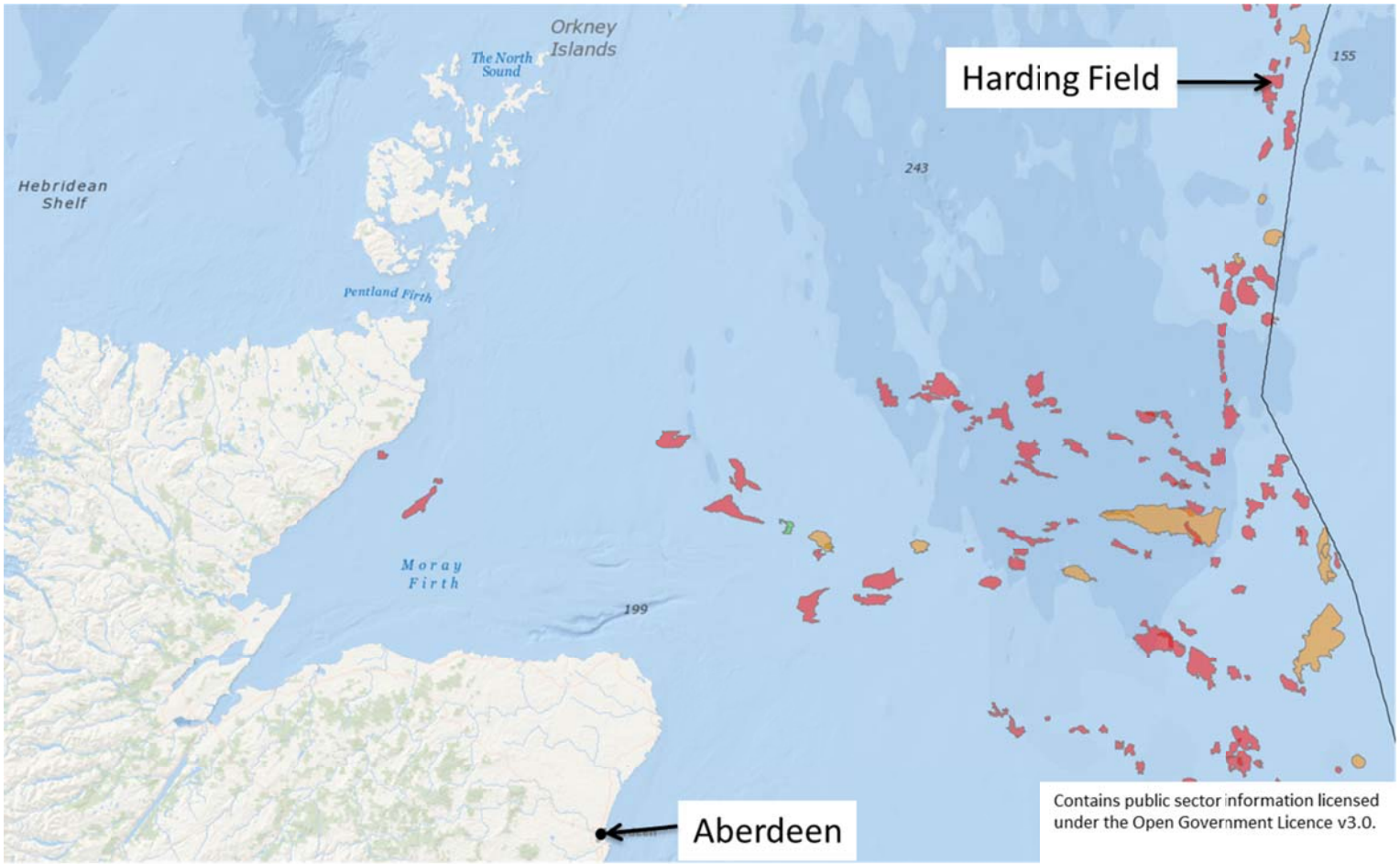
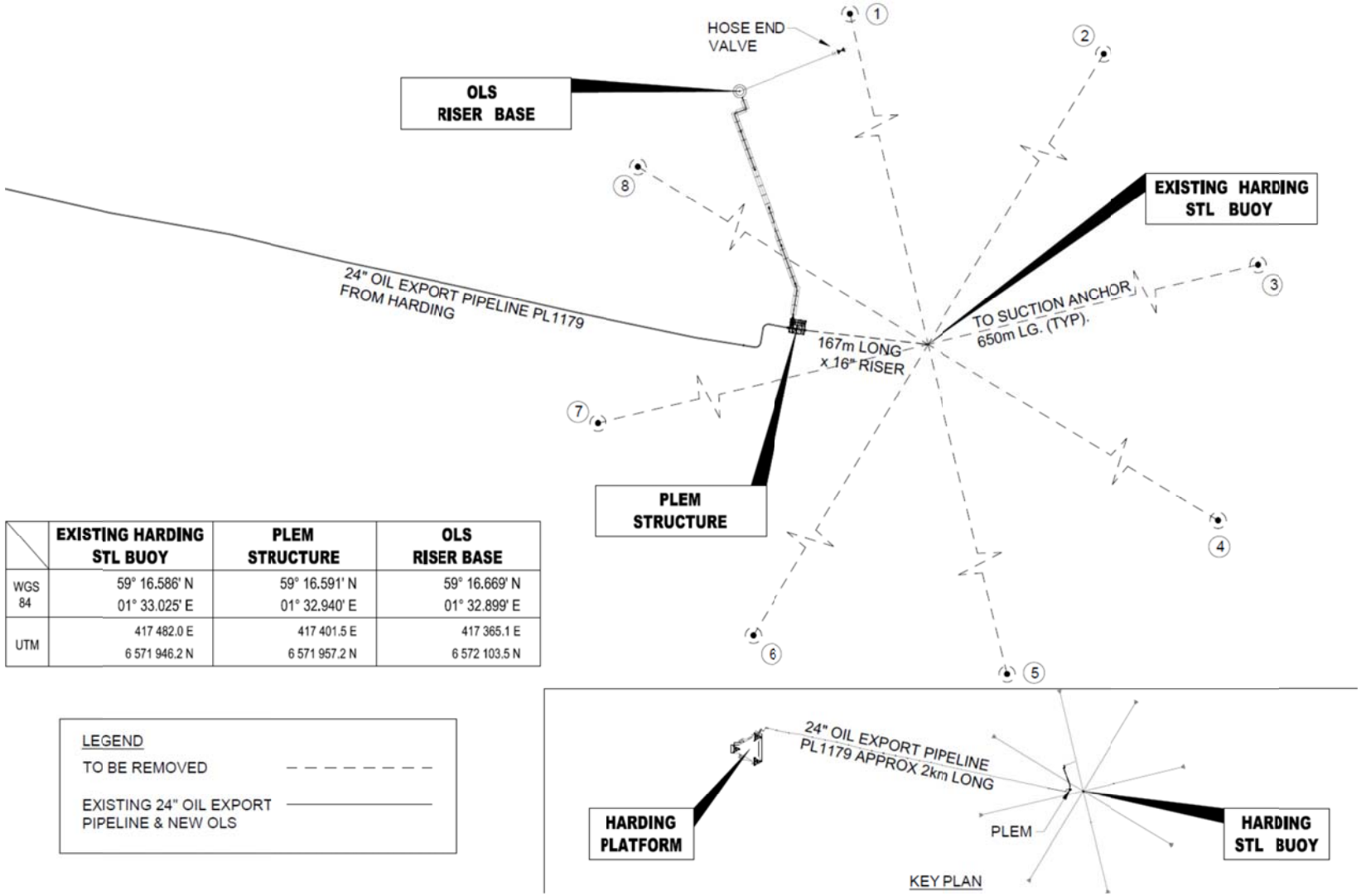


Figure 1.3 Field Location in UKCS



	EXISTING HARDING STL BUOY	PLEM STRUCTURE	OLS RISER BASE
WGS 84	59° 16.586' N 01° 33.025' E	59° 16.591' N 01° 32.940' E	59° 16.669' N 01° 32.899' E
UTM	417 482.0 E 6 571 946.2 N	417 401.5 E 6 571 957.2 N	417 365.1 E 6 572 103.5 N

Figure 1.4 Field Layout (Existing & Proposed)

Table 1.4: Adjacent Facilities						
Owner	**Name**	**Type**	**Distance/ Direction**		**Information**	**Status**
TAQA /Maersk Oil	Harding Platform	Semi Mobile Offshore Production Unit, with an integral concrete base used for crude storage	2km - North West		Harding Production Platform	Operational
			WGS84 Decimal	59.279183 1.514617		
			WGS84 DEC Min	59° 16.751' 01° 30.877'		
TAQA /Maersk Oil	PL1176	24“ crude oil export pipeline from Harding Platform	From Harding Platform to the STL, 2km long		Harding platform to shuttle tanker discharge	Temporarily non-operational during STL decommissioning activities
			WGS84 Decimal	59.279183 1.514617		
			WGS84 Dec Min	59° 16.751' 01° 30.877'		
			WGS84 Decimal	59.276417 1.550433		
			WGS84 Dec Min	59° 16.586' 01° 33.025'		
Impacts of decommissioning proposals						
Decommissioning activities will be scheduled around offloading operation intervals. No impact is anticipated to third parties.						

1.7 Industrial Implications

In planning and preparing for the decommissioning of the Harding STL, TAQA, as the operator of the Harding field, and on behalf of the Section 29 Notice Holders, has undertaken a contract/procurement and communications strategy as follows:

- Engaged with representatives from DECC, statutory consultees and associations, inviting those who expressed an interest in attending, to the main Stakeholder Engagement, Decommissioning Options Comparative Assessment review, held on 15th December 2014.
- Specific engagement sessions relating to the decommissioning of the facilities covered under this Decommissioning Programme, are summarised in Table 5.1: Summary of Stakeholder Comments.
- Whilst First Point Assessment Ltd (FPAL) remains the primary source for establishing tender lists for contracts/purchases, it is TAQA’s intention, given the nature and size of this scope, to use the new loading system installation contractor to complete the Harding STL removal activities.
- With regard to waste management, TAQA intend to use its existing competent approved waste management contractors, who will be engaged to deal with any and all waste as a result of the decommissioning activities.

2.0 DESCRIPTION OF ITEMS TO BE DECOMMISSIONED

2.1 Installation: Surface Facilities

N/A

2.2 Installation: Subsea including Stabilisation Features

Table 2.1: Subsea Installations and Stabilisation Features

Subsea installations including stabilisation features	Number	Size/Weight (Te)	Location		Comments / Status
Suction Anchors	8	8m long x 5m diameter, 40 tonnes	Anchor 1		1.5m protruding above seabed
			WGS84 Decimal	59.282050 1.547600	
			WGS 84	59˚ 16.923' 01˚ 32.856'	
		8m long x 5m diameter, 40 tonnes	Anchor 2		1.8m protruding above seabed
			WGS84 Decimal	59.281500 1.556117	
			WGS 84	59˚ 16.890' 01˚ 33.367'	
		8m long x 5m diameter, 40 tonnes	Anchor 3		1.6m protruding above seabed
			WGS84 Decimal	59.277933 1.561450	
			WGS 84	59˚ 16.676' 01˚ 33.687'	
		10m long x 5m diameter, 48 tonnes	Anchor 4		1.1m protruding above seabed
			WGS84 Decimal	59.273517 1.560317	
			WGS 84	59˚ 16.411' 01˚ 33.619'	
		10m long x 5m diameter, 48 tonnes	Anchor 5		1.0m protruding above seabed
			WGS84 Decimal	59.270783 1.553333	
			WGS 84	59˚ 16.247' 01˚ 33.200'	
		10m long x 5m diameter, 48 tonnes	Anchor 6		1.0m protruding above seabed
			WGS84 Decimal	59.271333 1.544750	
			WGS 84	59˚ 16.280' 01˚ 32.685'	
		8m long x 5m diameter, 40 tonnes	Anchor 7		2.0m protruding above seabed
			WGS84 Decimal	59.274950 1.539350	
			WGS 84	59˚ 16.497' 01˚ 32.361'	
		8m long x 5m diameter, 40 tonnes	Anchor 8		1.8m protruding above seabed
			WGS84 Decimal	59.279383 1.540550	
			WGS 84	59˚ 16.763' 1˚ 32.433'	

Table 2.1: Subsea Installations and Stabilisation Features (cont'd)					
Subsea installations including stabilisation features	**Number**	**Size/Weight (Te)**	**Location**		**Comments / Status**
Shuttle tanker mooring and loading interface Buoy	1	8.39m x 7.4 m x 99 Te	WGS84 Decimal	59.276417 1.550433	
			WGS 84	59° 16.586' 01° 33.025'	
Mooring Lines (chain element)	8	Each = 450 m x 131 Te	Lay between anchor & shuttle tanker mooring and loading interface buoy location		Connected between suction anchor & Tri-plate*
Mooring Lines (wire element)	8	Each = 225 m x 11.5 Te	Lay between anchor & shuttle tanker mooring and loading interface buoy location		Connected between Tri-plate and buoy
Mooring Line Tri-plates	8	Each = 1 m x 1.3 Te	Lay between anchor & shuttle tanker mooring and loading interface buoy location		In between wire & chain elements
Mooring Line shackles	24	Each = 0.42 Te	Lay between anchor & shuttle tanker mooring and loading interface buoy location		At either ends of the wire and chain elements
Mooring line wire sockets	16	Each = 0.77 Te	Lay between anchor & shuttle tanker mooring and loading interface buoy location		Fitted to either end of the wire elements
Messenger & Pick up line with marker buoys & navigation warning lights & Lifting Bridle	1	363m x 9 Te (approx.)	As per shuttle tanker mooring and loading interface buoy		Attached to the top of buoy and weather vanes as sea & tide dictate.
Wellheads	N/A	N/A	N/A		N/A
Manifold	N/A	N/A	N/A		N/A
Protection Frame(s)	N/A	N/A	N/A		N/A
Concrete Mattresses	N/A	N/A	N/A		N/A
Grout bags	N/A	N/A	N/A		N/A
Formwork	N/A	N/A	N/A		N/A
Frond Mats	N/A	N/A	N/A		N/A
Rock Dump	N/A	N/A	N/A		N/A

* The mooring chain will be severed at the seabed as close to the suction anchor as possible. The length of chain remaining attached to the suction anchor will be relatively short and will have a free end which would prevent the chain from becoming a snagging hazard. During the offshore operations, if the chain is considered a hazard the chain will be jetted below the surface of the seabed.

