Auk, Fulmar and Auk North
Subsea and Pipelines Infrastructure
Comparative Assessment Report

March 2021

DOCUMENT CONTROL

Approvals

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Revision Control

Revision No	Reference	Changes/Comments	Issue Date
1	Issued for Comment		23/02/18
2	Re-issued for Use	Incorporated R01 comments.	23/01/19
3	Re-Issued for Use		21/11/19
4	Re-Issued for Use	Incorporated OPRED comments.	09/01/20
5	Re-issued for Use	Incorporated final project comments	05/02/20
6	Re-Issued for Use	Incorporated additional OPRED comments	26/05/20
7	Re-Issued for Use	Incorporated additional OPRED Comments	11/06/20
8	Re-Issued for Use post Consultation	Incorporated additional OPRED and consultees Comments	05/03/21

Distribution List

Name	Company	No of Copies
OPRED	Department for Business, Energy and Industrial Strategy	1

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Terms, Abbreviations and Acronyms

Abbreviation	Explanation
AD	Advanced Drilling
AHP	Analytical Hierarchy Process
BAT	Best Available Technology
BEIS	Department of Business, Energy and Industrial Strategy
BEP	Best Environmental Practice
CA	Comparative Assessment
CSV	Construction Support Vessel
DSV	Diver Support Vessel
DP	Decommissioning Programme
HAZID	Hazard Identification
JNCC	Joint Nature Conservation Committee
MCDA	Multi-Criteria Decision Analysis
MFE	Mass Flow Excavator
MS	Much Stronger
MW	Much Weaker
NORM	Normally Occurring Radioactive Material
NRV	Non-Return Valve
OD	Outside Diameter
OGA	Oil & Gas Authority
OPRED	Offshore Petroleum Regulator for Environment & Decommissioning
P&A	Plug and Abandon
ROV	Remotely Operated Vehicle
S	Stronger
SEPA	Scottish Environmental Protection Agency
SFF	Scottish Fishermen's Federation
ToP	Top of Pipe
VMS	Very Much Stronger
VMW	Very Much Weaker
W	Weaker

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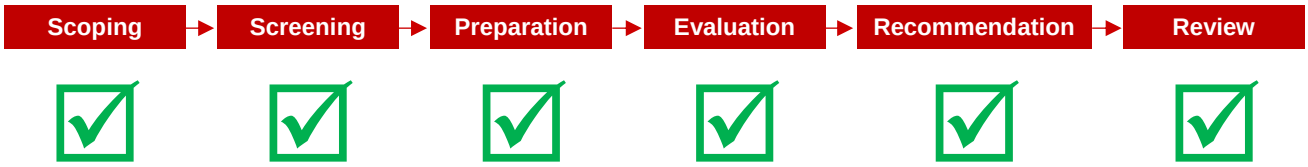
EXECUTIVE SUMMARY

Repsol Sinopec Resources UK has conducted a Comparative Assessment (CA) in support of the Auk, Fulmar and Auk North fields to be decommissioned as described in the Decommissioning Programmes (DPs). The following steps from the Oil and Gas UK Guidelines have been completed:



This report presents the findings from the CA for the Subsea Infrastructure of the Auk, Fulmar and Auk North Field Decommissioning Project.

The outcome of the CA process has made the following recommendations:

Group No.	Description of Decommissioning Group	Decommissioning Recommendation	Justification
1	24" Concrete Coated Pipeline, Surface Laid and Exposed (PL1315)	Trench and Bury The pipeline shall be fully trenched and buried to a target depth of 0.6m Top of Pipe (ToP). Should technical difficulties arise that prevent this from being achieved then leave in-situ and mitigate spans with rock cover is the chosen fall-back position.	This option was assessed to be the safest whilst maintaining cost effectiveness.
2	10" Concrete Coated Pipeline, Surface Laid and Exposed (PL38)	Trench and Bury The pipeline shall be fully trenched and buried to a target depth of 0.6m ToP. Should technical difficulties arise that prevent this from being achieved then full removal is the chosen fall-back position.	This option was assessed as the safest and carried the least environmental impact.
3	Pipelines & Umbilicals, Surface Laid and Rock Covered (PL208, PL1316, PLU4472, PLU4473)	Leave in-situ All pipelines & umbilicals to have exposed ends removed and returned to shore for processing. Cut ends shall be made safe to mitigate snagging hazards for other users of the sea.	As the lines are rock covered and stable, removing them would not present any clear benefit.
4	Pipelines, Fully Trenched and Buried (PL378, PL2561)	Leave in-situ All pipelines to have exposed ends removed and returned to shore for processing. Cut ends shall be made safe to mitigate snagging hazards for other users of the sea.	As the lines are buried and stable removing them would not present any clear benefit.
5	Pipelines, Partially Trenched and Buried (PL63 &PL648)	Rock Cover Exposures Pipeline exposed ends to be removed and returned to shore for processing. Cut ends shall be made safe to mitigate snagging hazards for other users of the sea. Remaining pipeline spans, exposures and areas of insufficient burial to be rock covered to a target depth of 0.6 , ToP.	This option was the strongest technically, and scored second most preferred from a safety perspective. It scored weakest environmentally, however, the mitigation of potential snag hazards was considered justifiable when there is existing rock cover in the field.

Group No.	Description of Decommissioning Group	Decommissioning Recommendation	Justification
6	Umbilicals & Cables – Trenched and Buried (PLU4471, PLU2652, PLU2653)	Leave in-situ All umbilicals and cables to have exposed ends removed and returned to shore for processing. Cut ends shall be made safe to mitigate snagging hazards for other users of the sea.	As the lines are buried and stable removing them would not present any clear benefit.
7	Subsea Installations / Structures	Full Removal	In accordance with OPRED Guidelines
8	SALM Base & Base Piles	Full Removal	In accordance with OPRED Guidelines
9	Mattresses & Grout Bags[1]	Full Removal	In accordance with OPRED Guidelines
11	Spools / Jumpers	Full Removal	In accordance with OPRED Guidelines

This CA report presents the methodology, decisions which needed to be taken, the preparation works carried out, the outcomes (recommendations) from the internal and external (with stakeholders) workshops.

The Fulmar Alpha jacket CA recommendation is detailed within a separate report ref. [2].

[1] Where mattresses and / or grout bags cannot be safely recovered due to degradation these shall be discussed and agreed with OPRED.

1 INTRODUCTION

1.1 Purpose

The purpose of this document is to present the Comparative Assessment (CA) for the Subsea Infrastructure of the Auk, Fulmar and Auk North Field Decommissioning Project in support of the Decommissioning Programmes (DPs). It is produced in satisfaction of the requirement to perform a CA for subsea equipment as detailed in OPRED Guidelines ref. [3] and the Oil & Gas UK Guidelines ref. [4]. Having read and utilised OPRED Guidelines & Oil & Gas UK Guidelines, Repsol Sinopec Resources UK believe these fully express the requirements of the decision.

This report describes the field infrastructure addressed, the decommissioning options considered, the CA methodology used and the recommendations made during the CA process.

1.2 Background

Repsol Sinopec Resources UK commenced planning for the decommissioning of the Auk, Fulmar and Auk North fields.

The Fulmar Platform is located approximately 241 km south east of Dundee in Central North Sea blocks 30/11B and 30/16. Installed in 1982, the Fulmar Platform sits in a water depth of 82.6 m and consists of two bridge-linked jacket structures; Fulmar Alpha (Fulmar A) and the linked Fulmar Advanced Drilling (AD) platforms.

The Auk Platform was installed in 1974 and is located approximately 12km to the southwest of Fulmar Platform.

The Auk North field was developed in 2010 as a 4 well tie-back to the Fulmar Platform. It is situated approximately 11 km west of the Fulmar Platform.

Full technical details of the Auk, Fulmar and Auk North subsea infrastructure can be found in the Subsea Material Inventory Study ref. [5].

The Auk, Fulmar and Auk North field layout is presented below in Figure 1-1.

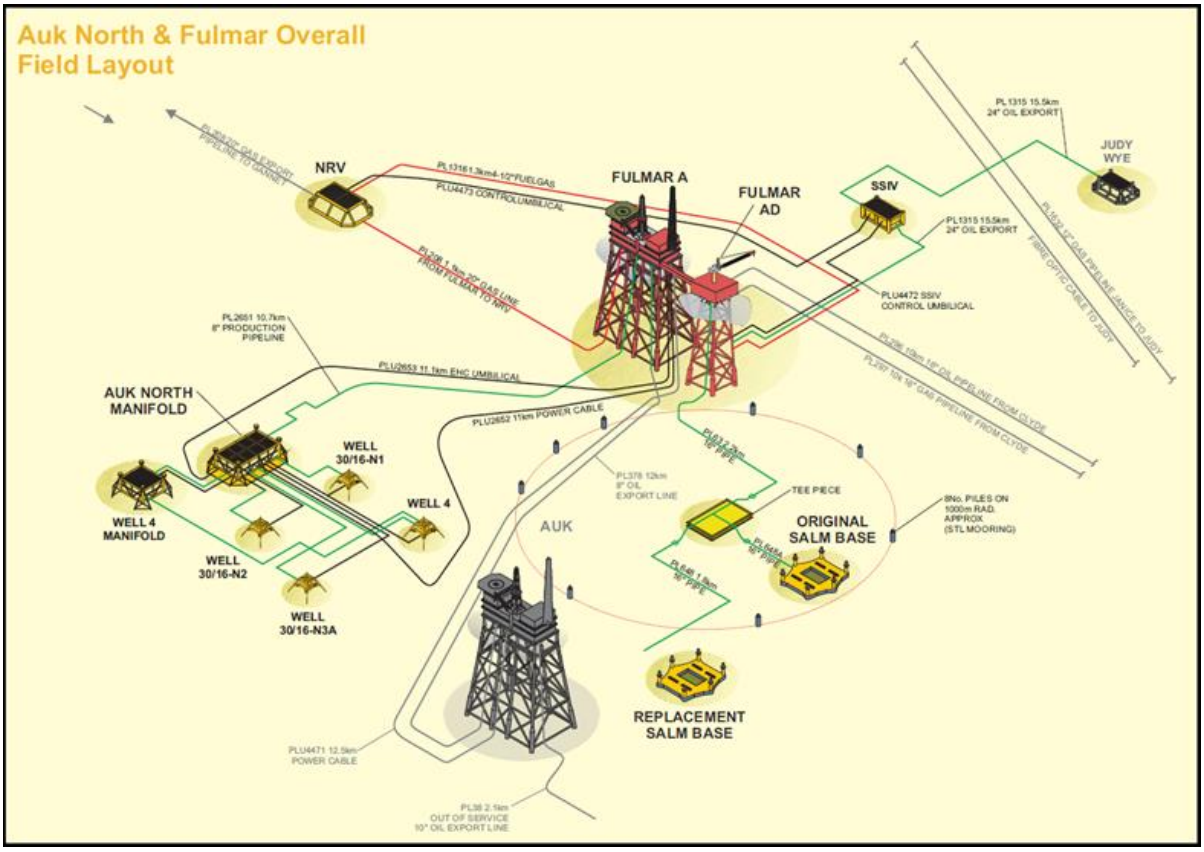


Figure 1-1: Auk, Fulmar and Auk North Field Layout

2 METHODOLOGY

2.1 Overview

CAs are conducted widely in engineering to ensure robust and justified decision making, they are not limited to decommissioning. However, industry guidance on the preferred approach to CA for decommissioning is published by OGUK ref. [4]. As such, CA is a core part of the overall decommissioning planning process being undertaken by Repsol Sinopec Resources UK for the Subsea Infrastructure of the Auk, Fulmar and Auk North Fields Decommissioning Project.

The Oil and Gas UK Guidelines [4] were prepared in 2015, where seven steps to the CA process were recommended. Table 2-1 provides an introduction to each of these steps, along with a status and commentary to demonstrate the project's current position.

Title	Scope	Status	Commentary
Scoping	Decide on appropriate CA method, confirm criteria, identify boundaries of CA (physical and phase).	✓	Subsea Material Inventory Report ref. [5] prepared for subsea infrastructure. Battery limits defined; CA methodology and criteria established for Screening and revisited following Screening to ensure appropriate to evaluation phase.
Screening	Consider alternative uses and deselect unfeasible options.	✓	Screening workshops held Q2 2017 with internal project team. Screening outcomes documented in Screening Report ref. [6].
Preparation	Undertake technical, safety, environmental and other appropriate studies. Undertake stakeholder engagement.	✓	Studies identified during screening phase undertaken to inform the evaluation of the remaining options. Studies completed detailed in Section 2.4.
Evaluation	Evaluate the options using the chosen evaluation methodology.	✓	Internal workshops held during Q3 2017. Evaluation methodology described in Section 2.5 and outcomes detailed in Section 3.
Recommendation	Create recommendation in the form of narrative supported by charts explaining key trade-offs.	✓	The emerging recommendations for the decommissioning options selected are as identified during the Internal Workshop and as detailed in this CA Report.
Review	Review the recommendation with internal and/or external stakeholders.	✓	The Stakeholder Workshop was held with key external stakeholders (JNCC, SFF, Marine Scotland, OPRED, and OGA) 7th August 2019 prior to formal CA submission to provide an opportunity to review emerging recommendations and incorporate stakeholder feedback.
Submit	Submit to OPRED as part of / alongside Decommissioning Programme (DP)	Q1 2020	The CA Report is to be submitted in support of the DP.

Table 2-1: CA Process Overview and Status

2.2 Scoping

The scoping phase of the CA process addresses the following elements:

- Boundaries for CA
- Physical attributes of equipment
- Decommissioning Groups
- Decommissioning options

These are addressed in the following sub-sections.

2.2.1 CA Boundaries

The boundaries (battery limits) adopted by Repsol Sinopec Resources UK for the Subsea Infrastructure of the Auk, Fulmar and Auk North Field Decommissioning Project are as follows:

- The subsea riser tie-in flanges at Fulmar A, Fulmar AD and Auk A Platforms
- Topside umbilical hang-offs at Fulmar A, Fulmar AD and Auk A Platforms
- Judy Wye tie-in flange
- FV15 valve within the NRV structure
- Auk North tree tie-in flanges

Note that the PL296 and PL297 pipelines from Clyde and PL378 from Auk, operated by Repsol Sinopec Resources UK, are not included in this decommissioning study. The interfaces for these pipelines are at the base of the Fulmar A jacket and any remedial / destruct work of these lines will be managed separately.

In each of the above fields, the following equipment is included:

- All subsea structures including their foundations
- All rigid and flexible subsea pipelines / flowlines
- All control and chemical jumpers
- All spools
- All umbilicals / cables
- All deposits (mattresses / grout bags)

2.2.2 Physical Attributes of Equipment

All subsea equipment within the scope of the Auk, Fulmar and Auk North Field Decommissioning Project is listed in the Subsea Materials Inventory Report ref. [5].

2.2.3 Decommissioning Groups

Once the equipment to be decommissioned and their attributes are captured, it is often beneficial for the CA process to group similar equipment together. This allows many items to be considered as a single group and can reduce the number of items for consideration, streamlining the process.

For the Subsea Infrastructure of the Auk, Fulmar and Auk North Field Decommissioning Project, the decommissioning groups, along with a list of each individual item within those groups, is detailed in full in the Subsea Material Inventory Report ref. [5]. A summary of the decommissioning groups identified is included in Table 3-1.

2.2.4 Decommissioning Options

With the decommissioning groups established, all potential decommissioning options for each of the groups are identified. The base case for all groups is full removal as per the OPRED Guidelines ref. [3] and it is only those decommissioning groups where default full removal is not considered to be the clear optimum solution, that alternative decommissioning options are considered.

Alongside full removal options, the following partial removal scenarios should be considered as specified in OPRED Guidelines ref. [3] and North Sea Pipeline Decommissioning Guidelines ref. [7]:

- Pipelines, Umbilicals and Cables
  - Re-use
  - Minimal Intervention i.e. exposed end removal
  - Minor Intervention i.e. exposed end / spans / exposure removal
  - Major Intervention i.e. full re-trench or rock placement

All other subsea infrastructure is required to be fully removed in accordance with the OPRED Guidelines ref. [3].

2.3 Screening

The CA screening phase considers each feasible decommissioning option against the main criteria, as defined within the Oil & Gas UK Guidelines ref. [4].

Main Criteria
1. Safety
2. Environment
3. Technical
4. Societal
5. Economic

Table 2-2: CA Main Criteria

For Auk, Fulmar and Auk North the screening phase was carried out during a series of workshops held in Q3 2017. The methodology adopted, workshop attendance and outcomes obtained are detailed fully in the Screening Report ref. [6]. The methodology is briefly summarised below:

1. Identify decommissioning groups for full removal
2. Review proposed decommissioning options for each remaining group
3. Assess decommissioning options against the main criteria and record assessment and outcome in screening worksheets
4. Record actions required to support retained decommissioning options
5. Compile Screening Report

The screening assessment was performed using a coarse, Red / Amber / Green method, as recommended in ref. [4]. An additional category of 'showstopper', coloured dark grey was used. These categories are described Table 2-3.

Category	Description
Attractive	The option is considered attractive i.e. it has positive attributes in terms of the criterion being assessed.
Acceptable	The option is considered acceptable i.e. its attributes are not positive or negative in terms of the criterion being assessed.
Unattractive	The option is considered unattractive i.e. it has negative attributes in terms of the criterion being assessed.
Showstopper	The option is considered unacceptable. Should an option be assessed as unacceptable against any of the criteria, it is discounted and no further assessment is required.

Table 2-3: Screening Assessment Categories

The cumulative assessment for each decommissioning option was then captured based on some basic, non-binding, ground rules. These are:

- Three or more criteria assessed as red resulted in the option being considered for screening out (red)
- For similar full removal options, the likely least onerous option was retained (green) with any more onerous option considered as a sub-set of the less onerous option (light grey)
- For similar leave in-situ options, the most onerous option was retained (green) with any less onerous options considered as a sub-set of the more onerous option (light grey)

This approach was considered appropriate to ensure that the best-case full removal options were compared to the most onerous leave in-situ options. This ensures, during the evaluation phase, that the assessment is not skewed such that leave in-situ options are selected over full removal options.

The outcomes for each group are summarised in Table 4-2, Table 5-2, Table 6-2, Table 7-2, Table 8-2 and Table 9-2.

2.4 Preparation Phase

During the preparation phase, detailed studies / analyses are conducted to provide information to support the Evaluation phase of the CA. The detailed studies / analyses that may be required are often identified early in the CA process. These studies / analyses are then supplemented by additional studies / analyses identified during the screening phase of the CA.

The studies / analyses conducted during the preparation phase of the CA process to support the evaluation are as follows:

Pipelines Status & Historical Review	The as surveyed current status and history of each pipeline was documented to inform the CA decision making process.
Decommissioning Method Statements	Detailed method statements were developed for options carried forward to ascertain the activities and resources required to deliver each option.
Emissions Assessment	Fuel consumption and atmospheric emissions assessment performed for options carried forward based upon activities and resources identified in method statements.
Underwater Noise Assessment	Underwater noise assessment performed for options carried forward based upon activities and resources identified in method statements.
Environmental Impact Review	Environmental impact reviews were conducted for options carried forward in areas of planned discharges, unplanned discharges and seabed disturbance based on activities and resources identified in method statements.
HAZID	Hazard identification workshops were held to consider the risks associated with individual activities and subsequently decommissioning options.
ENVID	An Environmental Issues Identification workshop was held to consider the environmental aspects of the decommissioning operations.
Fishing Intensity Study	A Fishing Intensity Study was conducted to understand the extent of fishing operations in the area and to consider the potential fishing activity post decommissioning.

The findings of the studies / analyses are gathered in preparation for the evaluation phase of the CA. The key information obtained from these studies / analyses, used during the evaluation phase are provided in data sheets, included in Appendices C – H.

2.5 Evaluation Phase

The evaluation phase of the CA is where the remaining decommissioning options for each group are evaluated against each other. This evaluation process is conducted according to the Oil & Gas UK Guidelines ref. [4] and employs the data obtained during the preparation phase as summarised in the data sheets, included within the Appendices C – H.

The evaluation phase was conducted during a number of workshops attended by the decommissioning project team. On a group by group basis, each option is scored against sub-criteria defined by the Project. The definition of each sub-criteria is provided within Appendix A.2.

Options are scored against each other on a pair-wise basis, using the qualitative terms Neutral, Stronger, Much Stronger, Very Much Stronger, Weaker, Much Weaker and Very Much Weaker. By this means the assessment team is able to debate the strengths and weaknesses of each option at the sub-criteria level and reach a consensus without having to apply quantitative scoring. The preferences are processed within the worksheet to produce a percentage split for each sub-criterion and this is cumulatively displayed to provide a score for each option. The resulting emerging recommendation may be subjected to sensitivities to test the robustness of the result.

2.5.1 Criteria and Sub-Criteria Weightings

The primary criteria have been weighted neutrally. Given the differing, and sometimes conflicting, considerations that are represented by the criteria it was considered appropriate that they be weighted equally to one another to avoid favouring any particular aspect or group. However, it was considered acceptable to weight the sub-criteria toward those areas that had higher importance to the overall impact of the proposed decommissioning options on the main criteria. Weightings are applied to relate scores against one criterion, to scores against another. They reflect the fact that the range from 'worst' to 'best' on one criterion might not be equivalent to the range of another criterion. Weights allow a single measure of preference to be derived for each option and highlight which criteria are the key drivers/differentiators.

More detail of the methodology adopted for the evaluation phase of the Auk, Fulmar and Auk North Field Decommissioning Project is detailed in Appendix A.

2.6 Review

The outcome from the CA process was reviewed with key external stakeholders during Q3 2019. Formal minutes from the stakeholder engagements sessions were recorded and all relevant feedback was captured. Details of the queries raised during the sessions and RSRUK's responses to those queries are included in the Decommissioning Programmes document for Fulmar and Auk North Topsides and Subsea Facilities ref. [1].

3 COMPARATIVE ASSESSMENT – SCOPING OUTCOME

3.1 Decommissioning Groups

The subsea infrastructure was arranged into groups, as detailed within the CA Scoping Report ref [8]. All feasible decommissioning options for each group were considered and those options which were considered sufficiently unattractive were screened out, as detailed within the CA Option Screening Report ref. [6].

The requirement or otherwise to comparatively assess each identified group is summarised within Table 3-1 below.

Group	Description	Decommissioning Approach
1	24" Concrete Coated Pipeline, Surface Laid and Exposed (PL1315)	Subject to full CA
2	10" Concrete Coated Pipeline, Surface Laid and Exposed (PL38)	Subject to full CA
3	Pipelines & Umbilicals, Surface Laid and Rock Covered (PL208, PL1316, PLU4472, PLU4473)	Subject to full CA
4	Pipelines, Fully Trenched and Buried (PL378, PL2561)	Subject to full CA
5	Pipelines, Partially Trenched and Buried (PL63 &PL648)	Subject to full CA
6	Umbilicals & Cables – Trenched and Buried (PLU4471, PLU2652, PLU2653)	Subject to full CA
7	Subsea Installations / Structures • PL1305 SSIV • NRV • Fulmar Igloo • SALM Tee Piece Structure • Fulmar AD Template • Auk North Production Manifold • Auk J4 Manifold	Full Removal
8	SALM Base & Base Piles	Full Removal
9	Mattresses & Grout Bags[2]	Full Removal
11	Spools & Jumpers[3] [4]	Full Removal

Table 3-1: Groups and Decommissioning Recommendation

The equipment included in each of these groups is detailed comprehensively in the Subsea Infrastructure Inventory Report ref. [5] and the CA Scoping Report ref. [8].

[2] Where mattresses and / or grout bags cannot be safely recovered due to degradation these shall be discussed and agreed with OPRED.
[3] PL648A is a pipeline. However, as it is a short surface laid line (34 metres long) it is treated as a spool and shall be fully removed.

[4] Spoolpiece connections between Auk North Manifold and Auk North Subsea Wells (PL2651JN1, PL2651JN2, PL2651JN3 and PL2651JN4), as also Electrical Jumpers (PLU2652JN1, PLU2652JN2, PLU2652JN3 and PLU2652JN4), and Umbilical Jumper Bundles (PLU2653JN1, PLU2653JN2, PLU2653JN3 and PLU2653JN4) are part of the Auk North development and will be fully removed. The riser section of PL4752 shall be decommissioned as part of the Fulmar Sub-structure DP.

4 CA OUTCOME – GROUP 1 – 24" CONCRETE COATED PIPELINE, SURFACE LAID AND EXPOSED (PL1315)

4.1 Group Characteristics

The individual item that makes up Group 1 – 24" Concrete Coated Pipeline PL1315 is detailed in full within the Subsea Materials Inventory Report ref. [5] and the CA Scoping Report ref. [8]. By way of summary, the key characteristics are presented in Table 4-1:

ID	Description	Field	OD (inches)	Length (m)	Weight (T)
PL1315	Concrete Coated 24" Oil Pipeline	Fulmar	24	15,184[5]	8,022

Table 4-1: Group 1 Item

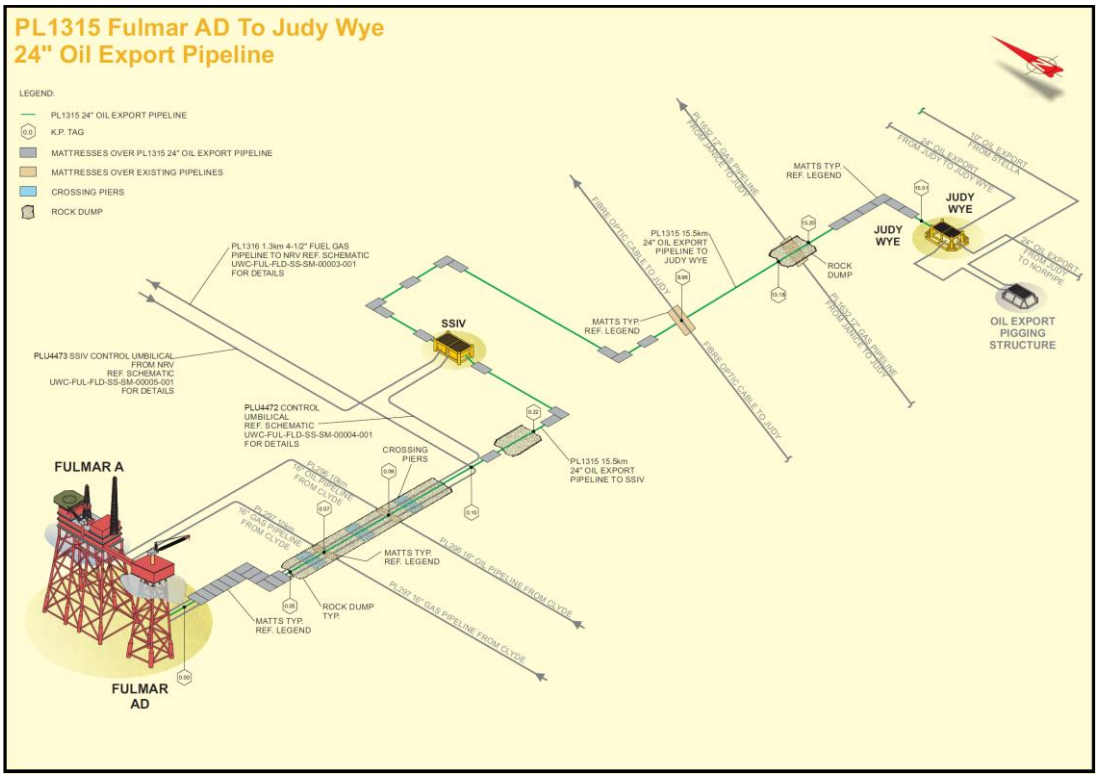


Figure 4-1: PL1315 Fulmar AD to Judy Wye 24" Oil Export Pipeline

PL1315 is a surface laid export pipeline. There are four pipeline crossings:

- A 16" gas pipeline PL297 (East) crossing under PL1315 rock cover at KP 0.067
- A 16" oil pipeline PL296 (East) crossing under PL1315 rock cover at KP 0.093
- A fibre optic cable crossing over the PL1315 pipeline at KP 8.956. Mattresses draped over PL1315, however no rock cover
- A gas pipeline PL1632 crossing over PL1315 and under rock cover at KP 13.192

Based on the lack of self-burial to date, the pipeline is thought to be laid on stable seabed, and as such, exposures are not expected to occur once the pipeline is trenched to target depth.