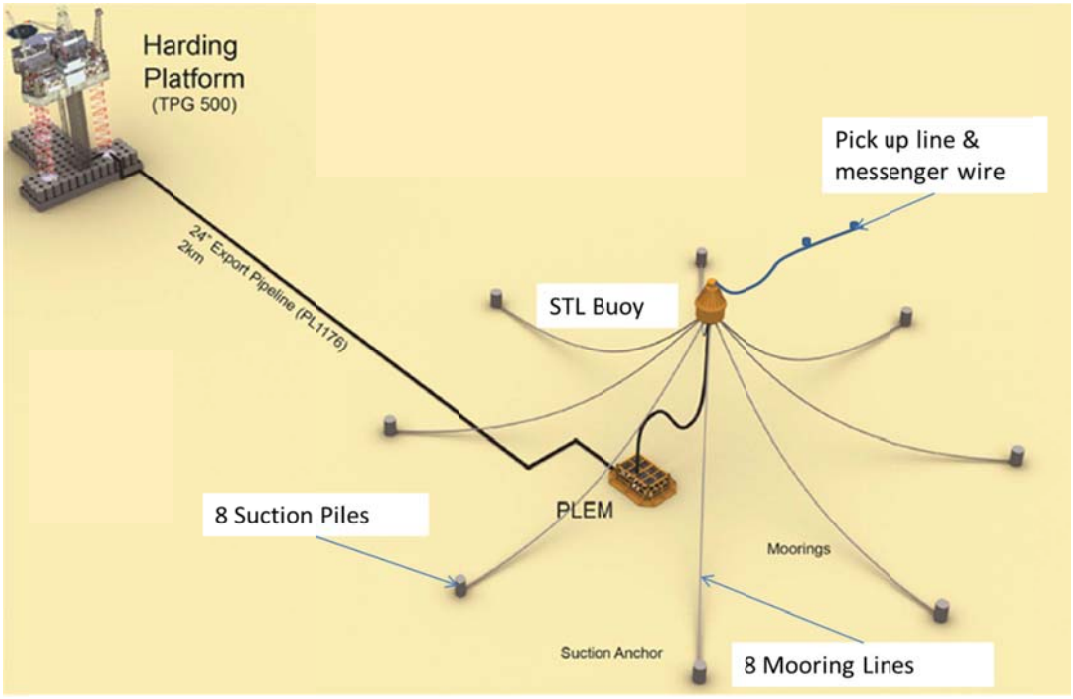


Figure 2.1 Harding STL Components to be decommissioned

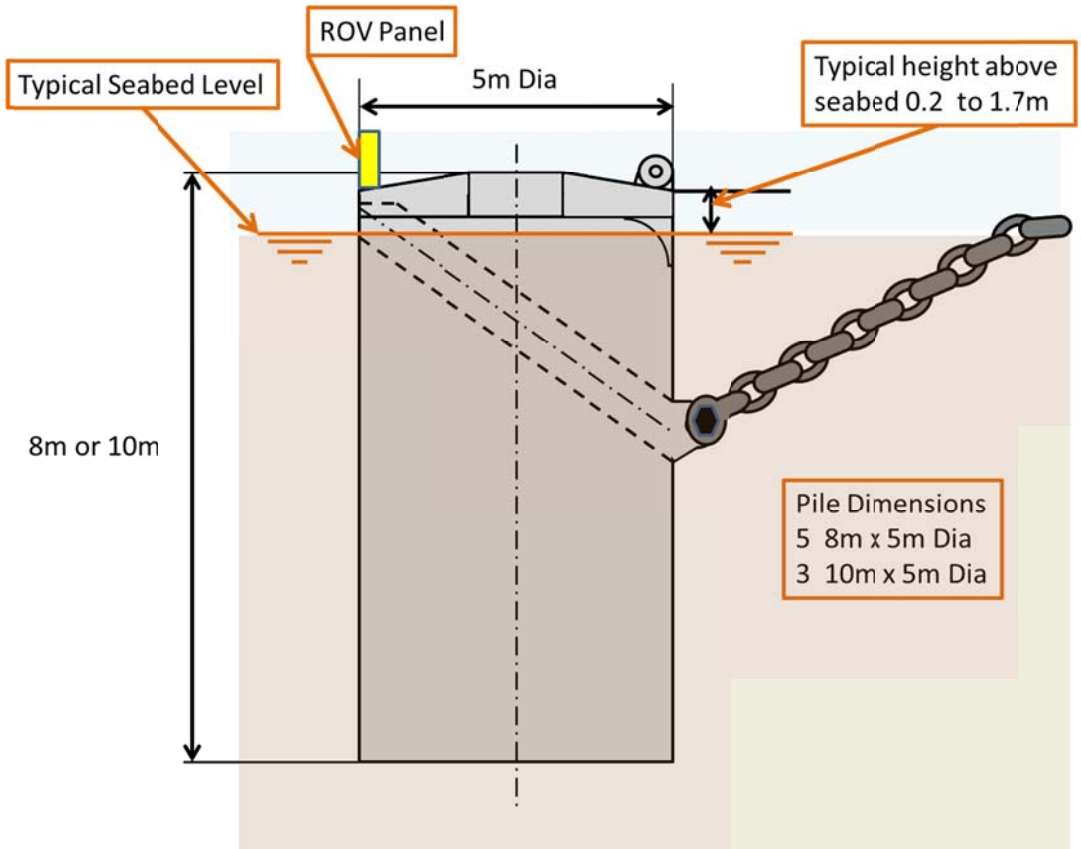


Figure 2.2 Harding STL Suction Anchor Schematic

2.3 Pipelines including Stabilisation Features

The Harding crude oil export pipeline, PL1176, does not form part of the Harding STL Installation and therefore, although reference is made, does not form part of this DP scope of activities.

This pipeline will be modified for re-use as part of the new OLS system, the details of which will be defined in a variation to PWA 23/W/95.

2.4 Wells

Table 2.2: Well Information			
Platform Wells	Designation	Status	Category of Well
N/A			
Subsea Wells			
N/A			

2.5 Drill Cuttings

Table 2.3: Drill Cuttings Pile(s) Information		
Location of Pile Centre (Latitude/Longitude)	Seabed Area (m^2)	Estimated volume of cuttings (m^3)
N/A		

2.6 Inventory Estimates

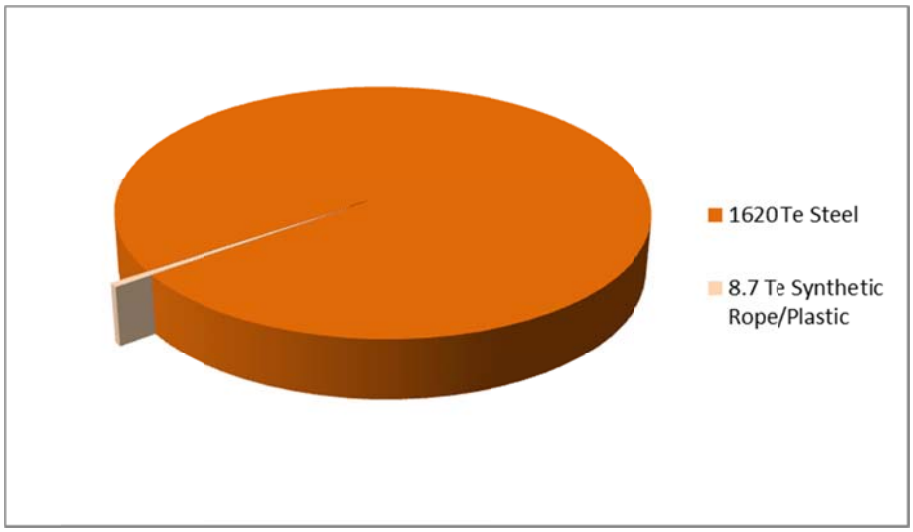


Figure 2.3 Inventory Estimate

Table 2.4: Estimated Inventory: Installations STL and Moorings								
STL and Moorings		Qty	Weight	Length	Diameter	Total	Made from	
Item	Description		kg/m	m	m	kg		Te
1	STL Buoy	1	99000	8	7.8	99000	Steel	99
2	Wire	8	51	225	111mm dia	91800	Steel	91.8
3	Chain K3 studless	8	291	450	120mm	1047600	Steel	1047.6
4	Tri Plates	8	1335	1	N/A	10680	Steel	10.68
5	Suction Anchor 1	5	41 tonnes est	8	5	205000	Steel	205
6	Suction Anchor 2	3	48 tonnes	10	5	144000	Steel	144
7	Misc shackles	24	415	1	n/a	9960	Steel	9.96
8	Wire Socket	16	765	1	n/a	12240	Steel	12.24
9	Pick Up Line	1	est 22 + buoy	363.6	26mm - 150mm	8739	Plastic & Synthetic rope	8.739
								Tonnes
					Total Mass	1620280	Steel	1620.3
						8739	Plastic & Synthetic rope	8.7
							Total	1629.0

The inventory list in Table 2.4 has a total weight of 1629Te of which 1530Te is to be returned to shore for recycling/disposal. The shuttle tanker interface buoy (99Te) is to be returned to its owner TEEKAY Shipping Norway AS.

3.0 REMOVAL AND DISPOSAL METHODS

In line with the waste hierarchy, the re-use of an installation (or parts thereof) is first in the order of preferred decommissioning options.

Equipment and vessel obsolescence is the driver for replacing the STL, and as such, assessment determined that none of the STL Installation component parts were suitable for re-use or redeployment at this time.

TAQA shall return the STL submerged buoy to the owner, TEEKAY Shipping Norway AS.

However; acknowledging that the crude oil export pipeline PL1176 and PLEM are not considered part of the STL Installation, the assessment did confirm that both the export pipeline and PLEM should remain in place as part of the replacement OLS system.

3.1 Topsides

N/A

3.2 Jackets

N/A

3.3 Subsea Installations and Stabilisation Features

All STL component parts owned by the field owners, shall be removed to shore for recycling or disposal.

Table 3.1: Subsea Installations and Stabilisation Features

Subsea installations including stabilisation features	Number	Option	Disposal Route (if applicable)
Suction Anchors	8	Removal as part of the works undertaken to install the replacement offloading system.	Onshore for recycling.
Shuttle tanker mooring and loading Interface Buoy	1	Removal as part of the works undertaken to install the replacement offloading system.	Returned to equipment owner.
Mooring Lines (Chain Element)	8	Removal as part of the works undertaken to install the replacement offloading system.	Onshore for recycling.
Mooring Lines (wire element)	8	Removal as part of the works undertaken to install the replacement offloading system.	Onshore for recycling.
Mooring Line (Tri-plates)	8	Removal as part of the works undertaken to install the replacement offloading system.	Onshore for recycling.
Mooring Line Shackles	24	Removal as part of the works undertaken to install the replacement offloading system.	Onshore for recycling.

Table 3.1: Subsea Installations and Stabilisation Features			
Subsea installations including stabilisation features	**Number**	**Option**	**Disposal Route (if applicable)**
Wire Sockets	16	Removal as part of the works undertaken to install the replacement offloading system.	Onshore for recycling.
Messenger + Pick up line with marker buoys & navigation warning lights	1	Removal as part of the works undertaken to install the replacement offloading system.	Onshore for disposal.
Wellheads	N/A	N/A	N/A
Manifolds	N/A	N/A	N/A
Templates	N/A	N/A	N/A
Production Frames	N/A	N/A	N/A
Concrete Mattresses	N/A	N/A	N/A
Grout bags	N/A	N/A	N/A
Formwork	N/A	N/A	N/A
Frond Mats	N/A	N/A	N/A
Rock Dump	N/A	N/A	N/A

3.3.1 Suction Anchors Comparative Assessment

The system includes amongst its elements, eight suction anchors which are utilised in the provision of the mooring capability of the system. Due to their unique seabed application type, the suction anchors have been the subject of a specific decommissioning options review.

This took the form of a formal removal options Comparative Assessment (CA) [2], in which various technical options previously developed in dealing with these types of anchors, were considered. The options were then ranked through a process as described in the following sections.

3.3.2 Comparative Assessment Method

A CA of the suction anchors decommissioning options was conducted by an independent consultant, Project Development International (PDi), following their process and terms of reference, derived from and underpinned by the requirements of OSPAR.

Initially eleven decommissioning methods were considered for decommissioning of suction anchors. The eleven options are listed in Table 3.2 on page 25.

Based on a technical feasibility review the eleven options were reduced to seven. These seven options were brought forward for Comparative Assessment.

Comparative Assessment Session:

The CA session was held in TAQA offices on the 15th December 2014 and facilitated and chaired by PDi and attended by a number of stakeholders in the project, including:

- TAQA
- Maersk Oil
- Joint Nature Conservation Committee (JNCC)
- Marine Scotland Science (MS)
- Environ (Independent environmental consultants)
- Scottish Fisheries Federation (SFF) – who, whilst not present on the day, had been advised of and consulted on the options being put forward for comparative assessment and provided feedback as to their position on each option.

In order to compare the options, each option was scored against a set of assessment criteria in the following categories:

- Safety
- Environmental
- Technical
- Societal
- Reputational
- Ongoing Liability
- Economic.

3.3.3 Suction Anchors Specific Decommissioning Options

An initial decommissioning scope development process generated a number of anchors specific decommissioning options. The table below covers all the options tabled in the Suction Anchors Decommissioning Options Selection Report[1] and identifies which options were disregarded and which options were subject to the Comparative Assessment Review.

Table 3.2: Suction Anchors Decommissioning

Option 1	**Leave in situ until end of field life, then fully recover.**	**Taken forward for Comparative Assessment.**
This option involves an initial offshore campaign to install protection over any suction anchors that lie outside the exclusion zone of the new loading system. Protection would consist of either rock dump or GRP/steel covers to prevent trawl gear snagging on the anchor. A second offshore campaign will be performed at the end of the Harding field life, to remove the protection covers and suction anchors.		
Option 2	**Leave in place to degrade naturally.**	**Taken forward for Comparative Assessment.**
This option proposes leaving the suction anchors in place, with no remedial protection and allows them to degrade naturally over time.		
Option 3	**Leave in place to degrade naturally but cover with rock to provide over-trawlability.**	**Taken forward for Comparative Assessment.**
Similar to option 2. In this case the anchors will be left in situ to degrade naturally, however they will also be covered with rock to provide overtrawlability. Estimate to cover all anchors 8,400 tonnes of rock, impacting area of 0.003 km², ref appendix 2		
Option 4	**Complete removal by reverse installation.**	**Taken forward for Comparative Assessment.**
This option involves applying a reverse installation method, during which water is pumped into the anchors to force them out of the seabed. The anchors will then be recovered back to the vessel deck and transported for onshore disposal/recycling.		
Option 5	**Complete removal by direct pull.**	**Taken forward for Comparative Assessment.**
This option involves divers installing rigging onto the suction anchors pad-eyes and opening the top vent on the anchors. Following this, a suitable heavy lift vessel will be mobilised to perform the direct pull of the anchors from the seabed. The anchors will be recovered to shore for disposal/recycling.		
Option 6	**Leave in situ and install Frond Mats**	**Disregarded, insufficient sediment in water column to encourage sediment deposits to build up.**
The suction anchors are to be left in situ, and frond mattresses are to be installed over them to encourage natural coverage.		
Option 7	**Leave in situ and drive to depth**	**Disregarded due to the high noise, vibration and the anchor was not designed with this application in mind.**
Using subsea piling equipment, drive the suction anchors to an agreed depth below the seabed and allow to backfill naturally.		
Option 8	**Complete removal by external excavation**	**Disregarded due to the large volume of seabed material that would be required to be removed from around the anchor.**
Use of dredging/excavation equipment to remove sufficient seabed around the suction anchors for them to be easily removed. Estimated 54,000m^3 (108,000 tonnes) of material would be excavated, impacting an area of 0.018km².		
Option 9	**Complete removal by water injection**	**Disregarded – due to technical difficulty. To be successful, the lifting of the anchor would have to be completed whilst the soils in the full length of the anchor were 'fluidised'.**
This option involves the fabrication of bespoke tool used to inject water around the circumference of the suction anchors, and allow it to be completely removed.		
Option 10	**Complete removal by reverse installation preceded by partial excavation**	**Disregarded – due to the large volume of seabed material that would be required to be removed from around the anchor.**
This option is a combination of options 4 and 8 – firstly partially excavate around the suction anchors, followed by the reverse installation process to completely remove the suction anchors.		
Option 11	**Partial removal by cut and burial.**	**Taken forward for Comparative Assessment.**
This option proposes to dredge around the circumference of the suction anchors and perform an initial cut of the internal stiffening beam. A second cut around the circumference of the anchors will then be performed, and the top section removed. A final cut of the remaining internal stiffening beam will then be carried out. The cut sections will be recovered to the vessel and transported onshore for disposal/recycling.		