[5] Pipeline length stated is the pipeline only and does not include spools or risers

There were 151 spans (7.5% of length) recorded in 2017 for this pipeline, as detailed within the Pipeline Status & Historical Review Report ref. [9]. The spans are distributed along the length and are generally not confined to a specific location. No spans exceed FishSAFE limits (spans greater than 10m in length and 0.8m in height).

4.2 Decommissioning Options & Screening Outcome

The decommissioning options identified for Group 1 are detailed in Table 4-2. The colour coding indicates the outcome from the CA Screening process. Green indicating that the option is carried through to evaluation, whereas grey represents options that have been screened out. These findings are fully detailed within the CA Screening Report ref. [6].

Group 1 – 24" Concrete Coated Pipeline, Surface Laid and Exposed		
Category	**Option**	**Description**
Leave in-situ (minimal intervention)	1 – Disconnect / remove ends and minimal remediation.	The option will involve the disconnection and removal of the pipeline ends and make safe the remaining cut ends.
Leave in-situ (remedial intervention)	2a – Cut and remove exposures (including ends)	The option will involve disconnection of the pipeline ends, cut and removal of any exposures. This option was screened out as the entire line is exposed, therefore it is the same as Option 3a.
	2b – Rock cover exposures (including ends)	The option will involve the disconnection of the pipeline ends and the subsequent rock placement operations on cut ends and line exposures, (in this instance the entirety of the pipeline).
	2c – Trench and bury exposures (including ends)	The option will involve the disconnection of the pipeline ends and the subsequent trench and backfill of the pipeline to a sufficient depth below seabed level.
Full removal	3a – Cut and Lift – Cut pipe in to small sections and recover	The option will involve cutting the entire pipeline into manageable section and recovery of the pipe to shore.
	3b – Reverse Installation – Recover pipe using reverse S-lay or reverse reeling.	The option will involve disconnection and recovery of the pipeline ends for onshore disposal, followed by the removal of the remaining pipeline by reverse installation. This option was screened out as there is no track record for reverse S-lay for a rigid line of this diameter in the North Sea, there are currently significant technical limitations for this approach.

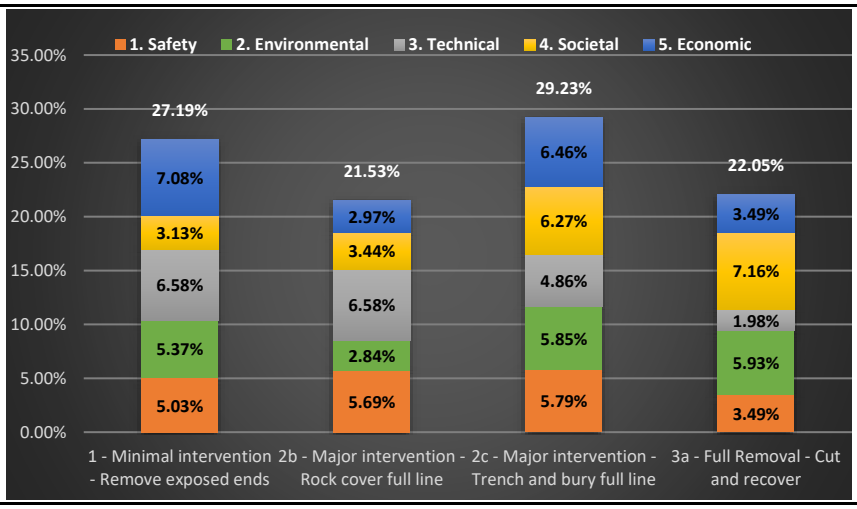
Table 4-2: Group 1 Decommissioning Options

4.3 Decommissioning Options for Evaluation

The decommissioning options for Group 1 that remained after screening and which were taken forward to the evaluation phase are:

- Leave in-situ (minimal intervention)
  - 1 – Disconnect / remove ends and minimal remediation
- Leave in-situ (remedial intervention)
  - 2b – Rock cover exposures (in this case the full line)
  - 2c – Trench and bury exposures (in this case the full line)
- Full removal
  - 3a – Cut and Lift – Cut pipe in to small sections and recover

4.4 Evaluation Summary

<table>
<tr><th colspan="4">Group 1 – 24” Concrete Coated Pipeline, Surface Laid and Exposed (PL1315)</th></tr>
<tr><td rowspan="2">Screening</td><td>1 – Minimal intervention: Remove exposed ends only.</td><td>2a – Minor intervention: Remove exposures.</td><td>2b – Major intervention: Rock cover full line.</td></tr>
<tr><td>2c – Major intervention: Trench and bury full line.</td><td>3a – Full Removal: Cut and recover.</td><td>3b – Full Removal: Reverse Installation.</td></tr>
<tr><td colspan="4">Note: for full attributes tables and assessment see Appendix C</td></tr>
<tr><td rowspan="5">Evaluation</td><td>Safety</td><td colspan="2">Option 1 and Option 2b are equally preferred options from a risk to Offshore Personnel perspective, with the increased risk exposure of back deck working associated with Options 2c and 3a being the key factor.
Options 1, 2b and 2c are equally preferred options from a risk to Onshore Personnel perspective due to the risks associated with handling, transporting and processing large quantities of cut pipe associated with Option 3a.
With regard to the risk to Other Users during the project, all options are considered equally preferable to each other.
With regard to Residual Risk, Option 3a is preferred being that the infrastructure is fully removed.
Overall, Option 2c is assessed as the preferred option against the Safety criterion.</td></tr>
<tr><td>Environment</td><td colspan="2">Option 1 is preferred from an Impact of Decommissioning Operations Offshore perspective due to considerably less vessel time (with the associated noise, emissions and discharges) than the other options.
Options 1, 2b and 2c are equally preferred from a Processing of Returned Materials perspective, as Option 3a involves the recovery of the entire pipeline and therefore scored lower.
Option 3a is preferred from a Resource Consumption perspective as rock placement is not required, and Option 3a represents the maximum amount of material available to be recycled.
Option 1 is preferred from a Seabed Disturbance perspective as it represents the least disturbance.
Options 2c and 3a are equally preferred options from a Loss of Habitat perspective as although minimal new material is associated with Option 1, the pipeline will remain on the seabed. Option 2b represents a significant permanent change to the seabed habitat.
Overall, considering all sub-criteria and associated weightings, Option 2c is assessed as the preferred option.</td></tr>
<tr><td>Technical</td><td colspan="2">Options 1, 2b and 2c are considered as routine subsea operations and all are technically feasible. However, option 3a scores lower than the leave in-situ options due to the extended operations and additional level of logistical complexity.
Options 1 and 2b are equally preferred options from a Technical Risk perspective. In general, the track record and higher risk of failure for the trenching and full removal options drive the differences.
Option 1 and 2b are assessed as equally preferred options.</td></tr>
<tr><td>Societal</td><td colspan="2">Option 3a, is preferred from an Impact on Commercial Fisheries perspective as the pipeline would be fully removed.
Option 3a is preferred from a Socio-economic impact on communities and amenities perspective, as on balance any negative impacts are considered to be outweighed by the potential for job retention / creation associated with the processing of the materials.
Considering both sub-criteria together, Option 3a is assessed as most preferred option, closely followed by Option 2c.</td></tr>
<tr><td>Economic</td><td colspan="2">With the lowest cost for operations, Option 1 is preferred with respect to short term costs.
With no long-term liability, Option 3a is preferred with respect to long term costs.
Considering both sub-criteria and associated weightings, Option 1 is assessed as the preferred option, closely followed by Option 2c.</td></tr>
<tr><td>Summary</td><td colspan="2">Overall, Option 2c, trench and bury is to be taken forward as the selected option.
This option was deemed to be the safest overall and it minimises future liability whilst maintaining cost effectiveness. Technically it is considered achievable, however, should technical difficulties arise when executing trenching and burying, leave in situ with selective rock cover would be considered the fall-back option. OPRED will be consulted on any proposed use of additional rock.</td><td> 
</td></tr>
</table>

5 CA OUTCOME – GROUP 2 – 10” CONCRETE COATED PIPELINE, SURFACE LAID AND EXPOSED (PL38)

5.1 Group Characteristics

The individual item that makes up Group 2 – 10” Concrete Coated Pipeline PL38 is detailed in full within Subsea Infrastructure Inventory Report ref. [5] and the CA Scoping Report ref. [8]. By way of summary, the key characteristics are presented in Table 5-1:

ID	Description	Field	OD (inches)	Length (m)	Weight (T)
PL38	10” Oil Pipeline, Auk A to SBM	Auk	10	1,917[6]	482

Table 5-1: Group 2 Item

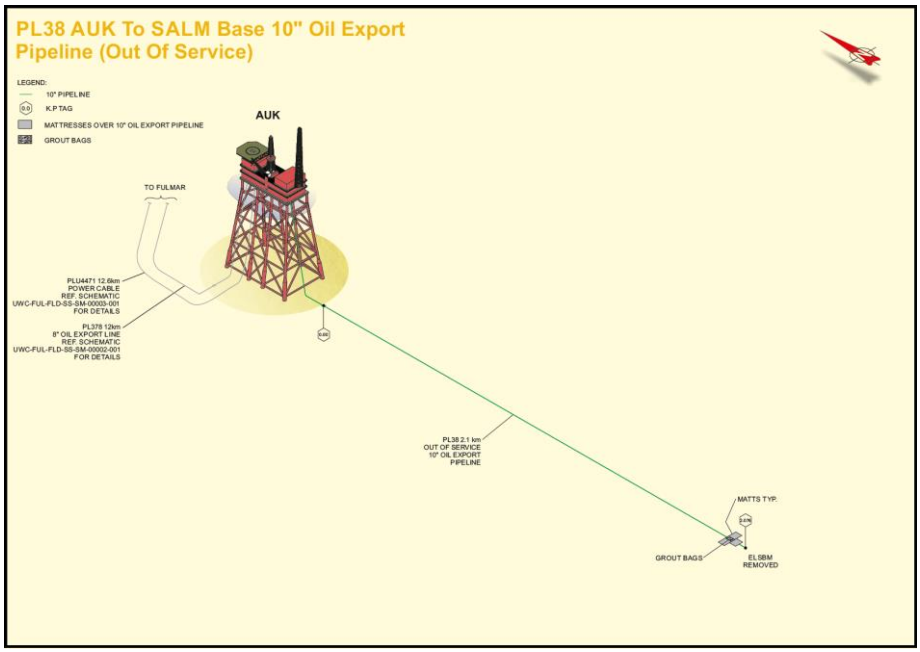


Figure 5-1: PL38 Auk to SALM Base 10” Oil Export Pipeline

Between 1996 and 2017 the number of surveyed spans generally fluctuated between 26 and 55, as detailed within the Pipeline Status & Historical Review Report ref. [9]. Based on the lack of self-burial to date, the pipeline is thought to be laid on stable seabed, and as such, exposures are not expected to occur once the pipeline is trenched to target depth.

There were 55 spans (12.7% of pipeline length) recorded in 2017 for this pipeline. No spans exceed FishSAFE limits (spans greater than 10m in length and 0.8m in height).

[6] Pipeline length stated is the pipeline only and does not include spools or risers

5.2 Decommissioning Options & Screening Outcome

The decommissioning options identified for Group 2 are detailed in Table 5-2. The colour coding indicates the outcome from the CA Screening process, fully detailed in Screening Report ref. [6].

Group 2 – 10" Concrete Coated Pipeline, Surface Laid and Exposed		
Category	**Option**	**Description**
Leave in-situ (minimal intervention)	1 – Disconnect / remove ends and minimal remediation.	The option will involve the disconnection and removal of the pipeline ends and make safe the remaining cut ends.
Leave in-situ (remedial intervention)	2a – Cut and remove exposures (including ends)	The option will involve disconnection of the pipeline ends, cut and removal of any exposures. This option was screened out as the entire line is exposed, therefore it is the same as Option 3a.
	2b – Rock cover exposures (including ends)	The option will involve the disconnection of the pipeline ends and the subsequent rock placement operations on cut ends and line exposures, (in this instance the entirety of the pipeline).
	2c – Trench and bury exposures (including ends)	The option will involve the disconnection of the pipeline ends and the subsequent trench and backfill of the pipeline to a sufficient depth below seabed level.
Full removal	3a – Cut and Lift – Cut pipe in to small sections and recover	The option will involve cutting the entire pipeline into manageable section and recovery of the pipe to shore.
	3b – Reverse Installation – Recover pipe using reverse S-lay or reverse reeling.	The option will involve disconnection and recovery of the pipeline ends for onshore disposal, followed by the removal of the remaining pipeline by reverse installation. This option was screened out as there is no track record for reverse S-lay in the North Sea, there are currently significant technical limitations for this approach.

Table 5-2: Group 2 Decommissioning Options

5.3 Decommissioning Options for Evaluation

The decommissioning options for Group 2 that remained after screening and which were taken forward to the evaluation phase are:

- Leave in-situ (minimal intervention)
  - 1 – Disconnect / remove ends and minimal remediation
- Leave in-situ (remedial intervention)
  - 2b – Rock cover exposures (in this case the full line)
  - 2c – Trench and bury exposures (in this case the full line)
- Full removal
  - 3a – Cut and Lift – Cut pipe in to small sections and recover

5.4 Evaluation Summary

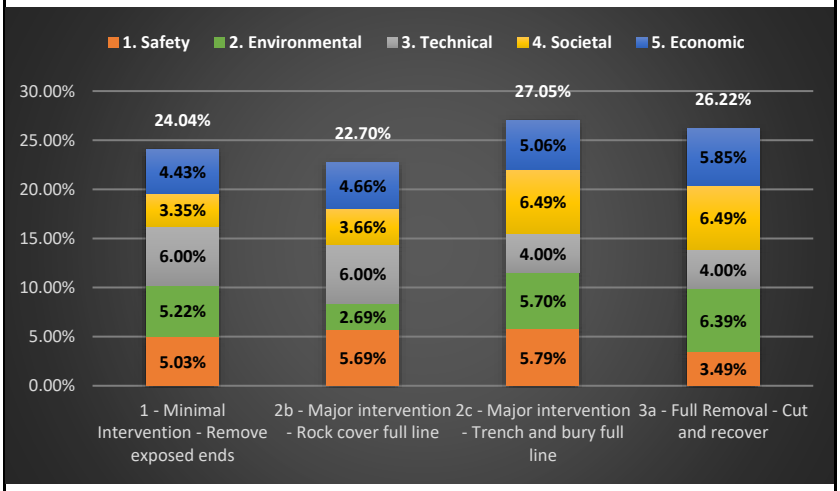
Group 2 – 10" Concrete Coated Pipeline, Surface Laid and Exposed (PL38)			
Screening	1 – Minimal intervention: Remove exposed ends only.	2a – Minor intervention: Remove exposures.	2b – Major intervention: Rock cover full line.
	2c – Major intervention: Trench and bury full line.	3a – Full Removal: Cut and recover.	3b – Full Removal: Reverse Installation.
Note: for full attributes tables and assessment see Appendix D			

Evaluation	
Safety	Option 1 and Option 2b are equally preferred options from a risk to Offshore Personnel perspective, with the increased risk exposure associated with back deck working for Options 2c and 3a being the key factor. Options 1, 2b and 2c are equally preferred options from a risk to Onshore Personnel perspective due to the risks associated with handling, transporting and processing large quantities of cut pipe associated with Option 3a. With regard to the risk to Other Users, all options are considered equally preferable to each other. With regard to Residual Risk, Option 3a is preferred being that the infrastructure is fully removed. Overall, Option 2c is assessed as the preferred option.
Environment	With respect to Impact of Decommissioning Operations Offshore all options are assessed as being neutral to each other as the environmental impact of the options are largely similar in terms of emissions, marine noise and fuel consumption. Options 1, 2b and 2c are equally preferred from a Processing of Returned Materials perspective as Option 3a involves the recovery of the entire pipeline. Option 3a is preferred from a Resource Consumption perspective as rock placement is not required, and Option 3a represents the maximum amount of material available to be recycled. Option 1 is preferred from a Seabed Disturbance perspective as it represents the least operations. Whereas, Options 2c and 3a are preferred equally from a Loss of Habitat perspective. Although minimal new material is associated with Option 1, the pipeline will remain on the seabed, Option 2b represents a significant permanent change to the seabed habitat. Overall, considering all sub-criteria and associated weightings, Option 3a is assessed as the preferred option.
Technical	Each of these options are considered as routine subsea operations and are technically feasible. Options 1 and 2b are equally preferred options from a Technical Risk perspective. In general, the track record and higher risk of failure for the trenching and full removal options drive the differences. Options 1 and 2b are assessed as equally preferred options.
Societal	Options 2c and 3a, are assessed as equally preferable from an Impact on Commercial Fisheries perspective as they each represent a clear seabed. From a Socio-economic impact on communities and amenities perspective all options are considered equally preferable. The processing of returned materials to shore has both positive and negative impacts on communities. Job creation and retention as well as disruption, impact on health and wellbeing from pollution, increases in noise and dust and/or odour can also occur. Options 2c and 3a are assessed as equally preferred options.
Economic	With the lowest cost for operations, Option 2c is preferred with respect to short term costs. With no long-term liability, Option 3a is preferred with respect to long term costs. Considering both sub-criteria and associated weightings, Option 3a is assessed as the preferred option.

Summary

Overall, Option 2c is selected as the preferred option.

This option was the most preferred against the Safety and Environmental criteria and equally preferred against the Societal criterion. It was not the most preferred against the Technical criterion, however this was insufficient to offset other preferences. Option 2c was the most preferred option prior to economic consideration being applied and remained so once economic considerations were included. However, if this cannot be achieved due to difficulties in executing trenching and burying, then spot rock placement or full rock armouring may be considered. OPRED will be consulted on any proposed use of additional rock



6 CA OUTCOME – GROUP 3 – PIPELINES & UMBILICALS, SURFACE LAID AND ROCK COVERED (PL208, PL1316, PLU4472, PLU4473)

6.1 Group Characteristics

The individual items that make up Group 3 – Pipelines & Umbilicals, PL208, PL1316, PLU4472 and PLU4473 are detailed in full within the Subsea Infrastructure Inventory Report ref. [5] and the CA Scoping Report ref. [8]. By way of summary, the key characteristics are presented in Table 6-1:

ID	Description	Field	OD (inches)	Length (m)	Weight (T)
PLU4472	Fulmar to Oil Export SSIV Umbilical J-tube Section	Fulmar	2	200	4
	Fulmar to Oil Export SSIV Umbilical Static Section	Fulmar	2	290	6
PLU4473	Oil Export SSIV to Gas Export Pipeline NRV Control Umb.	Fulmar	2	1,404	29
PL208	20" Gas Export Pipeline	Fulmar	20	1,008[7]	624
PL1316	4.5" Fuel Gas Pipeline	Fulmar	4.5	1,182[6]	28
Totals				4,084	691

Table 6-1: Group 3 Items

6.1.1 PLU4472 Summary

PLU4472 is a short, surface laid umbilical that extends from Fulmar AD to the Fulmar SSIV. It is rock covered for 61% of its length and mattressed for 32% of its length, becoming exposed only at the Fulmar AD J-tube. There have been no recorded spans in any of the surveys and no exposures as indicated in the latest survey, as detailed within the Pipeline Status & Historical Review Report ref. [9].

Pipeline crossings occur at the following locations:

- Crossing of the PL1315 pipeline on the approach to Fulmar AD platform
- Crossing of the 16" gas pipeline PL297 near Fulmar AD Platform
- Crossing of the 16" oil pipeline PL296 near Fulmar AD Platform
- Crossing of PLU4473 control umbilical on approach to SSIV tie-in

[7] Pipeline length stated is the pipeline only and does not include spools or risers

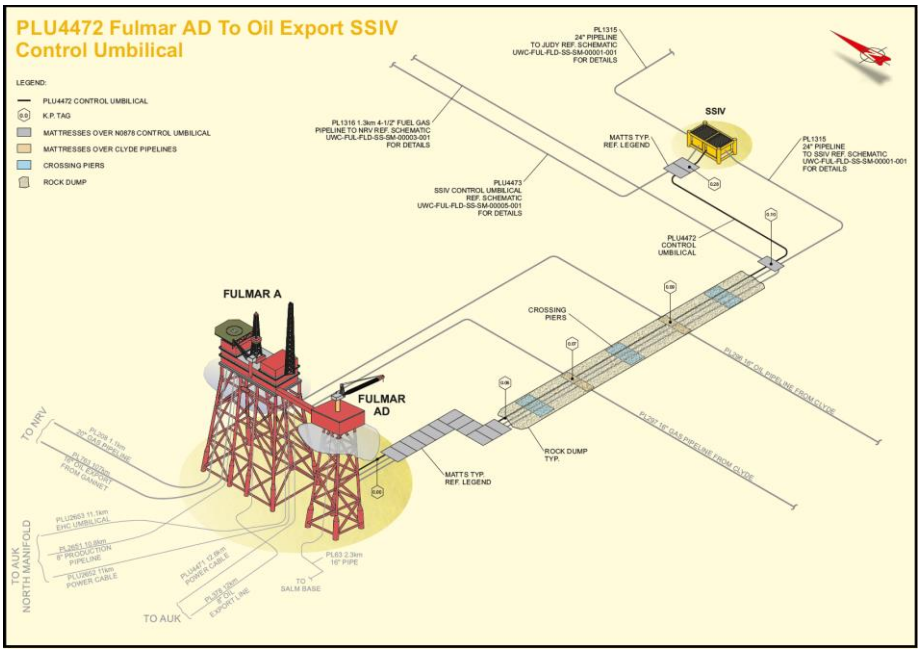


Figure 6-1: PLU4472 Fulmar AD to Oil Export SSIV Control Umbilical

6.1.2 PLU4473 Summary

PLU4473 was installed surface laid alongside PL1316. Protection of the umbilical is provided by blanket rock cover over 97% of its length. Mattresses are also used at the ends of the umbilical. Further detail of umbilical status can be found within the Pipeline Status & Historical Review Report ref. [9].

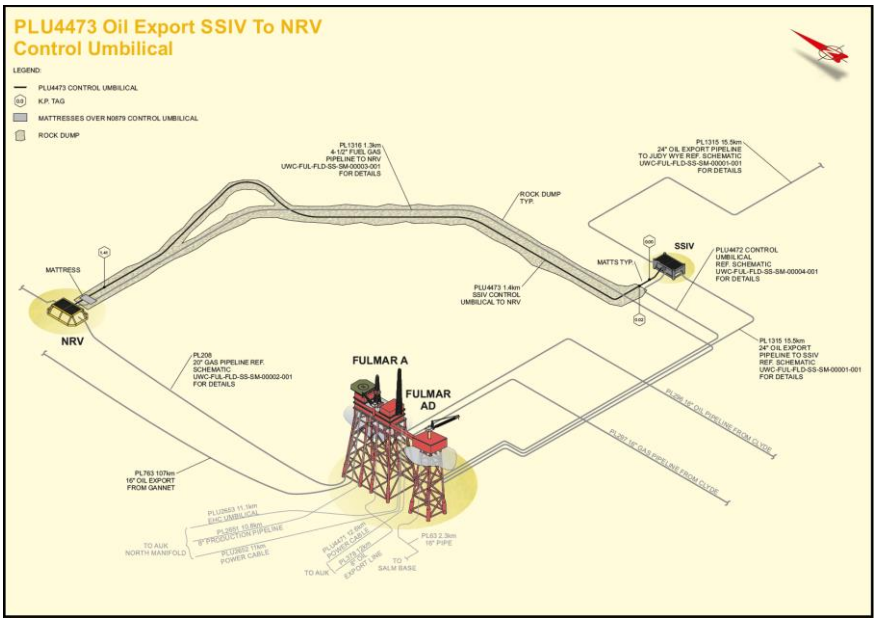


Figure 6-2: PLU4473 Oil Export SSIV to NRV Control Umbilical

6.1.3 PL208 Summary

The historical evidence shows that the pipeline maintains a relatively consistent burial status over time, as detailed within the Pipeline Status & Historical Review Report ref. [9]. The exposed length of pipeline is approximately 12% of the total length and is mainly associated with the approach to the tie-in at Fulmar A. Apart from two small exposures at KP 288.65 and KP 288.92, both of which are approximately 1 m in length, the remainder of the pipeline is fully rock covered.

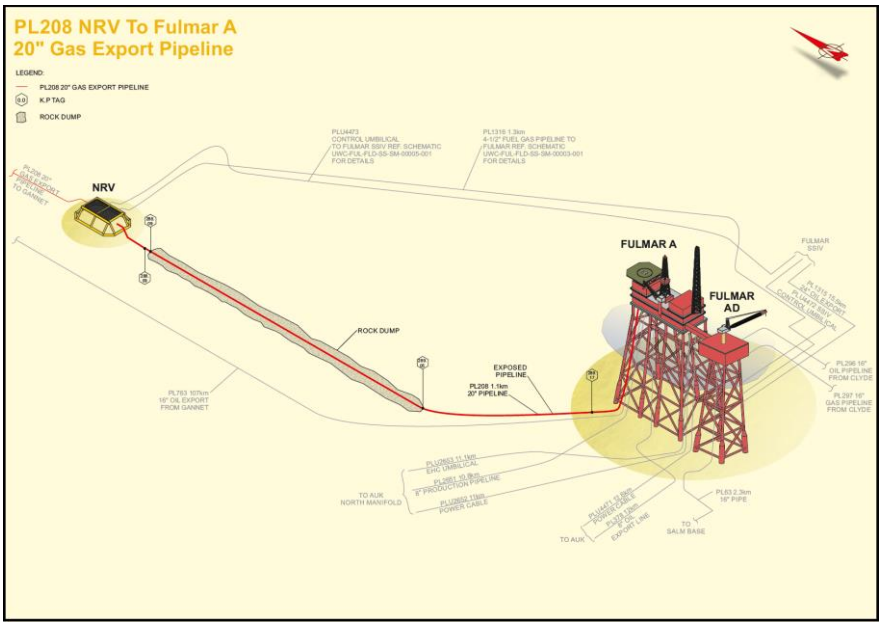


Figure 6-3: PL208 NRV to Fulmar A 20" Gas Export Pipeline

6.1.4 PL1316 Summary

PL1316 is surface laid and rock covered to approximately 95% of its length. The remaining 5% of the pipe is mattress covered. There have been no recorded exposures since installation. Further detail of pipeline status can be found within the Pipeline Status & Historical Review Report ref. [9].