3.3.4 Weighted Assessment

Weightings were given to each category of the comparative assessment. The weight factors were derived in consultation with TAQA in accordance with their corporate policies, and are presented in Table 3.3 below. Safety was judged as being the most critical category and is therefore applied the highest weighting.

Table 3.3: Weight Factors

Category	Weight factor
Safety	1.5
Environmental	1.3
Technical	1.0
Societal	1.1
Reputation	1.1
Ongoing Liability	1.2
Economic	1.2

3.3.5 Weighted Results

The following table lists the weighted options results.

Table 3.4: Weighted Comparative Assessment Summary Options Table

Assessment Criteria	Weight factor	Option 1a: Installation temporary fishing friendly protection cover	Option 1b: Complete removal by reverse installation at end of field life	Option 3: Place rock over suction anchors and leave to degrade	Option 4: Complete removal by reverse installation	Option 5: Complete removal by direct pull	Option 11: Partial removal and burial
Safety							
Risk to offshore personnel - Construction vessels	1.5	6	6	3	6	6	6
Risk to offshore personnel - Subsea (divers)		6	3	1.5	3	3	9
Risk to onshore personnel		1.5	13.5	3	13.5	13.5	13.5
Residual risk to other users of the sea		6	1.5	6	1.5	1.5	1.5
Environmental							
Physical Presence	1.3	7.8	1.3	7.8	1.3	7.8	7.8
Seabed Disturbance		7.8	7.8	7.8	7.8	7.8	20.8
Noise and Vibration		7.8	11.7	11.7	11.7	11.7	15.6
Atmospheric Emissions		5.2	5.2	5.2	5.2	5.2	5.2
Marine Discharges		5.2	5.2	5.2	5.2	5.2	5.2
Solid Waste		5.2	5.2	5.2	5.2	5.2	5.2
Loss of Containment		1.3	5.2	1.3	5.2	5.2	5.2
Technical							
Technical Challenge	1.0	6	12	2	9	16	9
Weather Sensitivity		6	8	4	8	8	8
Use of technology or equipment		4	6	1	4	8	4
Societal							
Fisheries Impacts	1.1	6.6	1.1	6.6	1.1	1.1	4.4
Amenities		3.3	6.6	3.3	6.6	6.6	6.6
Reputation							
Risk to Company	1.1	6.6	2.2	6.6	2.2	2.2	4.4
Ongoing liability	1.2	14.4	1.2	14.4	1.2	1.2	7.2
Economic	1.2	10.8	10.8	14.4	10.8	19.2	14.4
Individual Average Score:		**6.18**	**5.97**	**5.79**	**5.71**	**7.07**	**8.05**
Category Average Score:		**7.53**	**5.52**	**7.48**	**5.28**	**7.14**	**7.90**

3.3.6 Comparative Assessment Options Selection Results

Table 3.5: CA Option Selection Results			
Removal Option	**CA outcome order**	**Description**	**Score**
1a	6	Installation of suitably engineered temporary over fishing friendly protection cover.	7.53
1b	3	Complete removal by reverse installation (at end of Harding field life).	5.52
2	1	Leave in place to degrade naturally.	*
3	5	Place rock over suction anchors and leave to degrade.	7.48
4	2	Complete removal by reverse installation.	5.28
5	4	Complete removal by direct pull.	7.14
11	7	Partial removal and burial.	7.90

Notes *Option 2 “Leave in place to degrade naturally” was initially scored but on advice from stakeholder that this option was unacceptable and due to current DECC policy, the option was not taken forward for the weighted assessment.

3.3.7 Comparative Assessment Selected Option

Table 3.6: Selected Option		
Removal Option	**CA outcome order**	**Description**
4	2	Complete removal by reverse installation.

Option 2 was not considered viable due to concerns raised by stakeholder and current DECC policy. As a result Option 4 is ranked the first in the CA review. However it is recognised that the success of Option 4 cannot be guaranteed; see sub-section 3.3.8 and Appendix 2 below.

Option 5 was not considered viable due to the following reasons;

- The calculated loads required to direct pull the suction anchors out of the seabed were between 450 tonnes and 1600 tonnes.
- The suction anchor lift points (padeyes) are only designed for 55 tonnes each and would not be suitable for the loads required for direct pull
- There are currently no vessels that operate in the North Sea capable of providing the required lift capacity
- Cranes are not designed to withstand the significant shock load that occurs when anchor breaks free from the soil

Options 1a and 1b were considered to represent a single option but as there are two work campaigns they were evaluated separately in the CA review. However, degradation of the suction anchor in the period to end of field life is expected to prevent successful reverse installation so this option is not considered to be viable.

3.3.8 Suction Anchor Removal by Reverse Installation

A technical note is included in Appendix 2 providing more information on the reverse installation technique, the potential failures of the technique and mitigations for those failures.

It is intended that pressurisation shall be attempted for each anchor, regardless of any failures encountered.

The potential failures of reverse installation are (1) failure to achieve the required pressurisation, or (2) that the suction anchor / seabed soil interaction presents a resistance to the technique that requires an applied pressure, and / or flowrate, higher than predicted and which is not achievable. Where there are failures, of reverse installation that can be remedied using reasonable endeavours to carry out repairs, these shall be carried out in 2016 and pressurisation re-applied. However, failures which are due to soil piping or which for any other reason requires further engineering, potentially bespoke fabrication and / or novel solutions (complex failures), are not viable for repair / rectification to be effected in 2016.

Carrying out repairs of complex failures would require bespoke engineering, e.g. injection of drill mud or injection of leak sealant compounds. Such bespoke engineering would be unproven, have no guarantee of success and would require increased diving work, which would increase the safety and environmental impact, and would also be more costly.

If the design pressure (installation pressure +10%) is successfully applied and the suction anchor does not move then the reverse installation method is not viable and requires utilisation of another removal method which increases the safety and environmental impact, and would be more costly.

Therefore, it is intended to remove all anchors in 2016 using the reverse installation method. However, in the event of failure of the reverse installation method in 2016, where the failure is due to or resulting from a complex failure (i.e. further work would be required to identify a method to complete reverse installation after 2016), it is intended, following liaison and agreement with DECC, to cover the anchor, by rockdump and leave in situ; see Appendix 2 for estimate of rockdump quantity. It is considered that the ‘partial recovery’ of an anchor, i.e. suction anchor not fully removed from seabed at failure of reverse installation, is, after detailed engineering and utilisation of optimal removal procedure, rated as very unlikely / very low risk.

Figure 3.1 illustrates the decision flowchart intended for the suction anchor removal by reverse installation.

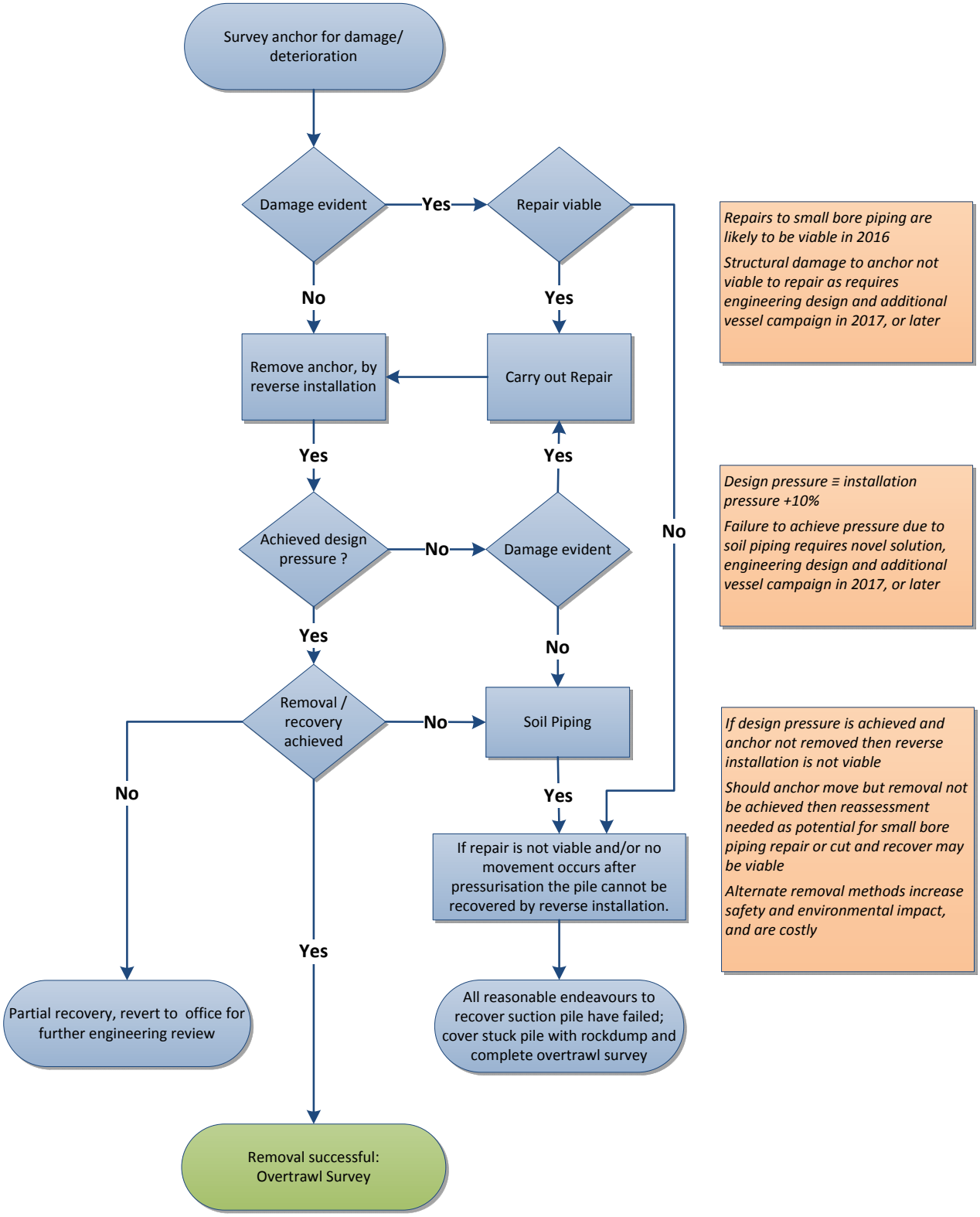


Figure 3.1 Removal by Reverse Installation Flowchart

3.4 Pipelines

No pipelines are being decommissioned as part of the STL decommissioning, however; the Harding oil export pipeline, PL1176 will be modified as defined in a variation to PWA 23/W/95.

3.5 Pipeline Stabilisation Features

N/A

3.6 Wells

N/A

3.7 Drill Cuttings

N/A

3.8 Waste Streams

Table 3.7: Waste Stream Management Methods	
Waste Stream	**Removal and Disposal method**
Bulk Liquids	N/A
Marine Growth	The bulk will be removed at sea, as part of the decommissioning recovery process and prior to return to shore. The remainder will be the subject of removal and disposal under appropriate guidelines.
NORM/LSA Scale	N/A
Asbestos	N/A
Other hazardous wastes	N/A
Onshore dismantling sites	It is the intention to use a licensed, TAQA preferred, waste management contractor, with a demonstrable proven track record in recycling and correct disposal capabilities.

Table 3.8: Inventory Disposition			
	Total Inventory Tonnage	**Planned Tonnage to shore**	**Planned left** (*in situ*)
Subsea 'other'	1629 Te	1629 Te	0

4.0 ENVIRONMENTAL IMPACT ASSESSMENT

4.1 Environmental Sensitivities Summary

TAQA commissioned an Environmental Report[3] that presents the findings of the independent environmental analysis, which has been completed to identify and evaluate the potential environmental effects associated with the preferred decommissioning option for the STL in the Harding field. The following tables summarises the key findings of this Environmental Report.

Table 4.1: Environmental Sensitivities

Environmental Receptor	Main Feature
Conservation interests	**Habitats Directive Annex I Habitats:** No Annex I habitats are recorded or have been confirmed within 5km of the STL. Small areas of *Lophelia pertusa* have *potentially* been recorded on the STL pipeline end manifold (PLEM) and risers during ROV survey (2014) although the resolution of current footage is insufficient to make a positive identification. The Braemar Pockmarks are the closest designation located approximately 20km from the STL. **Habitats Directive Annex II Species:** Harbour porpoise sightings are recorded regularly in the study area. **Habitats Directive Annex IV:** All cetacean species are listed, making it an offence to kill, injure, capture or disturb these animals. **CITES**: Small areas of *Lophelia pertusa* have *potentially* been recorded on the STL Mooring Buoy structures (PLEM and risers) during ROV survey 2014. **OSPAR Convention Annex V Species**: Species with recorded distributions in the area of the STL are; Lesser black-backed gull, Little shearwater, Balearic shearwater, Black legged kittiwake, Iberian guillemot, Basking shark, Common skate, Spotted ray, Porbeagle shark and Harbour porpoise. **OSPAR Convention Annex V Habitat:** Small areas of *Lophelia pertusa* have *potentially* been recorded on the STL Mooring Buoy structures (PLEM and risers) during ROV survey (2014). Burrowing megafauna communities are also potentially indicated to occur in the area (visible burrows in the ROV footage). Offshore deep sea mud habitats are recorded approximately 7km from the STL. **Scottish Biodiversity Action Plans (BAPs):** Species with recorded distributions in the study area are; Manx shearwater, European storm petrel, Arctic skua, Herring cull and Arctic tern. **Priority Marine Feature (PMFs):** Species with recorded distributions in the area of the STL Mooring Buoy are; Saith, Norway pout, Whiting, Mackerel, Basking shark, Blue shark, Common skate, Porbeagle shark, Sandy ray, Spiny dogfish, Minke whale, White beaked dolphin, Atlantic white sided dolphin, Harbour porpoise, Harbour/common seal and the Grey seal.
Seabed	**Depth to seabed:** Up to 115m in the area. **Seabed classification:** Mud and sandy mud. **Seabed features:** The ROV footage of the seabed immediately surrounding the suction anchors does not provide any evidence of biogenic reef, pockmarks or unusual formations. There is evidence of burrows which indicate burrowing megafauna. **Seabed contamination:** Sampling carried out around the Platform included one sample approximately 500m away from the STL system (Gardline, 2013). This sample demonstrated less than background concentrations for all contaminants other than naphthalene and iron. Samples carried out in the wider area indicated little evidence of pronounced cuttings piles. The survey report concluded that 'based on previously published information, ecological impacts of hydrocarbons from the Platform in the concentrations found at all bar one of the stations are likely to fall somewhere between negligible and intermediate.'
Benthos	Benthos sampling at 500m from the STL indicated an ecologically diverse Benthos including annelids, crustaceans, molluscs and echinoderms. ROV video footage of the immediate area around the structures, and including the structures, indicated an abundance of echinoderms, cnidarian, crustaceans and algae.

Table 4.1: Environmental Sensitivities	
Environmental Receptor	**Main Feature**
Plankton	Blooms of phytoplankton occur every spring, followed by a smaller peak in the Autumn. The last publicly available dataset from 2001 demonstrated population peaks of various *Ceratium* species in February, June to August and October to November in the area of the STL (SAHFOS Win CPR). Zooplankton populations peak approximately two months following the increase in phytoplankton populations.
Fish	The STL is located within known spawning grounds of haddock (Feb to May), Saithe (Jan to April), Norway pout (Jan to April), Whiting (Jan to June) and Nephrops (all year round). Mackerel use the area as a nursery ground. Blue whiting use the area as juvenile fish. Important commercial adult fish species include Herring, Haddock, Saithe, Whiting, Mackerel, Cod, Norway pout, Sprat and Sandeel, Six species of sharks are also regularly recorded in the area (each with various conservation designations). The Basking shark is recorded in the area in high numbers between April and October coinciding with the peak plankton blooms.
Fisheries	Landings in the ICES rectangle 47F1 are dominated by demersal fisheries, although in some years, pelagic fisheries comprise a large component. Total landings in this area are lower than in other adjacent ICES rectangles. Demersal fisheries target Cod, Haddock and Whiting. Various fishing methods are used, with towed gear such as trawls and Scottish seine netting predominating.
Marine Mammals	The most commonly sighted marine mammals in the area around the STL Mooring Buoy are Minke whale (*Balaenoptera acutorostrata)* (May to Sept), White beaked dolphin (*Lagenorhynchus albirostris)* (June to November), Harbour porpoise *(Phocoena phocoena)* (April to September) and Atlantic white side dolphin (*Lagenorhynchus acutus*) (June to Sept). The Harbour porpoise is the most frequently sighted species. Other cetaceans are also recorded on a less regular basis. Harbour seals (*Phoca vitulina*) and Grey seals (*Halichoerus grypus*) are also recorded in the vicinity of the STL. Research carried out recently using tracking methods indicates minimal usage of this area and the immediate vicinity.
Birds	18 species of seabird are recorded regularly in the area around the STL. Vulnerability of individual species varies dependent upon the life cycle, bio-geographical population, conservation status, potential for recovery and contact time with the water. Overall, seabird vulnerability to oil pollution in the vicinity of Buoy is classified as 'High' in January, February, July and November and between 'moderate and only a few birds' in all other months.
Onshore Communities	An onshore decommissioning facility will be used for the final disposal of suction anchors during decommissioning that complies with all relevant permitting and legislative requirements.
Other Users of the sea	**Shipping**: No commercial ferry routes are located in proximity to the area. Fishing vessels will occur regularly in the vicinity. **Wrecks and historic artefacts:** No records exist of archaeological remains in the vicinity of the STL Mooring Buoy. **Ministry of Defence:** There are no offshore areas in the vicinity of the STL used by the Ministry of Defence (MOD). **Communication infrastructure:** The STL is located approximately 11.61 miles to the North East of active telecom cables. **Tourism:** No tourism activities are recorded to be carried out in the vicinity of the STL site.
Atmosphere	Local atmospheric conditions are influenced by emissions from nearby gas and oil facilities and vessel usage. Predominant wind direction and strength varies seasonally and will affect movement of any atmospheric emissions.

4.2 Potential Environmental Impacts and their Management

Environmental Impact Assessment Summary:

The Environmental Report (ER) identifies potential environmental effects by identifying interactions between the proposed decommissioning activities associated with the STL and the local environment while considering responses from stakeholders. The ER also details mitigation measures designed to avoid and reduce the identified potential environmental impacts and describes how these will be managed in accordance with TAQA established Environmental Management System (EMS).

The evaluation of the potential effect of the preferred option for decommissioning of the STL utilized a standard structured methodology based on established best practice guidance and the professional judgment of environmental specialists. The application of the methodology also draws, where appropriate, on previous experience and lessons learned from other decommissioning projects. Following this evaluation, which was completed through a workshop and subsequent environmental risk assessment, the ER concludes that the recommended options to decommission the redundant STL can be completed without causing significant impact to the environment.

Those activities that had a potential for a significant impact are summarised in Table 4.2, along with the proposed environmental management strategy. There will be no planned use of underwater explosives during these activities. We acknowledge that there will be a requirement for an environmental protection plan to be produced and submitted to JNCC should this plan change.

Impact Assessment Overview:

Table 4.2: Environmental Impact Management		
Activity	**Main impacts**	**Management**
Topsides Removal	N/A	N/A
Jacket(s)/Floating Facility removal	N/A	N/A
Subsea Installation(s): Removal of Shuttle tanker mooring & Loading interface Buoy	Whilst a number of activity/receptor interactions were considered in relation to this specific activity, none were considered likely to give rise to significant environmental effect.	Flushing will be completed from platform to tanker through the existing closed system and disconnection and removal will only take place once infrastructure has been cleaned of hydrocarbons and other potential contaminants. Buoy and risers will be recovered to deck and removed.
Subsea Installation(s): Removal of Mooring Lines	Underwater noise: Disturbance to marine mammals	Offshore vessels will avoid concentrations of marine mammals. All work programmes will be planned to optimise vessel time in the field. Similar noise levels are anticipated to those currently experienced in the area from commercial shipping and oil industry supply vessels. Minke whale, White beaked dolphin and Atlantic white-sided dolphin are known to be present in the area in the summer months at a low frequency (0.01 - 0.09/km) therefore there is unlikely to be significant disturbance.
Subsea Installation(s): Removal of Suction Anchors	Seabed Disturbance: Direct disturbance to localised area of seabed during suction anchors removal by reverse installation. Some localised sediment entrainment and smothering of benthic organisms through subsequent sediment settlement within close proximity to suction anchors.	All efforts will be made to reduce seabed disturbance to an absolute minimum. Where there are areas affected, they will be left in a condition fit for other users of the area; Disturbed seabed sediments will rapidly settle out or be dispersed by localised bottom currents.
	Underwater noise: Disturbance to marine mammals	Offshore vessels will avoid concentrations of marine mammals. Removal by reverse installation for each of the suction

Table 4.2: Environmental Impact Management		
Activity	**Main impacts**	**Management**
		anchors will be short duration operations and all work programmes will be planned to optimise vessel time in the field. Similar noise levels are anticipated to those currently experienced in the area from commercial shipping and oil industry supply vessels. Minke whale, White beaked dolphin and Atlantic white-sided dolphin are known to be present in the area in the summer months at a low frequency (0.01 - 0.09/km) therefore there is unlikely to be significant disturbance.
	Effects on Commercial Fisheries: Damage or loss of fishing gear/Dropped objectives.	UK Hydrographical Office and Kingfisher will be informed of all activities and of any structures left in place. Although not anticipated that any structures will be left in place, in the event that this is required they will be left in such a way that they present no greater risk to other users than at present. TAQA will via established lines of communication, e.g. kingfisher, Fish-safe, SFF bi annual updates, UK hydrographic office, seek to inform other sea users, including fishermen, of vessel operations during decommissioning activities. A post-decommissioning as-left survey will be conducted at the end of decommissioning, and any debris discovered and found to be a part of the removal operation, or off the elements previously removed, shall be recovered.
	Designations: Small areas of possible *Lophelia pertusa* growth have been observed in ROV footage on STL structures (PLEM and risers) Due to the resolution and orientation of the footage it has not been possible to make a confirmed identification of this feature.	No possible incidents of *Lophelia pertusa* coral have been recorded on the suction anchors. The PLEM is to be left in situ and reused in the replacement system. Small incidents of marine growth which *may* be *Lophelia* were identified in ROV footage of the risers. If confirmed it is considered unlikely that these incidents would comprise a coherent

Table 4.2: Environmental Impact Management		
Activity	**Main impacts**	**Management**
		biogenic reef habitat with sustainable ecosystem functionality; It is anticipated that this would be removed along with any other marine growth, prior to removal.
		A risk of both water column and sediment contamination does exist from oil spills from vessel activity during decommissioning. Standard operating procedures according to TAQA's relevant oil pollution emergency plan (OPEP) will be in place at all times to control this and mitigate any consequences from such spills. As no hydrocarbons or chemicals have been associated with the long term operation of the suction anchors it has been assumed no potential for large scale spills of historic hydrocarbon contaminants from suction anchor removal, and Continual monitoring of fuel status will be completed with regular visual inspections of sea surface throughout the works.
	Accidental events: oil/diesel spill discharges:	As no hydrocarbons or chemicals have been associated with the long term operation of the suction anchors and no use of chemicals is anticipated, no resultant discharges to seawater are expected.
	Energy Use and Emissions:	Vessels will be audited as part of selection and pre-mobilisation and only efficient service vessels will be utilised. Work programmes will be planned to optimise vessel time in the field.
Decommissioning Pipelines	N/A	N/A
Decommissioning Stabilisation Features	N/A	N/A
Decommissioning Drill Cuttings	N/A	N/A

5.0 INTERESTED PARTY CONSULTATIONS

Consultations Summary:

Table 5.1: Summary of Stakeholder Comments

Stakeholder	Comment	Response
INFORMAL CONSULTATIONS		
Marine Scotland	Initial engagement by email November 2014, followed by face to face meeting at Marine Scotland's offices in December 2014 to brief on the decommissioning scope covered. Marine Scotland were invited to the Comparative Assessment held in December 2014.	After initial engagement in December, Marine Scotland attended and contributed to the formal CA held later that same month, and any further comment, if required, would be made to the Decommissioning Programme during the consultation process.
Joint Nature Conservation Committee (JNCC)	Initial engagement by email November 2014, followed by face to face meeting in December 2014 at JNCC's offices, to brief on the decommissioning scope covered. JNCC were invited to the Comparative Assessment held in December 2014.	After initial engagement in December, JNCC attended and contributed to the formal CA session held later that same month. Any further comment if required would be made to the Decommissioning Programme during the consultation process.
HSE	Initial engagement by previously arranged telephone conference, December 2014, where a briefing was given of the decommissioning scope. This was followed by an email summary of the discussion and outcome. The HSE were invited to the Comparative Assessment held in December 2014.	The HSE declined the invitation to the CA on the basis that the scope presents no areas of specific concern. Any further comment, if required, would be made to the Decommissioning Programme during the consultation process.
STATUTORY CONSULTATIONS		
National Federation of Fishermen's Organisations (NFFO)	Initial engagement made with a phone call and followed up by e-mail on the 21st of May 2015.	NFFO have developed a joint position on decommissioning with the SFF and would like to be copied on any consultation for good order.
	Revision R6 issued to NFFO.	Letter received in response to revision R6 confirming 'no adverse comments'; see Appendix 1.3.
Scottish Fishermen's Federation	Initial engagement with a face to face meeting at the SFF offices in Aberdeen to brief on the decommissioning scope. The SFF's position on the decommissioning options discussed was made clear, with a preferred set of options indicated in this meeting. The SFF were invited to the Comparative Assessment held in December 2014.	SFF were unable to attend meeting in December 2014 due to commitment clashes. Their view of the options covered in the face-to-face was provided in their absence, and any further comment, if required, would be made to the Decommissioning Programme during the consultation process.
	Meeting held 2 September to present the proposals contained in the draft Decommissioning Programme.	No objections raised to TAQA's proposals for the Decommissioning Programme. TAQA provided, post-meeting, further information on the proposed new 500m safety zone and scour at mooring leg touch-down.
	Revision R6 issued to SFF.	Letter received in response to revision R6 confirming 'no adverse comments'; see Appendix 1.2.
Northern Irish Fish Producers Organisation (NIFPO)	Initial engagement made with a phone call on the 21st of May 2015 and followed up e-mail providing additional information.	NIFPO advised verbally that due to the location of the facilities and because we are in communication with the SFF that was sufficient. NIFPO followed up with an e-mail dated the 29/5/2015 advising that they had no comment to make as Harding is outwith the area that NIFPO operate; refer to Appendix 1.4.

Table 5.2: Summary of Stakeholder Comments		
STATUTORY CONSULTATIONS (continued)		
Stakeholder	**Comment**	**Response**
Public	A public consultation exercise has been undertaken, from 18 September to 19 October 2015, with advertisements taken out in Edinburgh Gazette, Times and Aberdeen Pres and Journal; refer to Appendix 1.1. Copies of the Decommissioning Programme were made freely available from TAQA office (located in Westhill, Aberdeenshire, Scotland) during the consultation period. Revision R6 of the Decommissioning Programme was also placed on the DECC website: DECC Decommissioning Programme website.	No concerns or objections were raised.
Global Marine Systems	Revision R6 issued to Global Marine Systems.	Email received in response to Revision R6 stating there were no specific comments to the programme of works; refer to Appendix 1.5.

6.0 PROGRAMME MANAGEMENT

6.1 Project Management and Verification

A TAQA Project Management team will be appointed to manage the sub-contractors for the removal of the STL. TAQA standard procedures for operational control and hazard identification and management will be used. TAQA will monitor and track the process of consents, permits and consultations required as part of this process. Any changes in detail to the offshore removal programme will be discussed with DECC.

6.2 Post-Decommissioning Debris Clearance and Verification

A post-decommissioning activity debris survey will be conducted. Any debris discovered and found to be a part of the STL or its removal operation shall be recovered for onshore disposal, in line with existing disposal methods.

Independent verification of the seabed at the site of the recovered anchors and mooring system will be obtained by over-trawling the seabed. This will be supported by a Certificate of Clearance which will be submitted to DECC.

The post decommissioning survey results will be notified to the UK Fisheries Offshore Oil and Gas Legacy Trust Fund Ltd (FLTC) for inclusion in their Fish Safe system, and for notification and marking on Admiralty Charts and notices to Mariners. The UK Hydrographical Office and Kingfisher will be informed.

6.3 Decommissioning Programme

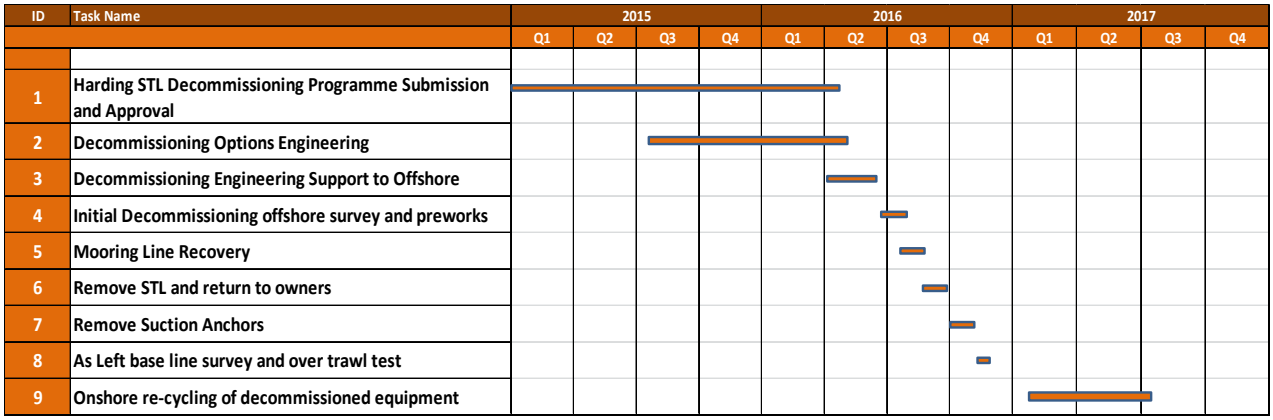


Figure 6.1 Decommissioning Programme

6.4 Costs

An overall cost estimate (covering the items shown in Table 6.1 below) has been provided to DECC in confidence.