There are three pipeline crossings at the following locations:

- A 16" gas pipeline PL297 (East) crossing under rock cover at KP 0.068
- A 16" oil pipeline PL296 (East) crossing under rock cover at KP 0.089
- PLU4472 crossing under rock at KP 0.096

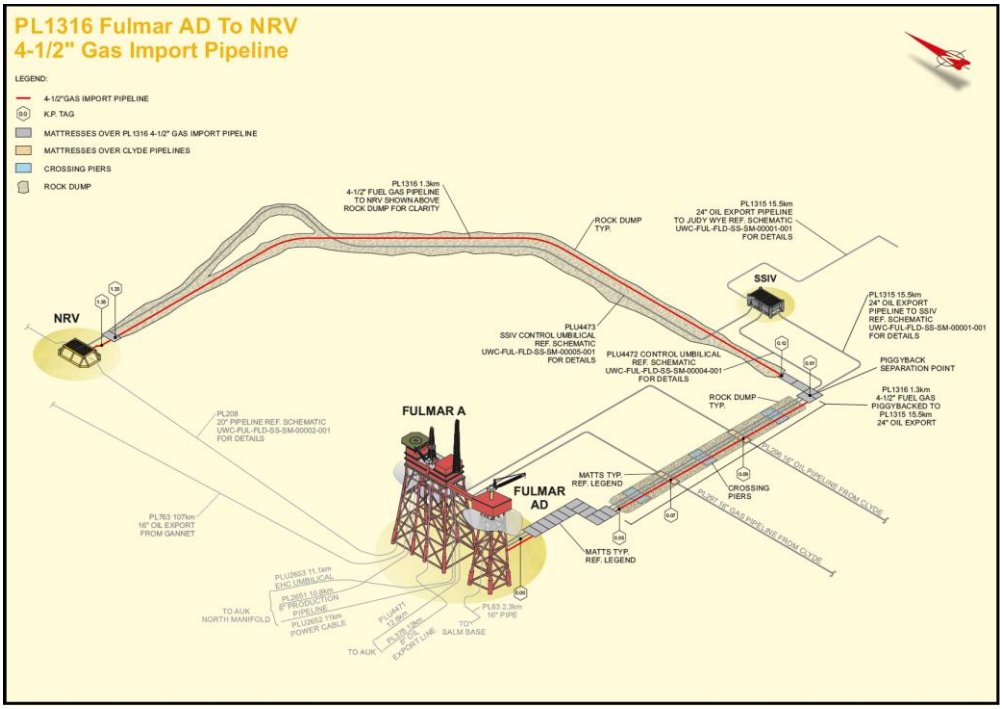


Figure 6-4: PL1316 Fulmar AD to NRV 4-1/2" Gas Import Pipeline

6.2 Decommissioning Options & Screening Outcome

The decommissioning options identified for Group 3 – Pipelines & Umbilicals, Surface Laid and Rock Covered are detailed in Table 6-2. The colour coding indicates the outcome from the CA Screening process, fully detailed in Screening Report ref. [6].

Group 3 – Pipelines & Umbilicals, Surface Laid and Rock covered		
Category	**Option**	**Description**
Leave in-situ (minimal intervention)	1 – Disconnect / remove ends and minimal remediation.	The option will involve the disconnection and removal of the pipeline ends and make safe the remaining cut ends.
Leave in-situ (remedial intervention)	2a – Cut and remove exposures (including ends)	The option will involve disconnection of the pipeline ends, cut and removal of any exposures. This option was screened out as there are no exposures along the line, being fully rock covered, hence the option is not applicable.
	2b – Rock cover exposures (including ends)	The option will involve the disconnection of the pipeline ends and the subsequent rock placement operations on cut ends and line exposures. This option was screened out as there are no exposures along the line, being fully rock covered, hence the option is not applicable.
	2c – Trench and bury exposures (including ends)	The option will involve the disconnection of the pipeline ends and the subsequent trench and backfill of the pipeline remaining exposures to a sufficient depth below seabed level. This option was screened out as the line is fully rock covered, hence the option is not applicable.
Full removal	3a – Cut and Lift – Cut pipe in to small sections and recover	The option will involve removal of rock and cutting the entire pipeline into manageable section and recovery of the pipe to shore.
	3b – Reverse Installation – Recover pipe using reverse S-lay or reverse reeling.	The option will involve disconnection and recovery of the pipeline ends for onshore disposal, followed by the removal of the remaining pipeline by reverse installation.

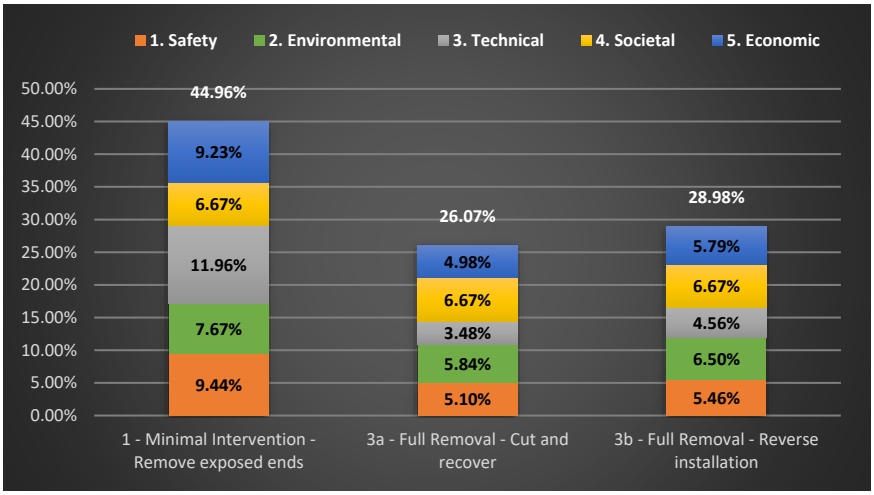
Table 6-2: Group 3 Decommissioning Options

6.3 Decommissioning Options for Evaluation

The decommissioning options for Group 3 that remained after screening and which were taken forward to the evaluation phase are:

- Leave in-situ (minimal intervention)
  - 1 – Disconnect / remove ends and minimal remediation
- Full removal
  - 3a – Cut and Lift – Cut pipe in to small sections and recover.
  - 3b – Reverse Installation – Recover pipe using reverse S-lay or reverse reeling

6.4 Evaluation Summary

<table>
<tr><th colspan="4">Group 3 – Pipelines & Umbilicals, Surface Laid and Rock Covered (PL208, PL1316, PLU4472, PLU4473)</th></tr>
<tr><td rowspan="2">Screening</td><td>1 – Minimal intervention: Remove exposed ends only.</td><td>2a – Minor intervention: Remove exposures and ends.</td><td>2b – Major intervention: Rock cover exposures and ends.</td></tr>
<tr><td>2c – Major intervention: Trench and bury exposures and ends.</td><td>3a – Full Removal: Cut and recover.</td><td>3b – Full Removal: Reverse Installation.</td></tr>
<tr><td colspan="4">Note: for full attributes tables and assessment see Appendix E</td></tr>
<tr><td rowspan="5">Evaluation</td><td>Safety</td><td colspan="2">Option 1 is preferred from a risk to Offshore Personnel perspective as it involves the least operations.
Option 1 is preferred from a risk to Onshore Personnel perspective as it involves the least material returning onshore and therefore represents the least operations.
All options are equally preferred from a risk to Other Users perspective.
With regards to Residual Risk, Options 3a and 3b are preferred as both result in the lines being fully removed.
Overall, Option 1 is assessed as the preferred option.</td></tr>
<tr><td>Environment</td><td colspan="2">All options are equally preferred from an Impact of Decommissioning Operations Offshore perspective as the environmental impact of the options are largely similar in terms of emissions, marine noise and fuel consumption.
Option 1 is preferred from a Processing of Returned Materials perspective as this involves the least material returned to shore.
Options 3a and 3b are preferred from a Resource Consumption perspective as they don't require any additional rock and involve the recycling of the most material.
Option 1 is preferred from a Seabed Disturbance perspective, as this involves the least activity. However, Options 1, 3a and 3b are preferred equally from a Loss of Habitat perspective as the rock would remain on the seabed in all cases.
Overall, Option 1 is assessed as the preferred option.</td></tr>
<tr><td>Technical</td><td colspan="2">Each of the options are considered as routine subsea operations. However, Option 1 would be the preferred option from a Technical Risk perspective. As it represents the least activity in field there is a low risk of failure and limited impact to cost and schedule in the event of failure.
Option 1 is assessed as the preferred option.</td></tr>
<tr><td>Societal</td><td colspan="2">With regard to Impact on Commercial Fisheries and Socio-Economic Impact on Communities and Amenities all three options are equally preferred as the existing rock cover would remain in all cases.
The quantities of material returned are insufficient to cause any significant negative impact on communities. Where there are greater quantities returned, Options 3a and 3b, this is offset by higher job creation / retention and thus largely balanced.
Overall, all options equally preferred.</td></tr>
<tr><td>Economic</td><td colspan="2">With the lowest cost for operations, Option 1 is preferred with respect to short term costs.
With no long-term liability, Options 3a and 3b are equally preferred with respect to long term costs.
Considering both sub-criteria and associated weightings, Option 1 is assessed as the preferred option.</td></tr>
<tr><td>Summary</td><td colspan="2">Overall, Option 1 is selected as the preferred option.
As the lines are rock covered and stable removing them would not present any clear benefit, as the rock would remain on the seabed.
This does result in an ongoing liability, however, that would be the case in any event.</td><td> 
</td></tr>
</table>

7 CA OUTCOME – GROUP 4 – PIPELINES, FULLY TRENCHED AND BURIED (PL378, PL2651)

7.1 Group Characteristics

The individual items that make up Group 4 – Pipelines, Fully Trenched and Buried PL378 and PL2651 are detailed in full in the Subsea Infrastructure Inventory Report ref. [5] and the CA Scoping Report ref. [8]. By way of summary, the key characteristics are presented in Table 7-1:

ID	Description	Field	OD (inches)	Length (m)	Weight (T)
PL378	8" Oil Pipeline, Fulmar A to Auk A	Auk	8	11,770[8]	791
PL2651	8" Production Pipeline, Auk North Manifold to Fulmar A	Auk North	8	10,488[9]	1121
Totals				22,258	1,912

Table 7-1: Group 4 Items

7.1.1 PL378 Summary

PL378 is fully trenched and buried, typically between 0.2m and 1m from top of pipe. There has been no indication of any change of this status since installation. Further detail of pipeline status can be found within the Pipeline Status & Historical Review Report ref. [9].

There are no exposures or spans identified, however 3 crossings were identified at the following locations on approach to Fulmar A:

- At KP 11.933 pipeline crossing under PLU4471
- At KP 11.959 pipeline crossing under PLU2652 (ESP Power cable)
- At KP 11.960 pipeline crossing under PLU2653 (E-H/CI Umbilical)

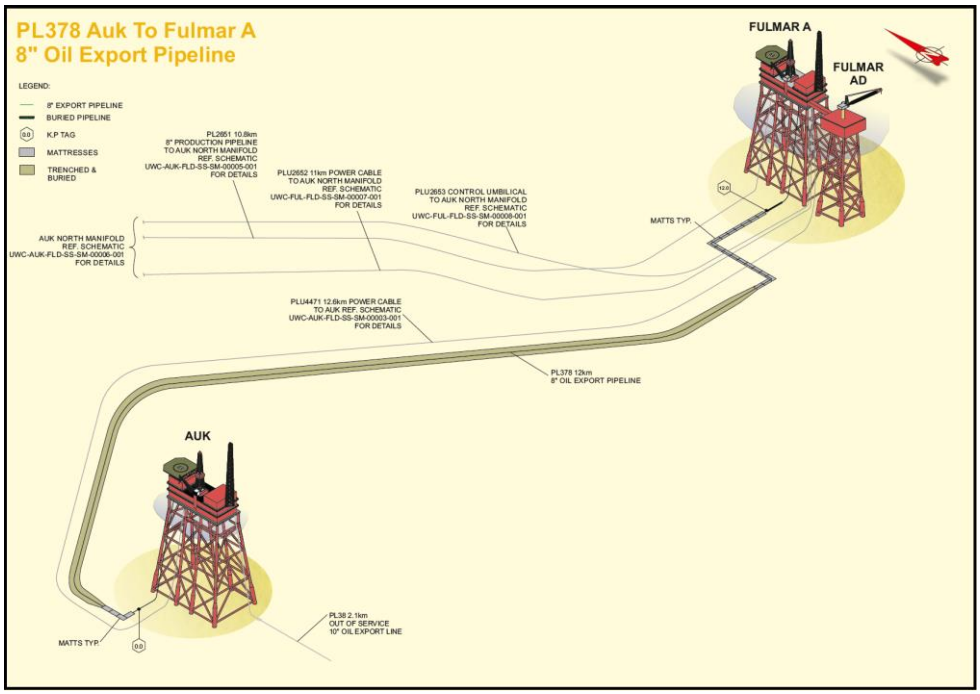


Figure 7-1: PL378 Auk to Fulmar A 8" Oil Export Pipeline

[8] Length given in PWA is for line pipe length only

[9] Pipeline length stated is the pipeline only and does not include spools or risers

7.1.2 PL2651 Summary

PL2651 is fully trenched and buried, typically between 0.5m and 2.5m from top of pipe, with areas of spot rock placement which has been used to mitigate against upheaval buckling but also in areas where target trench depth is not achieved. Further rock has been used at the trench transition at the Auk North site. Further detail of pipeline status can be found within the Pipeline Status & Historical Review Report ref. [9].