Table 6.1: Provisional Decommissioning Programme(s) costs

Item	Estimated Cost (£m)
Subsea Installation(s) and stabilisation Feature(s)	Provided to DECC
Continuing Liability	Provided to DECC
TOTAL	**Provided to DECC**

6.5 Close Out

On completion of the decommissioning scope in its entirety, a close out report will be submitted to DECC within 4 months.

Within the report will be independent verification of debris removal and verification of seabed clearance.

Any variances from the approved Decommissioning Programme will be explained in the close out report.

6.6 Post-Decommissioning Monitoring and Evaluation

It is anticipated that due to the removal process employed in decommissioning the mooring elements of the STL, there will be no requirement to complete further surveys, following completion of the 'as left' survey.

Notwithstanding, if the removal of suction anchors is unsuccessful, and there are some left in situ covered with rockdump, then the requirement for post-decommissioning surveys shall be reviewed in consultation with DECC and their statutory consultees.

7.0 SUPPORTING DOCUMENTS

Table 7.1: Supporting Documents		
	Document Number	**Title**
1.	HAR-01031-DEC-SS-REP-0001-PDI	Suction Anchors Decommissioning Options Selection Report
2.	HAR-01031-DEC-SS-REP-0003-PDI	Suction Anchors Comparative Assessment Report.
3.	HAR-01031-DEC-EN-REP-0001-ENV	TAQA Harding STL Decommissioning Environmental Assessment Report

8.0 PARTNERS LETTER(S) OF SUPPORT

A Partner Letter of Support from the other current equity holder (Maersk Oil North Sea UK Limited) is presented below.

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Date: 25 January 2016

Department of Energy and Climate Change
Offshore Decommissioning Unit
3rd Floor
Atholl House
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AB11 6AR

Dear Sir/Madam

HARDING SUBMERGED TURRET LOADING SYSTEM DECOMMISSIONG PROGRAMME

We acknowledge receipt of your letter dated 15 December 2015.

We, Maersk Oil North Sea UK Limited, confirm that we authorise TAQA Bratani Limited to submit on our behalf an abandonment programme relating to the Harding Submerged Turret Loading System as directed by the Secretary of State on 15 December 2015.

We confirm that we support the proposals detailed in the Harding Submerged Turret Loading System Decommissioning Programme, dated 17 December 2015 which is to be submitted by TAQA Bratani Limited in so far as it relates to those facilities in respect of which we are required to submit an abandonment programme under section 29 of the Petroleum Act 1998.

Yours faithfully

Director
For and on behalf of Maersk Oil North Sea UK Limited

APPENDIX 1

Public Notice and Statutory Consultee Correspondence

APPENDIX 1.1 Public Notices

TAQA BRATANI LIMITED
PETROLEUM ACT 1998
REPLACEMENT OF HARDING FIELD OIL EXPORT SYSTEM SUBMERGED TURRET LOADING SYSTEM DECOMMISSIONING PROGRAMME

TAQA Bratani Limited ("TAQA") has submitted, for the consideration of the Secretary of State for Energy and Climate Change, a draft decommissioning programme for the replacement of the obsolete Harding field Submerged Turret Loading system ("STL"), in accordance with the provisions of the Petroleum Act 1998 (The Act). It is a requirement of the Act that interested parties be consulted on such proposals.

The items covered by the Harding field STL draft decommissioning programme are located 2km to the east of the TAQA operated Harding platform in block 9/23b, 320km north-east of Aberdeen in the Central North Sea. The STL, which is to be replaced with a new offshore Loading System to enable the export of hydrocarbons from the Harding platform to shuttle tankers for the remaining economic life of the field, is comprised of eight suction anchors, eight mooring lines, a messenger/pick-up line, marker buoys, offloading riser and the submerged turret.

TAQA hereby gives notice that the Harding STL's draft decommissioning programme is available from the following location during office hours or can be requested by email as indicated:

TAQA Bratani Limited
TAQA House
Prospect Road
Arnhall Business Park
Westhill Aberdeenshire
AB32 6FE
Contact Sandy Hutchison, Legal, Commercial and Business Services Director:
01224 275275
Sandy.Hutchison@taqaglobal.com

Representations regarding the draft decommissioning programme should be submitted in writing to Sandy Hutchison at the above address where they should be received by the consultation closing date, Monday 19th October, and should state the grounds upon which any representations are being made. (2403437)

Public Notice Edinburgh Gazette 21 September 2016

PUBLIC NOTICE

PETROLEUM ACT 1998

Replacement of Harding Field Oil Export System

Submerged Turret Loading System Decommissioning Programme

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Contact Sandy Hutchison, Legal and Business Services Director:
01224 275275
Sandy.Hutchison@taqaglobal.com

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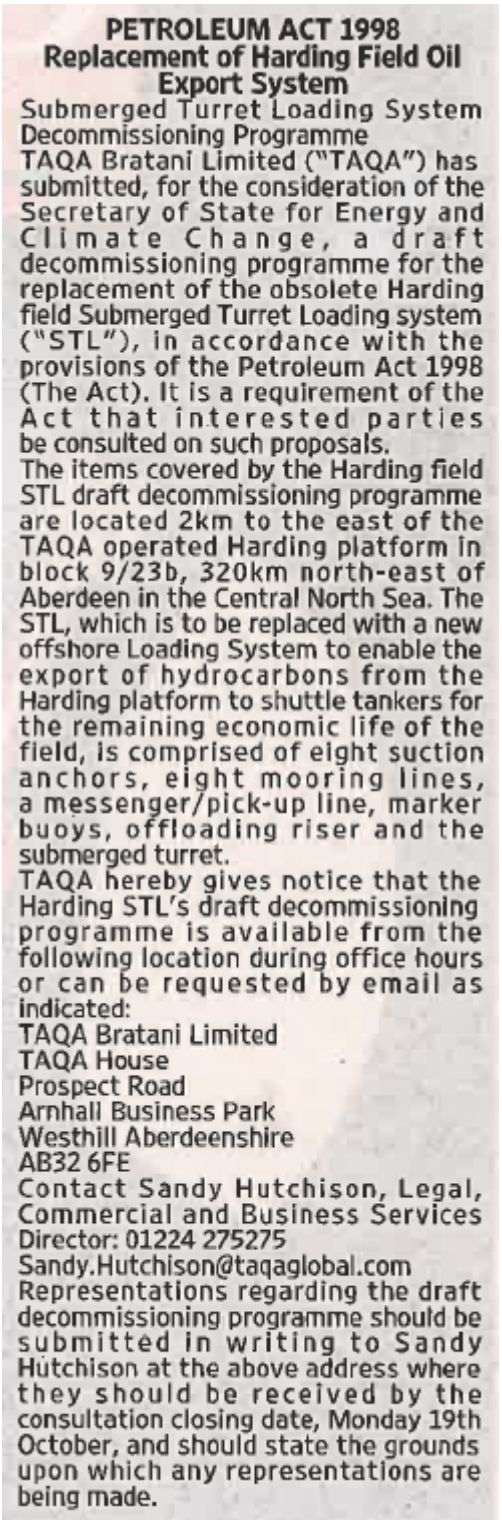
Public Notice The Press and Journal 18 September 2015



PETROLEUM ACT 1998
Replacement of Harding Field Oil Export System

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TAQA Bratani Limited
TAQA House
Prospect Road
Arnhall Business Park
Westhill Aberdeenshire
AB32 6FE

Contact Sandy Hutchison, Legal, Commercial and Business Services Director: 01224 275275
Sandy.Hutchison@taqaglobal.com

Representations regarding the draft decommissioning programme should be submitted in writing to Sandy Hutchison at the above address where they should be received by the consultation closing date, Monday 19th October, and should state the grounds upon which any representations are being made.

Public Notice The Times 18 September 2016

APPENDIX 1.2 SFF Correspondence

SCOTTISH FISHERMEN'S FEDERATION

Our Ref: SA

Your Ref: HLSR-001-Sept-15

6 October 2015

Scottish Fishermen's Federation
24 Rubislaw Terrace
Aberdeen, AB10 1XE
Scotland UK

T: +44 (0) 1224 646944
F: +44 (0) 1224 647058
E: sff@sff.co.uk

www.sff.co.uk

Ronnie Toal
Project Manager – Harding Loading System Replacement Project
TAQA Bratani Limited
Prospect Road
Westhill
Aberdeenshire
AB32 6FE

Dear Ronnie,

TAQA Bratani Limited: Harding Field STL System Decommissioning Programme Consultation

Thank you for your letter of 18 September 2015 and the accompanying Decommissioning Programme for the Harding Submerged Turret Loading System.

I can confirm that the documentation provided has been reviewed by the Scottish Fishermen's Federation (SFF) and that the SFF has no adverse comments to offer.

We would also take this opportunity to thank TAQA for information provided and the opportunity to discuss matters relating to the STL Decommissioning options at earlier meetings.

Yours sincerely,

Steven Alexander
Director of Business Development

APPENDIX 1.3 NFFO Correspondence

NFFO Services Ltd

30 Monkgate
York
YO31 7PF

Tel: 01904 635 432
Fax: 01904 635 431

e-mail: apiggott@nffo.org.uk

22 October 2015

To: Ronnie Toal
From: Alan Piggott

TAQA Bratani Ltd; Harding Field STL System Decommissioning Programme

Dear Ronnie

I would like to present NFFO Services response to the Decommissioning Programme for the Harding Submerged Turret Loading System.

I can confirm that the Programme of the above works have been reviewed by the NFFO and that we have no adverse comments to make in relation to this project.

Yours Sincerely

Alan Piggott
General Manager
NFFO Services.

APPENDIX 1.4 NIFPO Correspondence

See the following page for the email reply received from NIFPO.

Ronnie Toal

From: Ian Kelly <nifpo@btconnect.com>
Sent: 29 May 2015 14:54
To: Craig Stenhouse
Cc: Anthony Yates; Ronnie Toal
Subject: RE: Statutory Consultation Harding Loading System Decommissioning

Thank You for your consultation we have no comment to make as it is out with the area that our members usual operate.

Regards
Ian Kelly

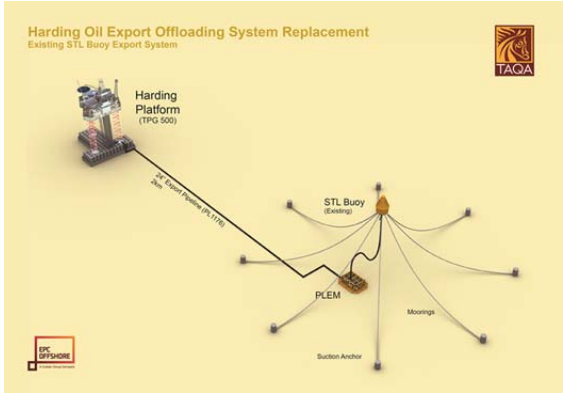
From: Craig Stenhouse [mailto:Craig.Stenhouse@taqaglobal.com]
Sent: 21 May 2015 15:25
To: nifpo@btconnect.com
Cc: Anthony Yates; Ronnie Toal
Subject: Statutory Consultation Harding Loading System Decommissioning

Dear Sir/Madam

NIFPO are listed as a statutory Consultee from DECC for decommissioning activities.

In accordance with the Petroleum Act 1998, TAQA Bratani Limited (TAQA), as the operator of the Harding field STL, and on behalf of the Section 29 holders (see Table 1.2), is applying to the Department of Energy and Climate Change (DECC), to obtain approval for decommissioning the Harding offloading system.

The Harding field is located in the UKCS Licence Block 9/23b in the Central North Sea, approximately 320 km north-east of Aberdeen (Figure 1.3). Water depth at the field is 110m. The field was discovered in January 1988 and first production was in April 1996. The field was operated by BP until June 2013, when TAQA purchased BP's share and took over the operatorship. The field has one central production, drilling and accommodation platform located between the Central and South reservoir accumulations. The Harding platform is a large, heavy-duty jack-up rig fixed to a concrete gravity base structure containing oil storage tanks. The oil is exported from the storage tanks to shuttle tankers via the STL which is located approximately 2km to the east of the platform.
The STL is supported by a submerged mooring and loading interface buoy, which is anchored to the seabed via eight mooring lines and suction anchors. Due to obsolescence the STL will be replaced by a new Offshore Loading System (OLS).

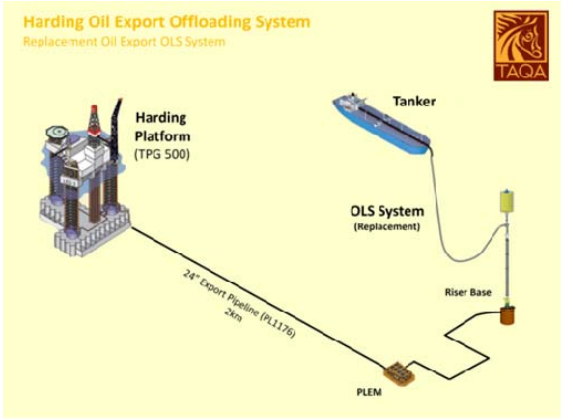


Existing System

The following components of the original system are redundant and will be removed:

- Eight mooring lines and associated components
- Eight steel seabed suction anchors (TBC)
- The shuttle tanker mooring and loading interface buoy and associated components
- The offloading riser *

The replacement system will be an Offshore Loading System, shown below



Replacement System

Please confirm the receipt of this e-mail and should you require any additional information please do not hesitate to give me a call or e-mail.
Please also advise, as discussed if you are happy, that we are in dialogue with the Scottish Fishing Federation.

Many Thanks

Craig Stenhouse
Construction Manager
TAQA Bratani Limited
D +44 (0)1224 286128
M +44 (0)7787148867
Prospect Road, Westhill, Aberdeenshire
AB32 6FE United Kingdom

TAQA
We mean energy
www.taqaglobal.com

APPENDIX 1.5 Global Marine Systems Correspondence

See the following page for the email reply received from Global Marine Systems.

Ronnie Toal

From: Wrottesley, John (GMSL) <John.Wrottesley@globalmarinesystems.com>
Sent: 06 November 2015 12:14
To: Ronnie Toal
Subject: RE: Decommissioning Programme Harding STL System issued for consultation

Hi Ronnie,

Apologies for the delay in responding.

I don't have any specific comments on the programme of works itself as no cables should be directly affected in the immediate vicinity, and if any interaction were unexpectedly to be necessary in the course of engineering the project, then it would be necessary to liaise with the specific cable owners who should be identified as early as possible. Contact details and general cable information for any systems affected can be found using KIS-ORCA cable awareness charts/interactive map http://www.kis-orca.eu/map#.VPmDJHZFDIU. Global Marine Systems would recommend that when notice to mariners are arranged for the offshore works, then the Kingfisher fortnightly bulletin should be updated (Contact: Kingfisher Information Service (kingfisher@seafish.co.uk) to include details of the works to inform sea users as well as notifying the relevant authorities and UKHO.

Please let me know if you require any further information.