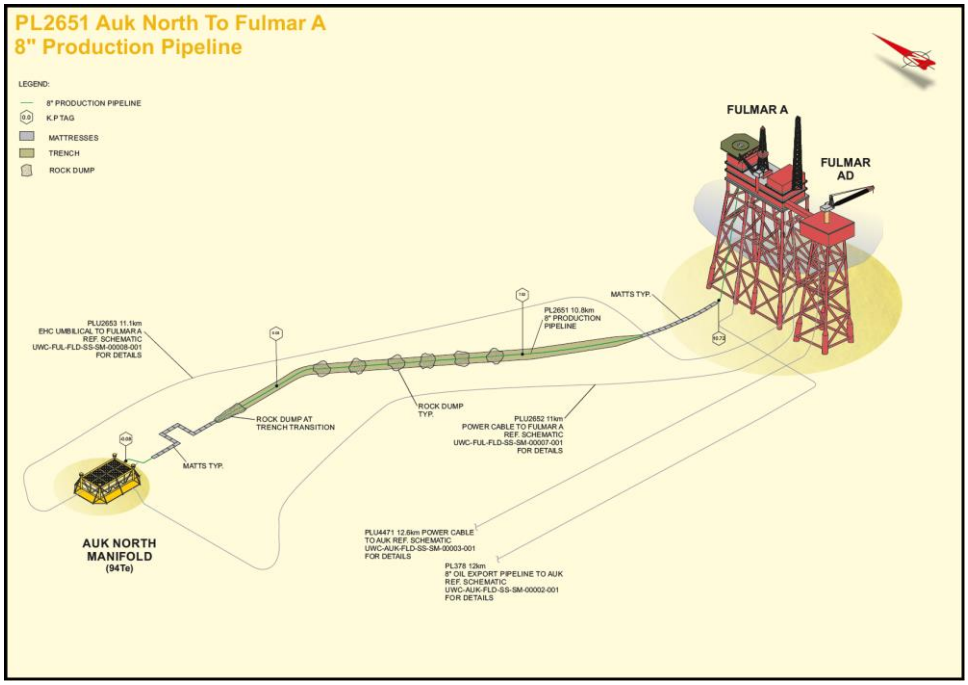


Figure 7-2: PL2651 Auk North to Fulmar A 8" Production Pipeline

7.2 Decommissioning Options & Screening Outcome

The decommissioning options identified for Group 4 – Pipelines, Fully Trenched and Buried are detailed in Table 7-2. The colour coding indicates the outcome from the CA Screening process, fully detailed in Screening Report ref. [6].

Group 4 – Pipelines, Fully Trenched and Buried		
Category	**Option**	**Description**
Leave in-situ (minimal intervention)	1 – Disconnect / remove ends and minimal remediation.	The option will involve the disconnection and removal of the pipeline ends and make safe the remaining cut ends.
Leave in-situ (remedial intervention)	2a – Cut and remove exposures (including ends)	The option will involve disconnection of the pipeline ends, cut and removal of any exposures. This option was screened out as there are no exposures along the line, being that it is fully trenched and buried.
	2b – Rock cover exposures (including ends)	The option will involve the disconnection of the pipeline ends and the subsequent rock placement operations on cut ends and line exposures. This option was screened out as there are no exposures along the line, being that it is fully trenched and buried.
	2c – Trench and bury exposures (including ends)	The option will involve the disconnection of the pipeline ends and the subsequent trench and backfill of the pipeline remaining exposures to a sufficient depth below seabed level. This option was screened out as the line is already fully trenched and buried.
Full removal	3a – Cut and Lift – Cut pipe in to small sections and recover	The option will involve unburial and cutting the entire pipeline into manageable section and recovery of the pipe to shore.
	3b – Reverse Installation – Recover pipe using reverse S-lay or reverse reeling.	The option will involve disconnection and recovery of the pipeline ends for onshore disposal, followed by unburial and the removal of the remaining pipeline by reverse installation.

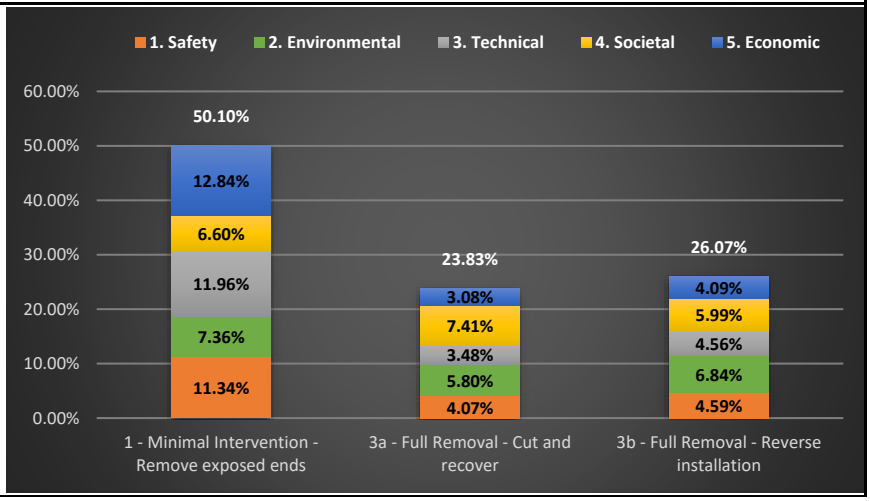
Table 7-2: Group 4 Decommissioning Options

7.3 Decommissioning Options for Evaluation

The decommissioning options for Group 4 that remained after screening and which were taken forward to the evaluation phase are:

- Leave in-situ (minimal intervention)
  - 1 – Disconnect / remove ends and minimal remediation.
- Full removal
  - 3a – Cut and Lift – Cut pipe in to small sections and recover
  - 3b – Reverse Installation – Recover pipe using reverse S-lay or reverse reeling

7.4 Evaluation Summary

<table>
<tr><th colspan="4">Group 4 – Pipelines, Fully Trenched and Buried (PL378, PL2651)</th></tr>
<tr><td rowspan="2">Screening</td><td>1 – Minimal intervention: Remove exposed ends only.</td><td>2a – Minor intervention: Remove exposures and ends.</td><td>2b – Major intervention: Rock cover exposures and ends.</td></tr>
<tr><td>2c – Major intervention: Trench and bury exposures and ends.</td><td>3a – Full Removal: Cut and recover.</td><td>3b – Full Removal: Reverse Installation.</td></tr>
<tr><td colspan="4">Note: for full attributes tables and assessment see Appendix F</td></tr>
<tr><td rowspan="5">Evaluation</td><td>Safety</td><td colspan="2">Option 1 is preferred from a risk to Offshore Personnel perspective as it involves the least operations.
Option 1 is preferred from a risk to Onshore Personnel perspective as it involves the least material returning onshore and therefore results in the least operations and least exposure.
All options are equally preferred from a risk to Other Users perspective.
With regards to Residual Risk, Options 3a and 3b are preferred as both result in the lines being fully removed.
Overall, Option 1 is assessed as the preferred option.</td></tr>
<tr><td>Environment</td><td colspan="2">Options 1 and 3b are equally preferred from an Impact of Decommissioning Operations Offshore perspective as the environmental impact of the options are largely similar in terms of emissions, marine noise and fuel consumption.
Option 1 is preferred from a Processing of Returned Materials perspective as this involves the least material returned to shore.
Options 3a and 3b are preferred from a Resource Consumption perspective as they don't require any additional rock and involve the recycling of the most material.
Option 1 is preferred from a Seabed Disturbance perspective, as this involves the least activity. However, Options 3a and 3b are preferred equally from a Loss of Habitat perspective as the lines are fully removed in these cases.
Overall, Option 1 is assessed as the preferred option.</td></tr>
<tr><td>Technical</td><td colspan="2">Each of the options are considered as routine subsea operations. However, Option 1 would be the preferred option from a Technical Risk perspective. As it represents the least activity in field there is a low risk of failure and limited impact to cost and schedule in the event of failure.
Option 1 is assessed as the preferred option.</td></tr>
<tr><td>Societal</td><td colspan="2">With regard to Impact on Commercial Fisheries all three options are equally preferred as the lines are buried and stable clear seabed remains in all cases.
From a Socio-Economic Impact on Communities and Amenities perspective, Option 3a is preferred as there are fewer onshore manhours relating to job creation / retention relating to Option 3b. The quantities of material returned in all cases are insufficient to cause any significant negative impact on communities.
Option 3a is assessed as the preferred option.</td></tr>
<tr><td>Economic</td><td colspan="2">With the lowest cost for operations, Option 1 is preferred with respect to short term costs.
With no long-term liability, Options 3a and 3b are equally preferred with respect to long term costs.
Considering both sub-criteria and associated weightings, Option 1 is assessed as the preferred option.</td></tr>
<tr><td>Summary</td><td colspan="2">Overall, Option 1 is selected as the preferred option.
As the lines are buried and stable removing them would not present any clear benefit.
This does result in an ongoing liability; however, this is considered minimal and acceptable (DoB >0.6m).</td><td> 
</td></tr>
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8 CA OUTCOME – GROUP 5 – PIPELINES, PARTIALLY TRENCHED AND BURIED (PL63 & PL648)

8.1 Group Characteristics

The individual items that make up Group 5 – Pipelines, Partially Trenched and Buried are detailed in full within the Subsea Infrastructure Inventory Report ref. [5] and the CA Scoping Report ref. [8]. By way of summary, the key characteristics are presented in Table 8-1:

ID	Description	Field	OD (inches)	Length (m)	Weight (T)	Burial
PL63	Concrete Coated 16" Oil Pipeline	Fulmar	16	2,200[10]	753	~43%
PL648	Concrete Coated 16" Oil Pipeline	Fulmar	16	1,776[9]	734	~64%
Totals				3,976	1,487	

Table 8-1: Group 5 Items

8.1.1 PL63 and PL648 Summary

The PL63 / PL648 pipelines were installed with a target trench depth of 0.3m. The earlier survey results suggest that approximately 50 – 55% of the pipeline length was trenched and buried, however, over time the proportion of pipe that is buried has increased to between 70 – 75%.

The pipe is fully exposed at the approach to Fulmar AD, the original SALM location and the replacement SALM Base location with smaller, localised exposures evident at locations close to the original SALM Base. The pipeline tie-in approach to Fulmar AD platform is buried in what is thought to be drill cuttings.

There were 36 spans recorded in 2017 for these pipelines. The pipeline is in free span for 7.4% of total pipelines length, typically located at approach to Fulmar, original SALM site and replacement SALM site. No spans exceed FishSAFE limits (spans greater than 10m in length and 0.8m in height). Further detail of pipeline status can be found within the Pipeline Status & Historical Review Report ref. [9].

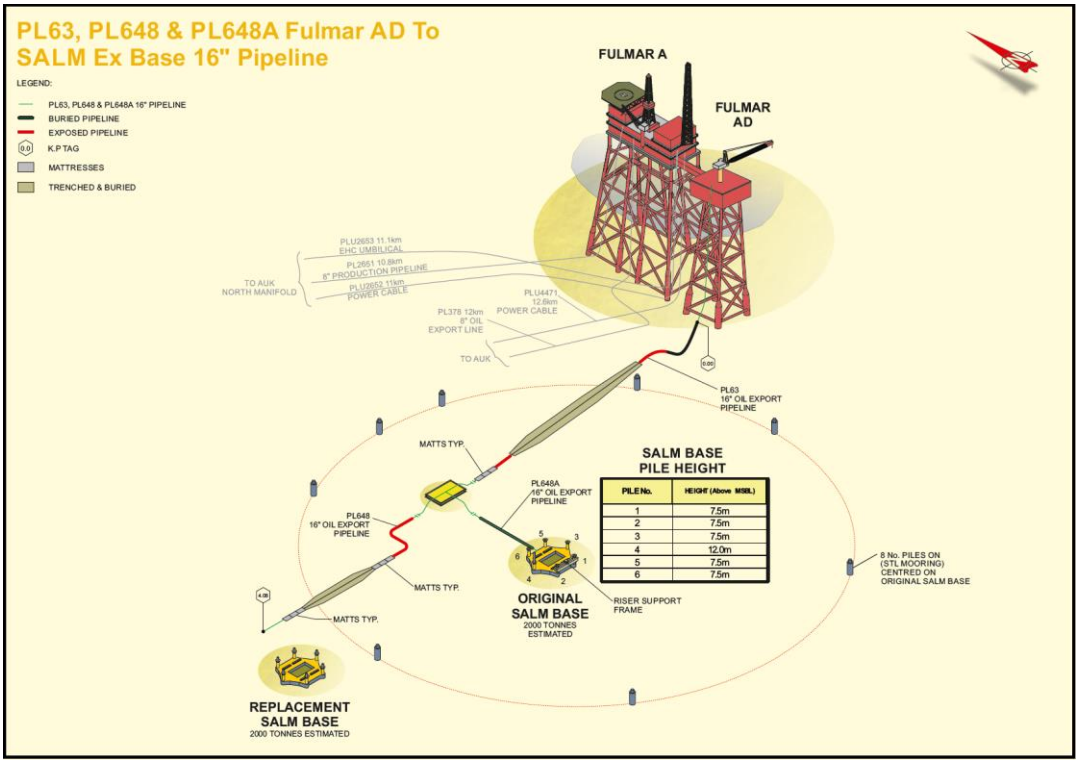


Figure 8-1: PL63, PL648 Fulmar AD to SALM Base 16" Pipeline

[10] Pipeline length stated is the pipeline only and does not include spools or risers

8.2 Decommissioning Options & Screening Outcome

The decommissioning options identified for Group 5 – Pipelines, Partially Trenched and Buried are detailed in Table 8-2. The colour coding indicates the outcome from the CA Screening process, fully detailed in Screening Report ref. [6].