Best regards,

John

From: Wrottesley, John (GMSL) [mailto:John.Wrottesley@globalmarinesystems.com]
Sent: 09 October 2015 12:18
To: Ronnie Toal
Subject: RE: Decommissioning Programme Harding STL System issued for consultation

Dear Ronnie,

My colleague passed on your message this morning. Apologies for the delay in responding – I can confirm receipt of the documentation that you sent by email and in the post.

I will review and provide my response asap.

Kind regards,

John

From: Ronnie Toal [mailto:Ronnie.Toal@taqaglobal.com]
Sent: 18 September 2015 07:50
To: Wrottesley, John (GMSL)
Subject: Decommissioning Programme Harding STL System issued for consultation

The attached document, Decommissioning Programme Harding STL System, has been issued for consultation today 18 September. We have sent a copy to Global Marine by post, with the attached letter, and this will arrive in the afternoon, and also attached is an electronic version of the Decommissioning Programme.

I would appreciate if you would reply confirming receipt, or otherwise, of the Decommissioning Programme.

Regards

Ronnie

Ronnie Toal, Project Manager
D +44 1224 737530, M +44 7703 004176, Ronnie.toal@taqaglobal.com

TAQA Bratani Limited Prospect Road, Westhill, Aberdeenshire AB32 6FE United Kingdom

TAQA
We mean energy
www.taqaglobal.com

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APPENDIX 2

Technical Note on Suction Anchor Removal Failure Modes

TAQA

Technical Note on Suction Anchor Removal Failure Modes

HAR-01031-DEC-PM-TNN-0001-TAQ

Report No:	HAR-01031-DEC-PM-TNN-0001-TAQ	
Revision No:	A2	
Report Date:	November 2015	
Signatories:	**Originated by**	**Approved by**
	Craig Stenhouse	**Ronnie Toal**

CONTENTS

1.0 EXECUTIVE SUMMARY

During development of the Decommissioning Programme for the Harding SLS it was identified through comparative assessment that the preferred decommissioning option for the suction anchors is removal by following a reversal of the installation procedure. TAQA have reviewed the installation records and expect to perform a successful recovery of all suction anchors by reverse installation.

However, TAQA have identified a number of potential failure modes and associated contingency measures, and have reviewed the practicality of implementing these contingencies.

- Contingency measures to deal with small bore piping / instrumentation leaks are straightforward and will be part of the onshore engineering preparation for the removal operation.
- Contingency measures to deal with a structural integrity or soil failure would not be considered reasonable (and have a low likelihood of success) and will therefore not form part of the onshore planning process.

In the event that after reasonable endeavours to remove/move the anchor, these attempts have been unsuccessful, the anchor will be covered in rockdump such that it does not pose a hazard to other users of the sea, and left in situ.

In the event that failure occurs part way through recovery (i.e. the anchor protrudes significantly further out of the seabed than initially found) the situation will be assessed prior to any further intervention to determine the appropriate course of action.

2.0 INTRODUCTION

The Harding field is located in the UKCS Licence Block 9/23b in the Central North Sea, approximately 320 km north-east of Aberdeen. Water depth at the field is 110m. The field was discovered in January 1988 and first production was in April 1996. The field was operated by BP until June 2013, when TAQA purchased BP's field equity and took over the operatorship.

The field has one central production, drilling and accommodation platform located between the Central and South reservoir accumulations. The Harding platform is a large, heavy-duty jack-up rig fixed to a concrete gravity base structure containing oil storage tanks. The oil is exported from the storage tanks to shuttle tankers via the Submerged Loading System (SLS) which is located approximately 2km to the east of the platform.

The SLS includes a submerged turret mooring and loading interface buoy (STL), which is anchored to the seabed via eight mooring lines and suction anchors. Due to obsolescence the SLS will be replaced by a new Offshore Loading System (OLS).

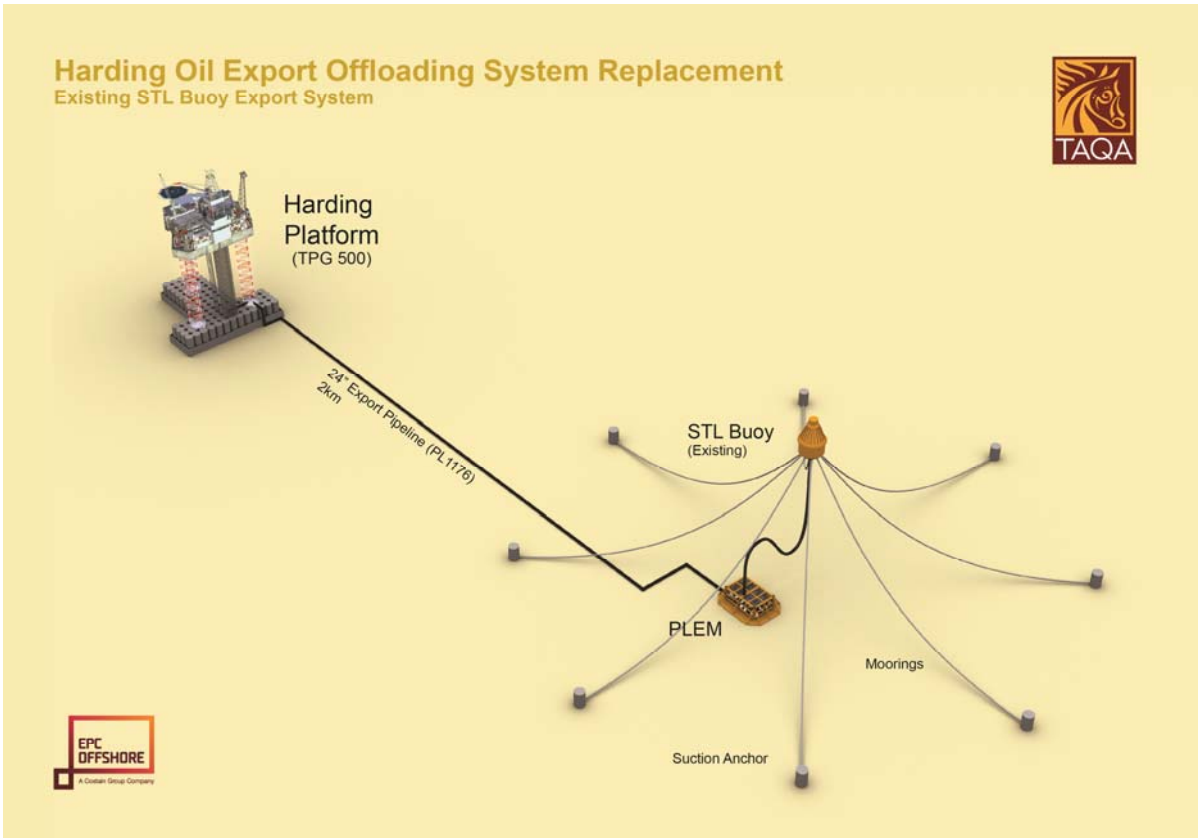


Figure 2.1 Existing Submerged Loading System

The following components of the original system are redundant and will be removed:

- Eight mooring lines and associated components
- Eight steel seabed suction anchors
- The shuttle tanker mooring and loading interface buoy and associated components
- The offloading riser

**The Harding oil export pipeline PL1176, inclusive of riser, is being modified. This will be defined in a variation to PWA 23/W/95; as a result the riser is not included in this Decommissioning Programme.*

3.0 OBJECTIVE

During development of the Decommissioning Programme for the Harding SLS it was identified through comparative assessment that the preferred decommissioning option for the suction anchors is removal by following a reversal of the installation procedure. TAQA have reviewed the installation records and expect to perform a successful recovery of all suction anchors by reverse installation.

The objective of this technical note is to identify the possible failure modes that could occur to prevent the successful removal, by reverse installation, of the Harding SLS mooring suction anchors. In addition, contingencies have been identified to address each failure. In the event that after reasonable endeavours to remove the anchor, these attempts are unsuccessful, the anchor will be covered in rockdump such that it does not pose a hazard to other users of the sea, and left in situ. The volume of rock dump has been calculated and is included in section 7.0.

The technical note addresses failure to initiate movement or limited movement of the anchor. In the event failure occurs part way through recovery with the anchor further out of the seabed than initially found then further engineering would be required to determine the appropriate course of action. It is considered that the 'partial recovery' of an anchor, i.e. suction anchor not fully removed from seabed at failure of reverse installation, is, after detailed engineering and utilisation of optimal removal procedure, rated as very unlikely / very low risk.

4.0 SUCTION ANCHOR DETAILS

There are 8 suction anchors ranging from 8m to 10m long and 5m diameter. The 10m long anchors weigh approximately 50 tonnes and the 8m long anchors weigh approximately 40 tonnes.

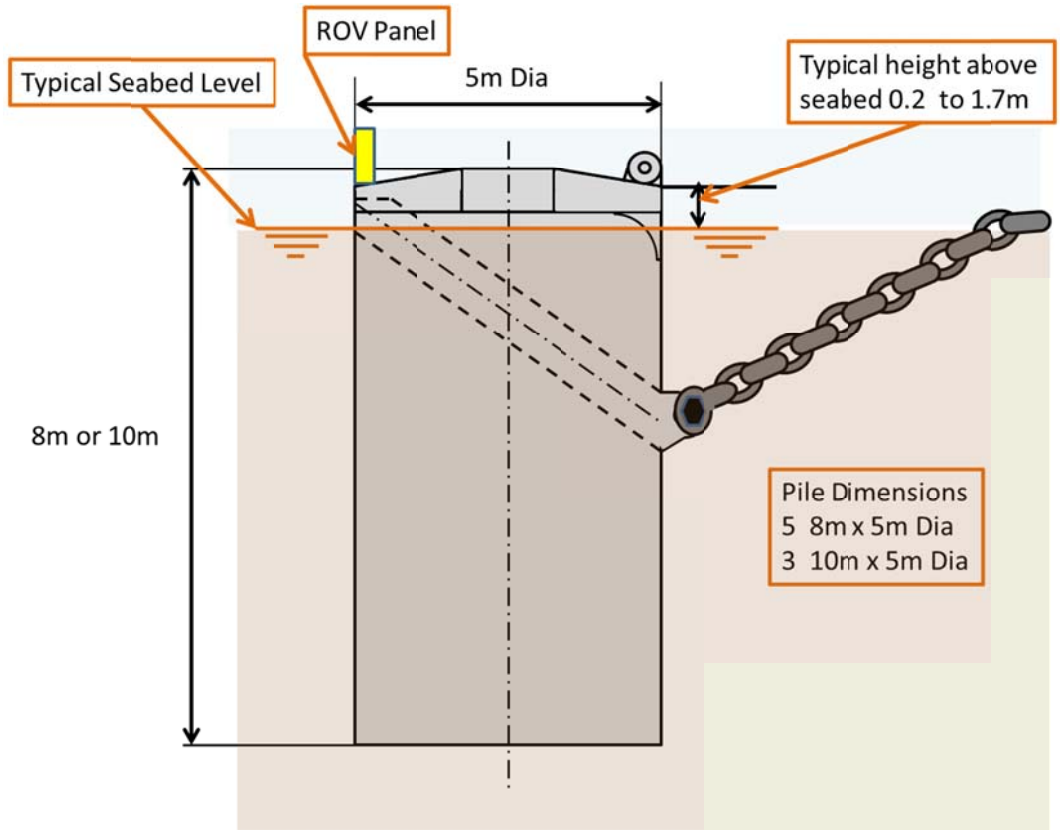


Figure 4.1 Suction Anchor Details

5.0 REVERSE INSTALLATION RECOVERY METHOD

To extract a suction anchor from the seabed the simplest method is to pump water into the anchor to create a differential pressure between the inside and outside of the anchor. The differential pressure acts over the diameter of the anchor effectively acting as a hydraulic cylinder. If the pressure differential can be maintained the force applied to the anchor will push the anchor out of the seabed. At some point sufficient crane tension will overcome the remaining soil friction and the anchor can be recovered to the surface.

The process to extract a suction anchor is essentially the installation procedure performed in reverse as outlined below and in Figures 5.1 and 5.2.

- Install recovery rigging to suction anchor
- Deploy WROV with pump and dock into ROV hot stab panel
- Vessel crane applies constant tension (5-20 tonnes in excess of self weight) to anchor
- WROV to pump water into anchor and maintain pressure

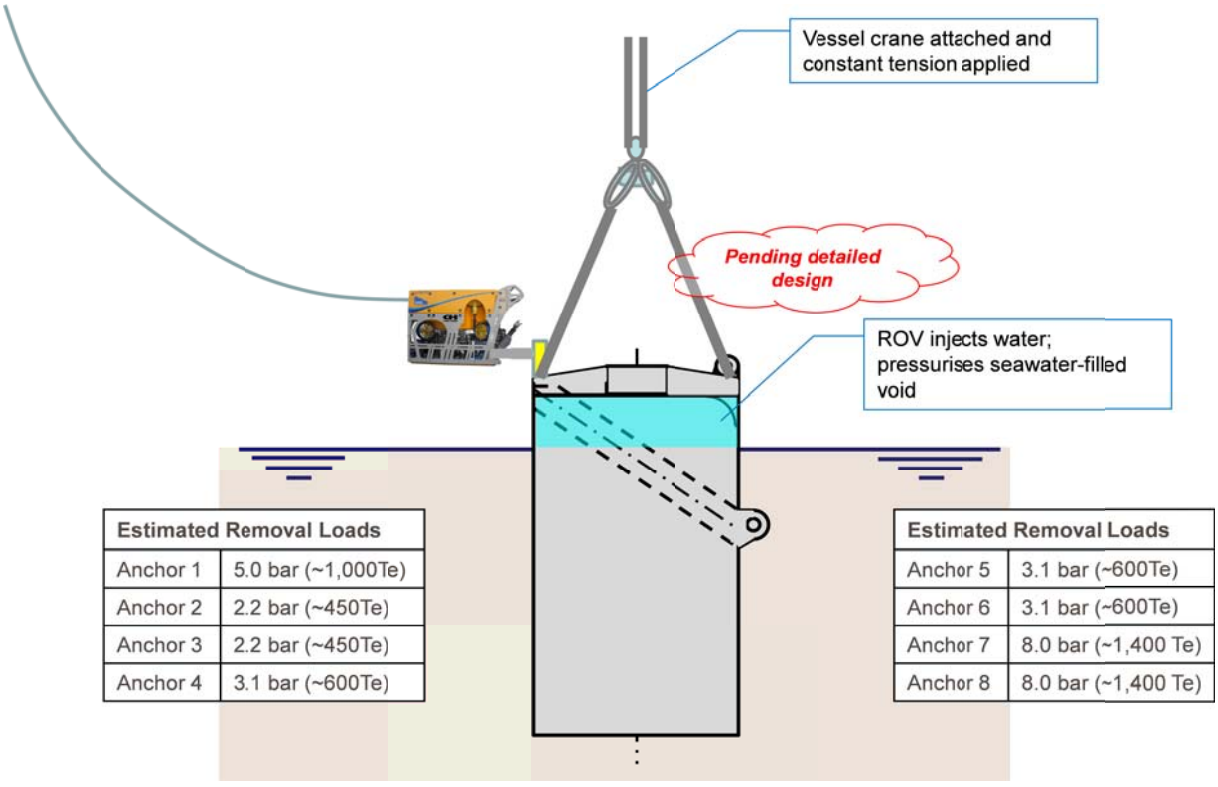


Figure 5.1 Suction Anchor – Reverse Installation Step 1

The anchor should start moving at a similar pressure achieved during installation i.e. between 2 and 8 bar.

- Once anchor starts to move WROV to maintain pressure and vessel crane continues to apply constant tension
- Continue with this operation until the anchor is clear of the seabed
- Disconnect WROV
- Recover anchor to surface

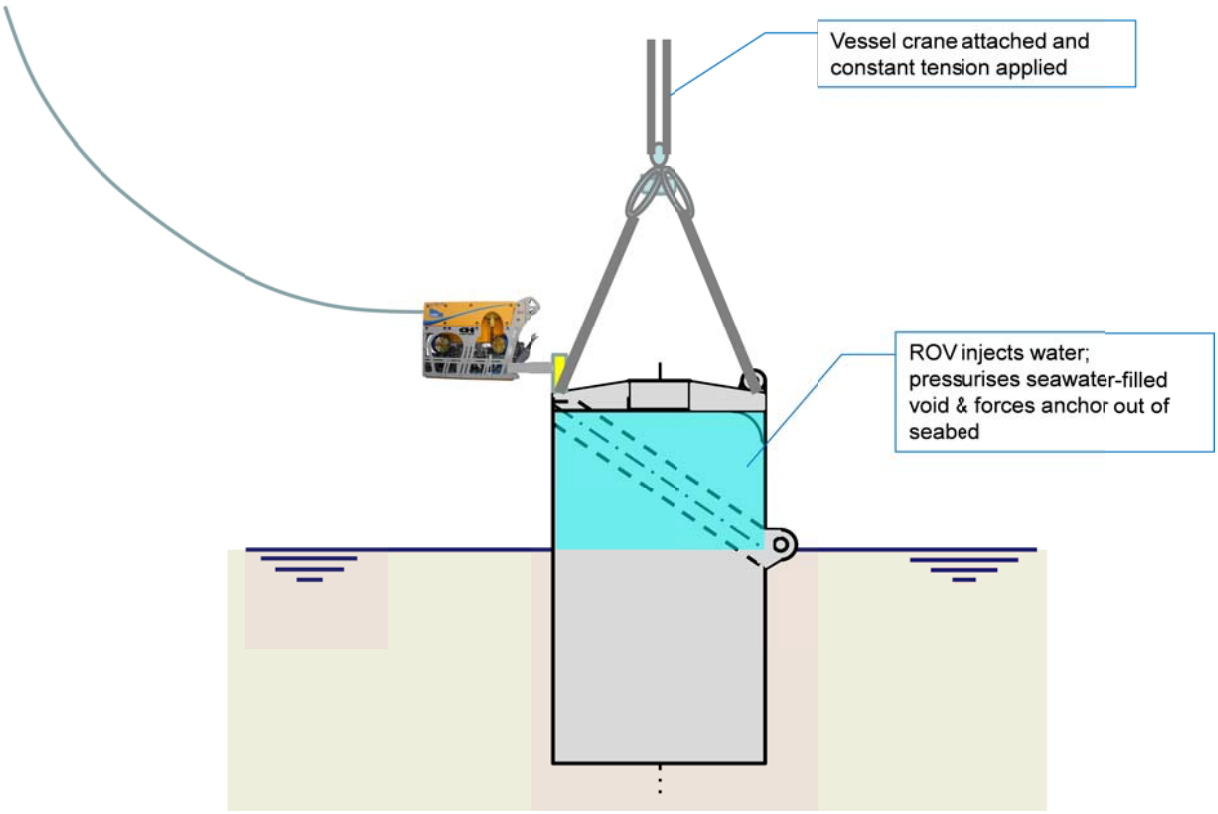


Figure 5.2 Suction Anchor – Reverse Installation Step 2

6.0 SUCTION ANCHOR FAILURE MODES AND CONTINGENCIES

The primary failure mode for a suction anchor is failure to achieve internal pressure in the anchor which can occur due to two reasons; soil failure or mechanical failure. Note that both failure modes can occur simultaneously during installation or recovery.

Soil piping occurs when the fluid leaks through the gaps between the soil particles and creates leak paths to the environment.

Mechanical failure would be the result of a material defect, damage by third party or damage during installation, corrosion or a combination of these factors.

The leak path results in pressure loss, i.e. failure to apply or increase pressure within the anchor, and the loss, if large enough, will exceed the pressure supplied by the pump. This will result in a situation where there is insufficient differential pressure available to overcome the soil friction and it will not be possible to extract the suction anchor by reverse installation.

Figure 6.1 illustrates pressure loss due to soil piping and Figure 6.2 illustrates pressure loss due to mechanical failure.

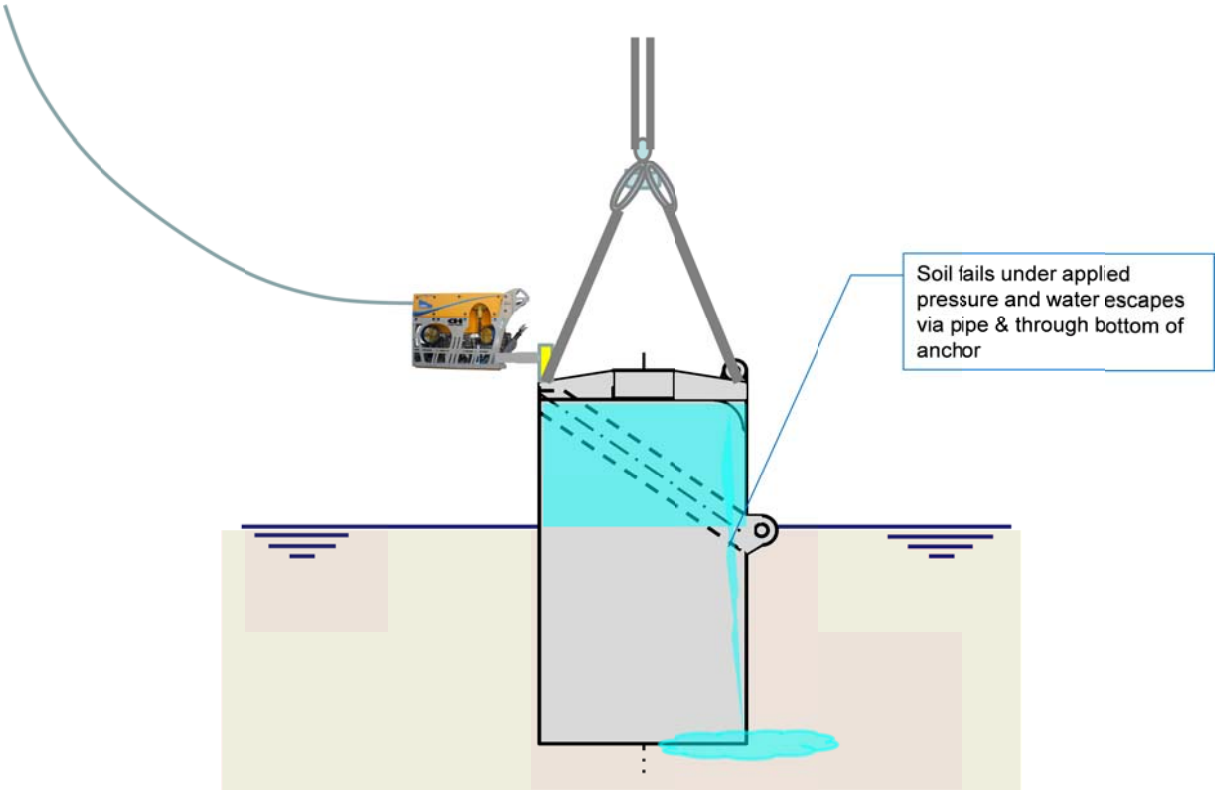


Figure 6.1 Soil Piping Failure of Reverse Installation

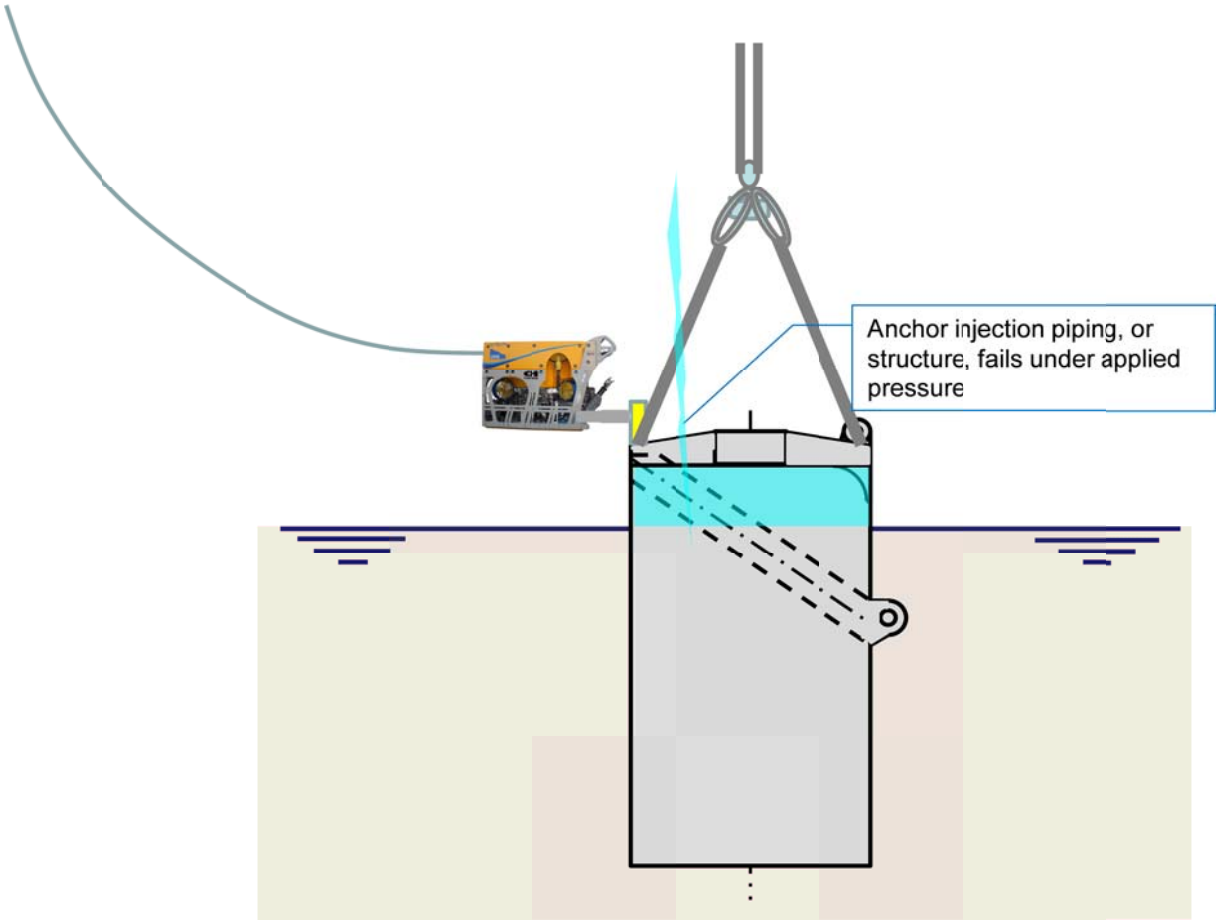


Figure 6.2 Mechanical Failure of Reverse Installation

The following tables identify failure modes that could be applicable to the suction anchors in the Harding Field. TAQA have identified the failure mode, the item of equipment that the failure is attributed to and a subsequent contingency repair option. In relation to the repair option TAQA have quantified the technical complexity, schedule impact, cost and likelihood of success. These have been rated HIGH, MEDIUM or LOW; see table 6.1 on page 11. Where possible, TAQA have included a photograph from a recent survey (May 2015) to illustrate where the relevant failure could occur and the equipment involved.

It should be noted that making a repair for one failure will not necessarily prevent another failure occurring.

Table 6.1 Ranking of Contingencies			
	Technical Complexity	**Schedule Impact**	**Cost**
High	New equipment or extensive modification to existing equipment. Offshore access difficult requiring further modifications.	Significant effort to achieve in 2016, therefore work shall be executed in 2017.	Additional vessel mobilisation and vessel days including specialised equipment and personnel.
Medium	Specialised equipment available for similar application but would require modification to suit this requirement. Offshore access difficult.	Could be achieved in 2016, although delay to 2017 is preferable.	Additional vessel mobilisation not required, but maybe preferable, and additional vessel days. Specialised equipment and personnel equipment required.
Low	Little preparatory engineering and off the shelf equipment. Offshore access good.	Would be achievable with only a few weeks preparation.	No additional vessel mobilisation required.

Table 6.2 Suction Anchor Failure Modes and Contingencies		
Failure to Achieve and/or Maintain Pressure		
Pressure loss caused by	**Instrument line leaking**	**Pressure gauge damaged**
Equipment Detail	The instrument line between the anchor and pressure gauge is small bore tubing. The gauge is located on the ROV panel. The gauge was used during installation to show the differential pressure.	Pressure gauge mounted on ROV panel used during installation.
Contingency	The small bore pipe can be clamped or crimped to reduce the leak rate.	Disconnect the gauge and clamp/plug or crimp the small bore pipe.
Technical complexity	**Low**	**Low**
Schedule Impact	**Low**	**Low**
Cost	**Low**	**Low**
Likelihood of success	**High**	**High**

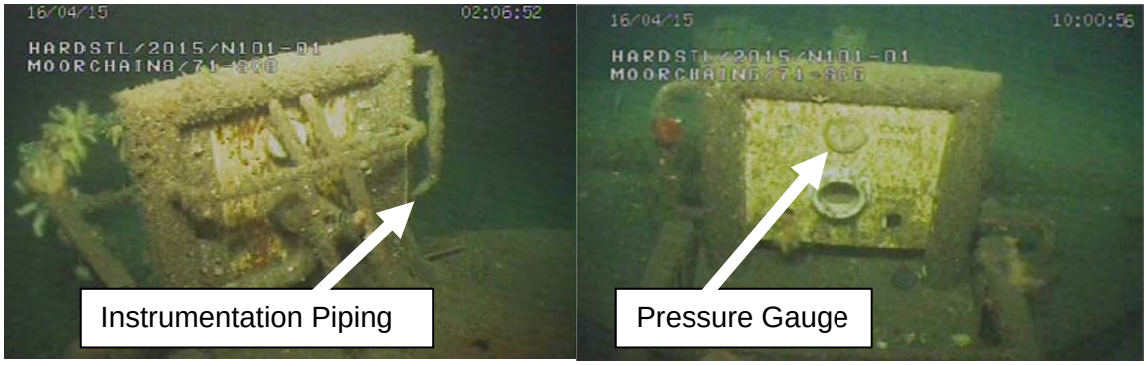


Table 6.3 Suction Anchor Failure Modes and Contingencies	
Failure to Achieve and/or Maintain Pressure	
Pressure loss caused by	**Pressurisation pipe leaking**
Equipment Detail	2” pipe (approx.) between suction anchor and WROV hot stab receptacle used for pressurisation of the suction anchor.
Contingency	If failure is accessible clamp the pipe. If access is not suitable it may be possible to cut the pipe work and re-route the injection water.
Technical complexity	**Medium/high**
Schedule Impact	**Medium**
Cost	**Medium**
Likelihood of success	**High**