Group 5 – Pipelines, Partially Trenched and Buried		
Category	**Option**	**Description**
Leave in-situ (minimal intervention)	1 – Disconnect / remove ends and minimal remediation.	The option will involve the disconnection and removal of the pipeline ends and make safe the remaining cut ends and spans.
Leave in-situ (remedial intervention)	2a – Cut and remove exposures (including ends)	The option will involve disconnection of the pipeline ends, cut and removal of any exposures and make safe remaining cut ends.
	2b – Rock cover exposed ends and exposures	The option will involve the disconnection of the pipeline ends and the subsequent rock placement operations on cut ends and line spans, exposures and areas of insufficient burial.
	2c – Trench and bury entire lines.	The option will involve the disconnection of the pipeline ends and the subsequent trench and backfill of the pipeline remaining exposures to a sufficient depth below seabed level.
Full removal	3a – Cut and Lift – Cut pipe in to small sections and recover	The option will involve unburial and cutting the entire pipeline into manageable sections and recovery of the pipe to shore.
	3b – Reverse Installation – Recover pipe using reverse S-lay or reverse reeling.	The option will involve disconnection and recovery of the pipeline ends for onshore disposal, followed by unburial and the removal of the remaining pipeline by reverse installation. This option was screened out as reverse reeling of a 16" diameter concrete coated pipeline is not technically feasible and there is no track record of reverse S-lay of pipelines in the North Sea.

Table 8-2: Group 5 Decommissioning Options

8.3 Decommissioning Options for Evaluation

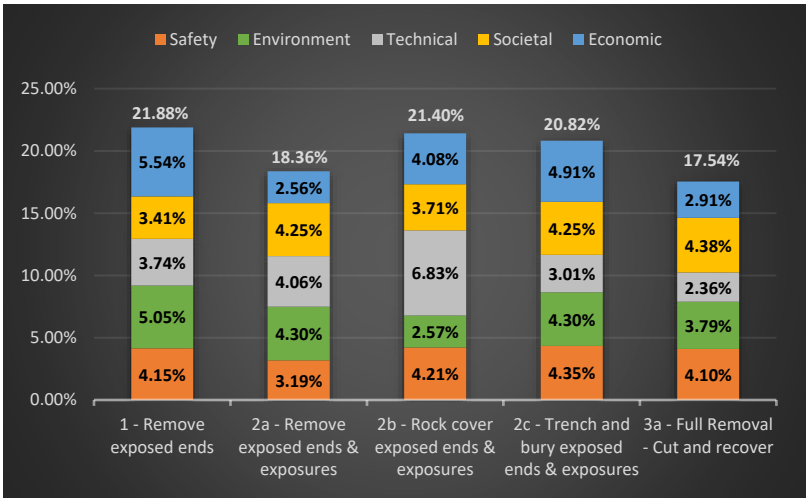
The decommissioning options for Group 5 that remained after screening and which were taken forward to the evaluation phase are:

- Leave in-situ (minimal intervention)
  - 1 – Disconnect / remove ends and minimal remediation
- Leave in-situ (remedial intervention)
  - 2a – Cut and remove exposures (including ends)
  - 2b – Rock cover exposures (including ends)
  - 2c – Trench and bury exposures (including ends)
- Full removal
  - 3a – Cut and Lift – Cut pipe in to small sections and recover

Note: during the initial evaluation of the options for Group 5, an adjustment to the methodology suggested for the removal of the exposed sections of pipeline in the Subsea Infrastructure Decommissioning Methodology ref. [10] was proposed. The evaluation presented in the following sections is based on that adjusted methodology i.e. use of Mass Flow Excavator (MFE) for making safe remaining cut ends / spans / exposures.

8.4 Evaluation Summary

<table>
<tr><th colspan="4">Group 5 – Pipelines, Partially Trenched and Buried (PL63 &PL648)</th></tr>
<tr><td rowspan="2">Screening</td><td>1 – Minimal intervention: Remove exposed ends only.</td><td>2a – Minor intervention: Remove exposures.</td><td>2b – Major intervention: Rock cover exposed ends and exposures</td></tr>
<tr><td>2c – Major intervention: Trench and bury full line.</td><td>3a – Full Removal: Cut and recover.</td><td>3b – Full Removal: Reverse Installation.</td></tr>
<tr><td colspan="4">Note: for full attributes tables and assessment see Appendix G</td></tr>
<tr><td rowspan="5">Evaluation</td><td>Safety</td><td colspan="2">Both Option 1 and 2b would be preferred options from a risk to Offshore Personnel perspective as these represent the least exposure for personnel.
Options 1, 2b and 2c are equally preferred options from a risk to Onshore Personnel perspective due to the risks associated with handling, transporting and processing large quantities of cut pipe associated with Option 3a.
With regard to the risk to Other Users, all options are considered equally preferable to each other.
With regard to Residual Risk, Option 3a is preferred being that the infrastructure is fully removed.
Considering all sub-criteria and associated weightings, Option 2c is assessed as the preferred option.</td></tr>
<tr><td>Environment</td><td colspan="2">Options 1, 2a, 2b and 2c are equally preferred from an Impact of Decommissioning Operations Offshore perspective as the associated noise, emissions and discharges are neutral and around half of Option 3a.
Options 1, 2a, 2b and 2c are equally preferred from a Processing of Returned Materials perspective, as Option 3a involves the recovery of the entire pipeline.
Option 3a is, however, preferred from a Resource Consumption perspective as no rock placement is required. Option 3a represents the maximum amount of material available to be recycled.
Option 1 is preferred from a Seabed Disturbance perspective as it has the smallest area of short-term impact.
Option 3a is the preferred option from a Loss of Habitat perspective as the infrastructure is fully removed from the field.
Overall, considering all sub-criteria and associated weightings, Option 1 is assessed as the preferred option.</td></tr>
<tr><td>Technical</td><td colspan="2">Each of the options are considered technically feasible. Achieving the level of lowering and burial required for Option 1, 2a and 2c is considered challenging, the variation in assessment being related to the amount of pipeline needing lowered / buried. Option 3a has technical challenges having never been performed before.
Option 2b is the preferred option from a Technical Risk perspective with rock cover considered routine operations. The lack of a track record for the full removal option and the higher risk of failure for the trenching option drive the outcome.
Options 2b is assessed as the preferred option.</td></tr>
<tr><td>Societal</td><td colspan="2">Option 3a is preferred from an Impact on Commercial Fisheries as it represents a clear seabed.
Options 1, 2a, 2b and 2c are equally preferred from a Socio-economic impact on communities and amenities perspective, as there is less impact on communities than from the handling of large quantities of returned material.
Considering both sub-criteria together, Option 3a is assessed as the most preferred option.</td></tr>
<tr><td>Economic</td><td colspan="2">The short-term (operations) costs for Options 1, 2b and 2c are so close as to be considered Neutral. As such these options are all preferred over the others. Of these options, Option 1 is lower than the others and so would be the preferred option from a short-term cost perspective.
Option 3a is preferred from a long-term costs perspective as this option carries no long-term liability.
Considering both sub-criteria and associated weighting, Option 1 is the preferred option.</td></tr>
<tr><td>Summary</td><td colspan="2">Overall Option 2b is selected as the preferred option.

It was close to being the most preferred option against the Safety criterion (marginally less preferred than the most preferred option). It was heavily preferred against the Technical criterion which was sufficient to offset it being less preferred against the Environmental and Societal criteria. Option 2b was the most preferred option prior to economic consideration being applied. Once economic considerations were applied, Option 1 became slightly preferred, however, given the guidance that economic consideration should not drive the outcome, Option 2b remains the preferred option.</td><td> 
</td></tr>
</table>

9 CA OUTCOME – GROUP 6 – UMBILICALS & CABLES – TRENCHED AND BURIED (PLU4471, PLU2652, PLU2653)

9.1 Group Characteristics

The individual items that make up Group 6 – Umbilicals & Cables – Trenched and Buried are detailed in full within the Subsea Infrastructure Inventory Report ref. [5] and the CA Scoping Report ref. [8]. By way of a summary, the key characteristics are presented in Table 9-1.

ID	Description	Field	OD (mm)	Length (m)	Weight (T)
PLU4471	Auk Fulmar Power Cable	Auk	119	12,560	369
PLU2652	Fulmar to Auk North Manifold Power Cable	Auk North	153.4	10,750[11]	498
PLU2653	Fulmar to Auk North Manifold EHC Umbilical	Auk North	122.7	10,870[10]	240
Totals				34,180	1,107

Table 9-1: Group 6 Items

9.1.1 PLU4471 Summary

PLU4471 is fully trenched and buried between 0 and 1m from top of the pipe, excluding approximately 180 m at Auk A and 450 m at Fulmar A. There has been no indication of any change of this status since installation. There were 48 spans recorded in 2017 for this power cable, however these are contained to the un-trenched sections at either end. Further detail of power cable status can be found within the Pipeline Status & Historical Review Report ref. [9].

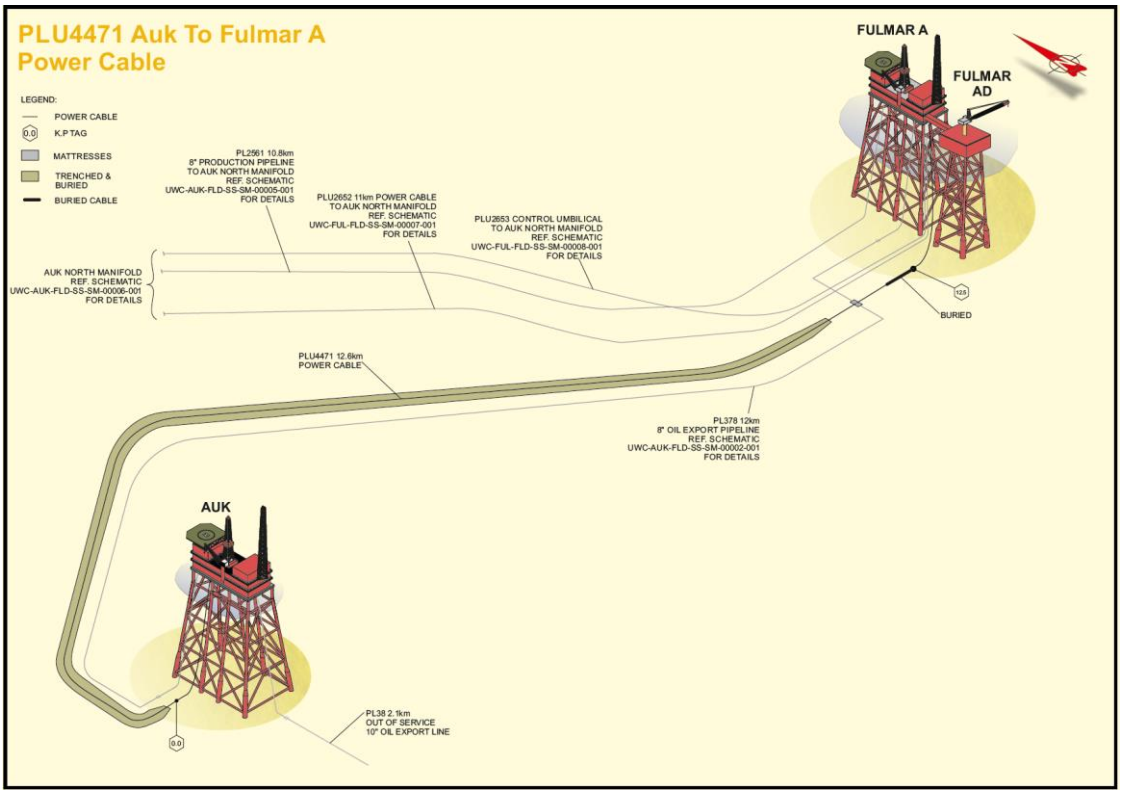


Figure 9-1: PLU4471 Auk to Fulmar A Power Cable

[11] Cable / umbilical length stated is the pipeline only and does not include J-tube section

9.1.2 PLU2652 Summary

The Auk North power cable, PLU2652, is fully trenched and buried, supplemented with areas of spot rock placement where target trench depth was not achieved. Depth of cover typically ranges from 0.4m to 1.4m from top of the umbilical. The areas of intermittent rock placement are located between KP6 and KP10. The cable is mattress protected at either end where it comes out of the trench.

There are two recorded crossings, PLU2652 is routed under the spools of well 4 / well 4 manifold and under the spools of wells 1 & 2. The average depth of burial, excluding the approach sections out with the trench, is 0.97m according to the 2017 survey. There were 5 exposures and 2 spans recorded during 2017, however these were all located in the un-trenched section at the Fulmar end of the cable. Further detail of power cable status can be found within the Pipeline Status & Historical Review Report ref. [9].