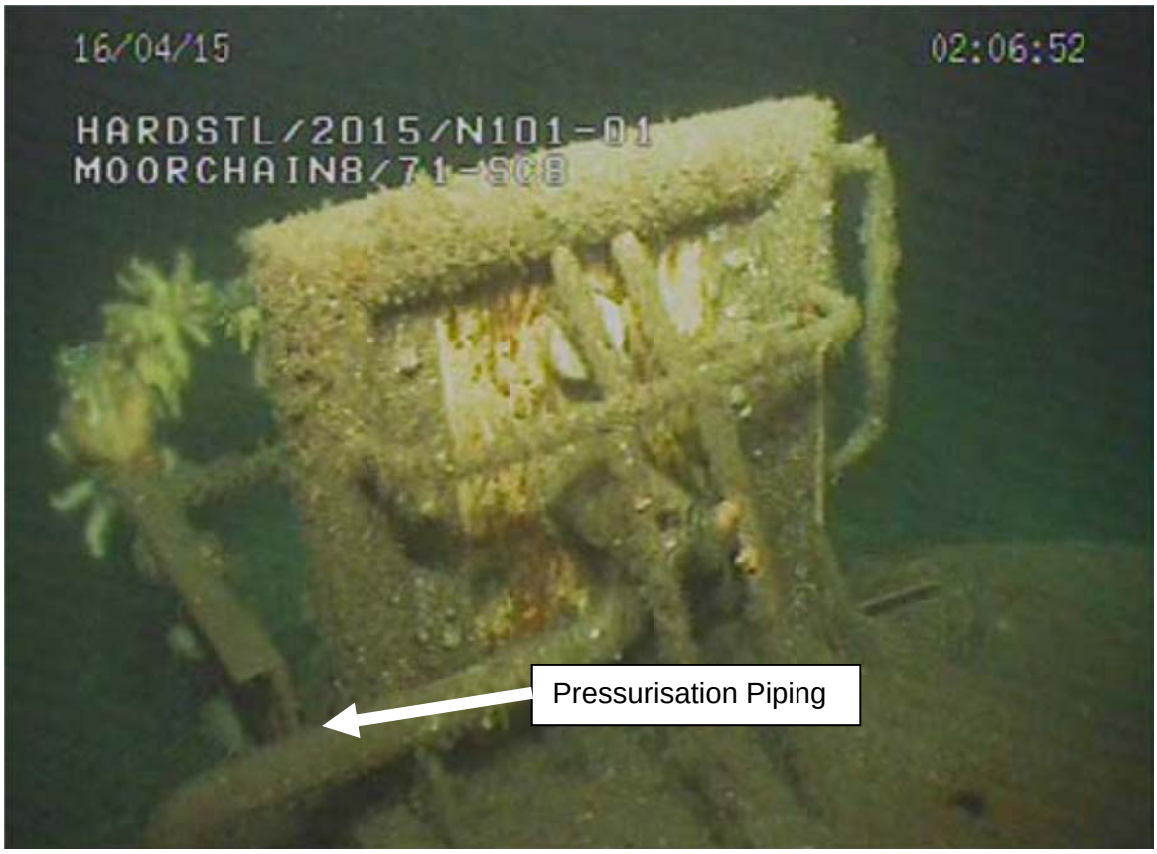


Table 6.4 Suction Anchor Failure Modes and Contingencies		
Failure to Achieve and/or Maintain Pressure		
Pressure loss caused by	**Vent hatch leaking**	**Vent hatch mechanical damage**
Equipment Detail	Vent hatch The hatch in the open position allows the water to flow out of the anchor during initial self-weight penetration. For suction operation the hatch is closed and seals via an "O" ring.	Vent hatch The hatch in the open position allows the water to flow out of the anchor during initial self-weight penetration. For suction operation the hatch is closed and seals via an "O" ring.
Contingency	Replace "O" ring seal.	Damage to be assessed and further engineering to be performed.
Technical complexity	**Low**	**High**
Schedule Impact	**Medium**	**Medium**
Cost	**Low**	**Medium**
Likelihood of success	**High**	**Medium**

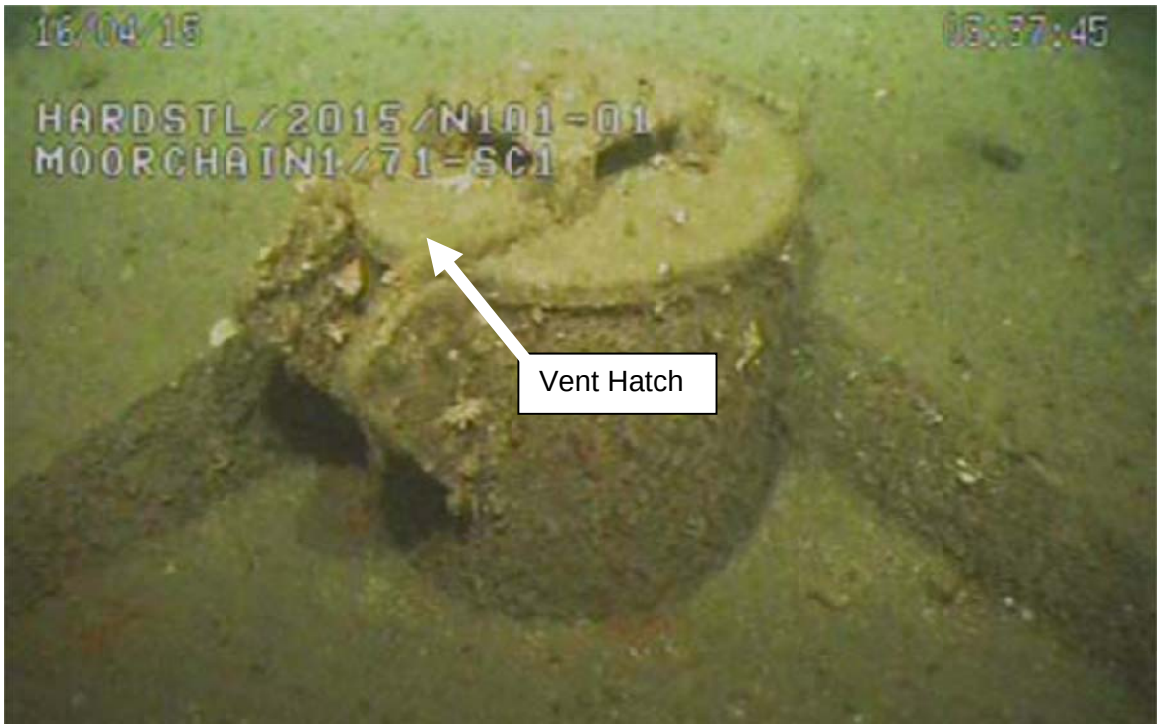
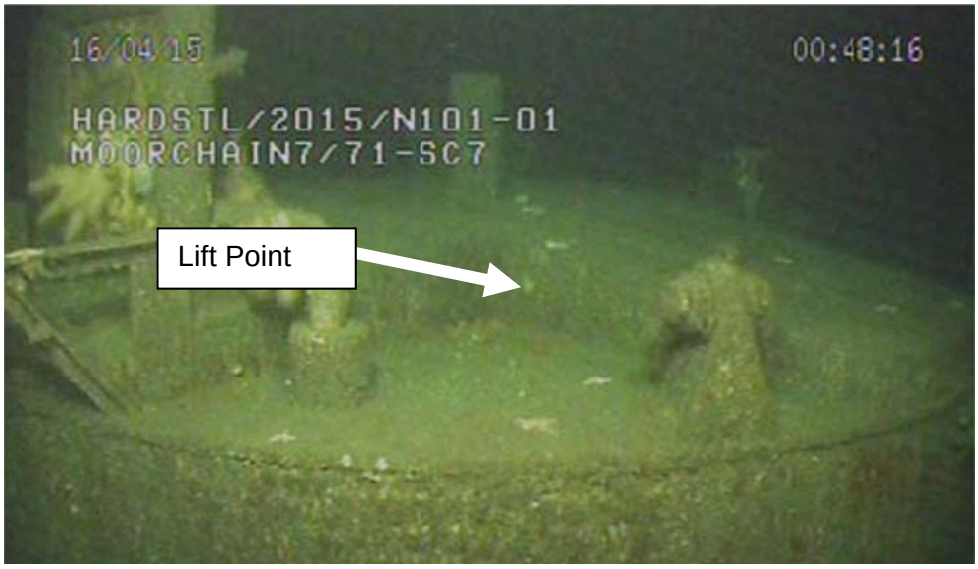


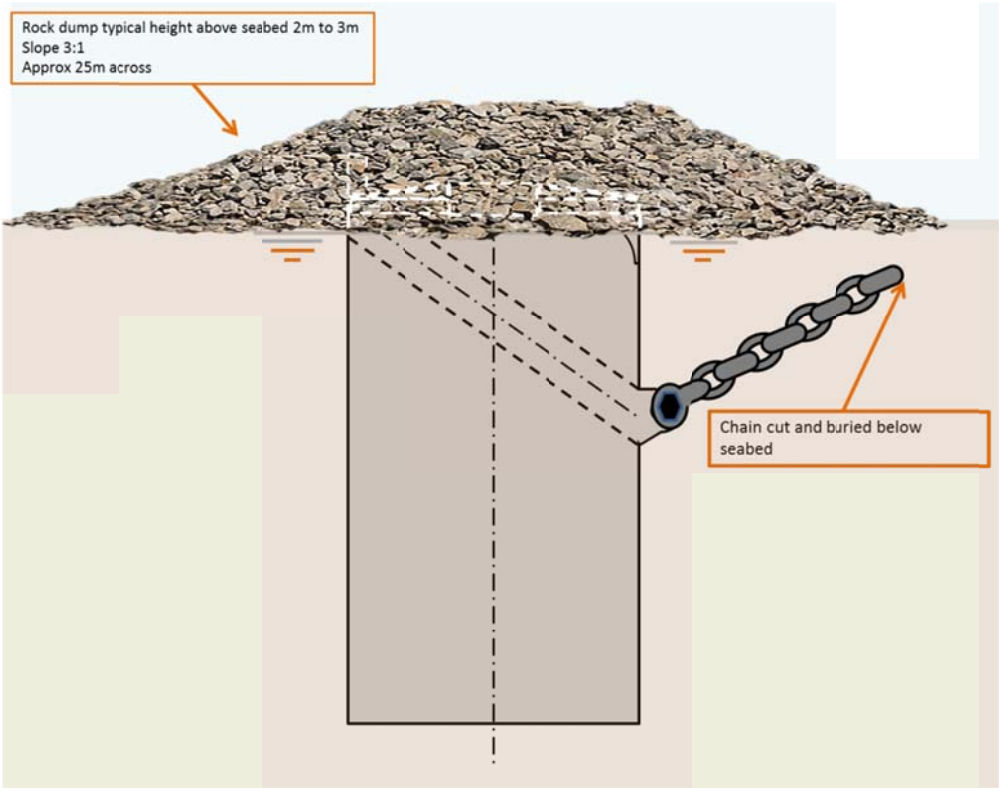
Table 6.5 Suction Anchor Failure Modes and Contingencies		
Failure to Achieve and/or Maintain Pressure		
Pressure loss caused by	**Failure of anchor structural Integrity**	**Soil piping**
Equipment Detail	Damage and / or corrosion to suction anchor during installation or service.	Failure of soils and leak to the environment.
Contingency	Damage to be assessed and further engineering to be performed.	In the event soil piping occurs, leak rate to be assessed and further engineering required including investigation of injection of drill mud type of fluid, or platelets or other bespoke solution.
Technical complexity	**High**	**High**
Schedule Impact	**High**	**High**
Cost	**High**	**High**
Likelihood of success	**Low**	**Low**

Table 6.6 Suction Anchor Failure Modes and Contingencies	
Lift Point Failure	
Mechanical failure caused by	**Corrosion**
Equipment Detail	There are three pad eyes designed for lifting the suction anchor during installation.
Contingency	Extent of corrosion to be measured and further detailed engineering analysis would be required to determine suitable plan.
Technical complexity	**High**
Schedule Impact	**High**
Cost	**High**
Likelihood of success	**Low**



7.0 ROCKDUMP REQUIREMENTS

In the event that reasonable endeavours to recover the suction anchor by reverse installation have been unsuccessful, the anchor will be covered with rock dump such that it does not pose a hazard to other users of the sea. An overtrawl survey of the rock berms will be performed on completion of the rockdump.



The total volume of rock required will depend on the number of anchors that cannot be successfully extracted.

An estimate of rock dump for each anchor has been calculated, based on data from the most recent offshore survey, carried out in May 2015, and minimum coverage of 1m.

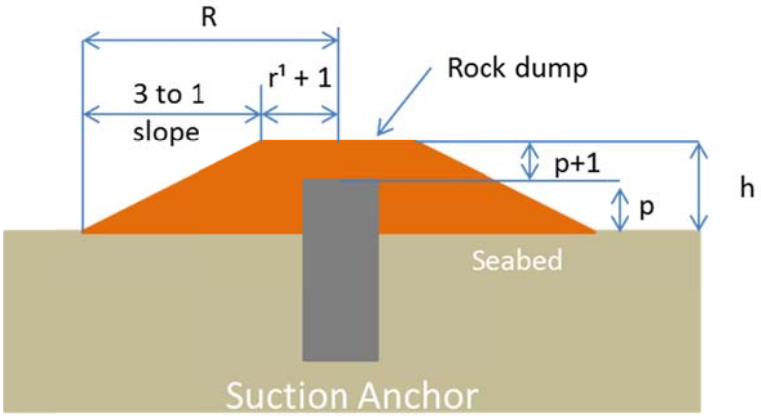


Table 7.1 Estimate of Rock Dump Coverage					
Pile No	Pile Protruding above seabed	Rock Dump Volume	Rock Dump Mass*	Plan area of rockdump	
	m	m³	tonne	m²	km²
1	1.5	450	1034	380	0.00038
2	1.8	573	1319	445	0.00044
3	1.6	489	1124	401	0.00040
4	1.1	314	721	302	0.00030
5	1.0	284	654	284	0.00028
6	1.0	284	654	284	0.00028
7	2.0	667	1534	491	0.00049
8	1.8	573	1319	445	0.00044
	Total	3634	8358	3031	0.00303

Assumptions

* Flat-topped cone shape, including 15% contingency

Rock density	2 te/m³
Rock coverage	1m above highest point
Slope	3 to 1

In the event failure occurs part way through recovery (i.e. the anchor protrudes significantly further out of the seabed than initially found) the situation will require to be assessed prior to any further intervention to determine the appropriate course of action.

Note in the event the suction anchors were dredged out, the mass of material to be excavated would be circa 110,000 tonnes and the area impacted approximately 0.01915km².

8.0 ABBREVIATIONS

Dia	Diameter
km	Kilometer
m	Meter
m^3	cubic meter
OLS	Offshore Loading System
ROV	Remotely Operated Vehicle
SLS	Submerged Loading System
STL	Submerged Turret Loading
Te	Tonne
WROV	Workclass Remotely Operated Vehicle

9.0 REFERENCES

Decommissioning Programme	HAR-01031-DEC-PM-ADP-0001
Suction Anchor Decommissioning Comparative Assessment Report	HAR-01031-DEC-SS-REP-0003
Suction Anchor Extraction Review	HAR-01031-DEC-SS-REP-0005