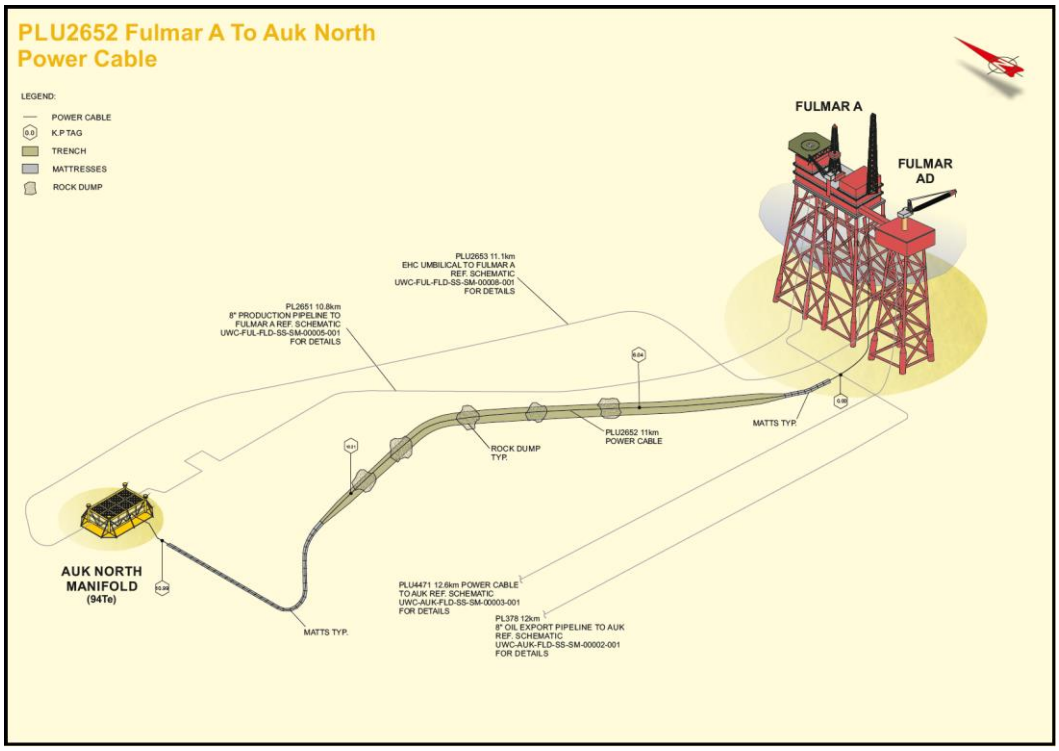


Figure 9-2: PLU2652 Fulmar A to Auk North Power Cable

9.1.3 PLU2653 Summary

PLU2653 is fully trenched and buried with areas of spot rock placement between KP 6.0 and KP 10.6. The umbilical is mattress protected at either end where it comes out of the trench. There is one recorded crossing where PLU2653 is routed over PL2651 near Fulmar A Platform.

The average depth of burial, excluding the approach sections that are out of the trench, is 0.91m according to the 2017 survey. There were 3 exposures and 2 spans recorded during 2017, all of which were located in the un-trenched section at the Fulmar end of the cable. Further detail of umbilical status can be found within the Pipeline Status & Historical Review Report ref. [9].

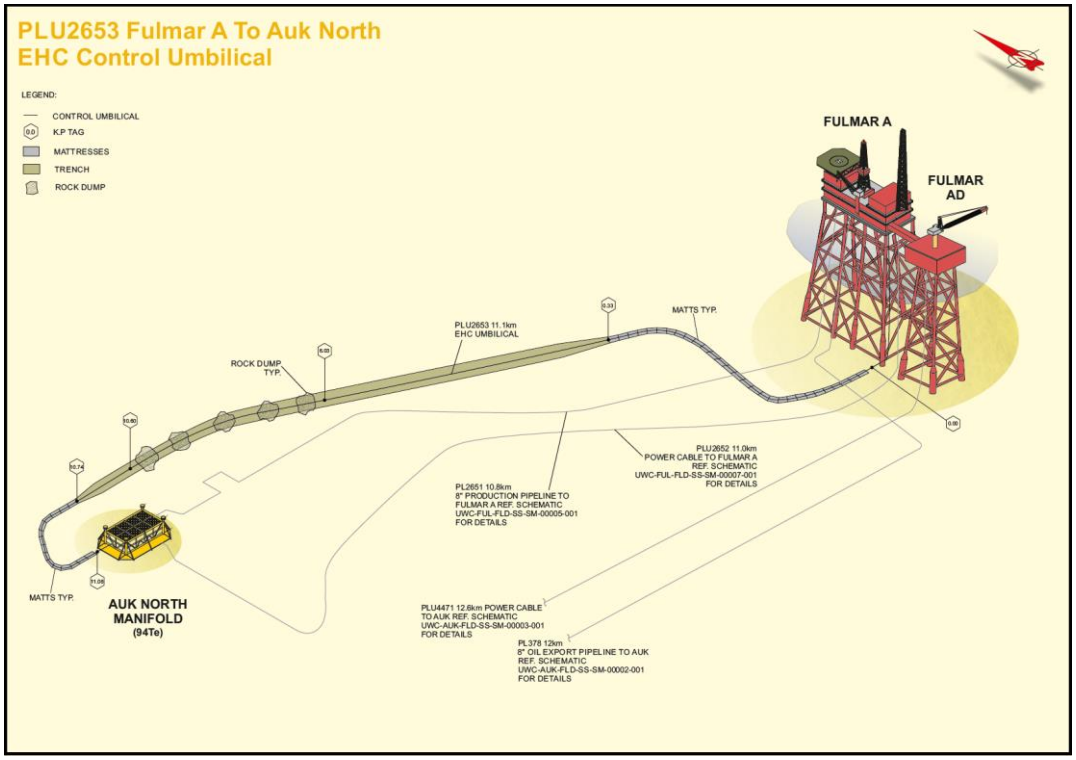


Figure 9-3: PLU2653 Fulmar A to Auk North EHC Control Umbilical

9.2 Decommissioning Options & Screening Outcome

The decommissioning options identified for Group 6 – Umbilicals & Cables – Trenched and Buried are detailed in Table 9-2. The colour coding indicates the outcome from the CA Screening process, fully detailed in Screening Report ref. [6].

Group 6 – Umbilicals & Cables – Trenched and Buried		
Category	**Option**	**Description**
Leave in-situ (minimal intervention)	1 – Disconnect / remove ends and minimal remediation.	The option will involve the disconnection and removal of the pipeline ends and make safe the remaining cut ends.
Leave in-situ (remedial intervention)	2a -: Cut and remove exposures (including ends)	The option will involve disconnection of the pipeline ends, cut and removal of any exposures. This option was screened out as there are no exposures, being that the lines are trenched and buried, hence this option is not applicable.
	2b – Rock cover exposures (including ends)	The option will involve the disconnection of the pipeline ends and the subsequent rock placement operations on cut ends and line exposures. This option was screened out as there are no exposures, being that the lines are trenched and buried, hence this option is not applicable.
	2c -: Trench and bury exposures (including ends)	The option will involve the disconnection of the pipeline ends and the subsequent trench and backfill of the pipeline to a sufficient depth below seabed level. This option was screened out as the lines are already trenched and buried, hence this option is not applicable.
Full removal	3a – Cut and Lift – Unbury and cut pipe in to small sections and recover	The option will involve cutting the entire pipeline into manageable section and recovery of the pipe to shore. This option was screened out as although technically feasible it is not an efficient option for cables and umbilicals in comparison to reverse reeling.
	3b – Reverse Installation – Recover pipe using reverse S-lay or reverse reeling.	The option will consist of the mobilisation of a construction vessel (CSV or DSV) to disconnect the pipeline ends and recover for onshore disposal. This will be followed by the subsequent mobilisation of a vessel to perform recovery by reverse installation.

Table 9-2: Group 6 Decommissioning Options

9.3 Decommissioning Options for Evaluation

The decommissioning options for Group 6 that remained after screening and which were taken forward to the evaluation phase are:

- Leave in-situ (minimal intervention)
  - 1 – Disconnect / remove ends and minimal remediation
- Full removal
  - 3b – Reverse Installation – Recover pipe using reverse S-lay or reverse reeling

9.4 Evaluation Summary

Screening

Group 6 – Umbilicals & Cables – Trenched and Buried (PLU4471, PLU2652, PLU2653)		
1 – Minimal intervention: Remove exposed ends only.	2a – Minor intervention: Remove exposures and ends.	2b – Major intervention: Rock cover exposures and ends.
2c – Major intervention: Trench and bury exposures and ends.	3a – Full Removal: Cut and recover.	3b – Full Removal: Reverse Installation.

Note: for full attributes tables and assessment see Appendix H

Evaluation

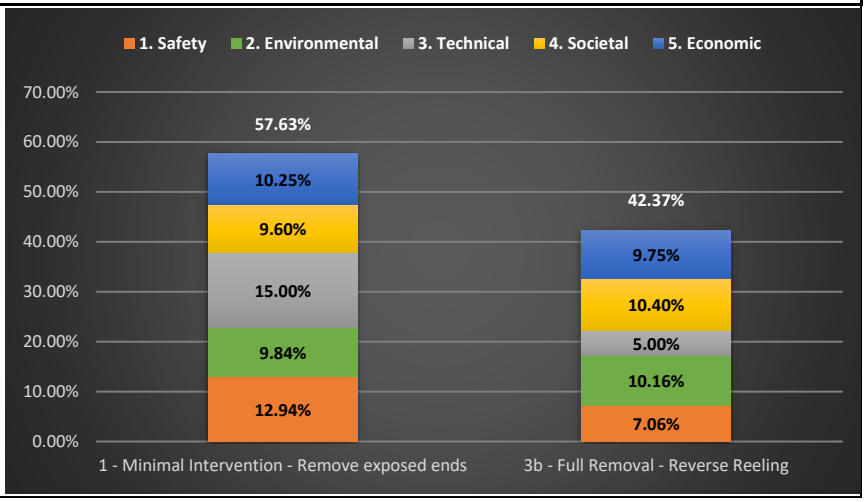
Safety	Option 1 is preferred from a risk to Offshore Personnel perspective as it requires less operations than Option 3b. Option 1 is preferred from a risk to Onshore Personnel perspective as it involves less material returning onshore and therefore results in less operations and less exposure. From a risk to Other Users perspective both options are equally preferred. From a Residual Risk perspective, Option 3b is preferred as the umbilicals and cables are fully removed and therefore present no remaining liability. Overall, Option 1 is the preferred option.
Environment	Both options, 1 and 3b, are equally preferred with respect to the Impact of Decommissioning Operations Offshore as they are largely similar in terms of emissions, marine noise and fuel consumption. Option 1 is preferable from a Processing of Returned Materials perspective as this involves less material returned onshore. Option 3b is preferable from a Resource Consumption perspective as this requires no rock placement and involves the recycling of the most material. Option 1 is preferable with respect to Disturbance as this involves the least activity. However, Option 3b is preferable from a Loss of Habitat perspective as the umbilicals and cables are fully removed and no additional rock is introduced. Overall, Option 3b is the preferred option.
Technical	Both of the options are considered achievable. However, Option 1 is considered to be preferable to Option 3b as this involves the least operations and therefore the lowest risk of failure or impact to cost and schedule in the event of failure. Option 1 is assessed as the preferred option.
Societal	Option 3b is assessed as preferable, as whilst the full area is available for commercial fishing operations under both options, the umbilicals and cables are fully removed under Option 3b. Option 1 is assessed as preferable driven by the larger quantity of umbilicals and cables returned with Option 3b, although the additional impact is expected to minimal due to transporting reeled umbilicals / cables. Overall, Option 3b is preferable.
Economic	With the lowest cost for operations, Option 1 is preferred with respect to short term costs. With no long-term liability, Option 3b is preferred with respect to long term costs. Considering both sub-criteria and associated weightings, Option 1 is assessed as the preferred option.

Summary

Overall, Option 1 is selected as the preferred option.

As the lines are buried and stable removing them would not present sufficient benefit to warrant that option.

This does result in an ongoing liability; however, this is considered minimal and acceptable (DoB >0.6m).



10 SUBSEA CA RECOMMENDATIONS

The outcomes obtained from performing the CA of the decommissioning groups and decommissioning options for the Subsea Infrastructure of the Auk, Fulmar and Auk North Fields Decommissioning Project are summarised here.

In accordance with OPRED Guidelines ref. [3] there were four groups identified at Scoping where full removal was the recommended decommissioning approach without any further consideration. These are:

- Group 7 – Subsea Installations / Structures
- Group 8 – SALM Bases and Piles
- Group 9 – Mattresses & Grout Bags (Accessible)
- Group 11 – Spools & Jumpers

It should be noted however, that where mattresses and grout bags are found which have deteriorated to a point where it would be unsafe to attempt to recover them then these shall be buried in situ to avoid causing future snagging hazards.

The full CA process was applied to the remaining decommissioning groups. The recommended decommissioning options for these group are as follows:

10.1 Group 1 – 24" Concrete Coated Pipeline, Surface Laid and Exposed

Option 2c – Trench and Bury Full Line

Following survey of the line, protective mattresses and grout bags shall be removed from the tie-ins and tie-in spools shall be disconnected and removed. The pipe shall be cut around two existing crossings. A dedicated trenching vessel shall be mobilised to trench the line to 0.6m ToP except for the crossing areas, which shall be left in-situ. Thereafter, the trenching vessel shall demobilise the trencher and remobilise with a backfill tool to backfill the trenched line and achieve a clear seabed. A trawl sweep is expected to be conducted following completion of works.

Option 2c was assessed as the most preferred option against the Safety and Environmental criteria. Whilst it is not assessed as being most preferred in the remaining Economic, Technical and Societal criteria, it is assessed as relatively attractive against all of these factors.

Should technical difficulties arise during trenching then Leave In-Situ with selective rock cover would be the chosen fall-back option. In this event Repsol Sinopec Resources UK would liaise with OPRED.

10.2 Group 2 – 10" Concrete Coated Pipeline, Surface Laid and Exposed

Option 2c – Trench and Bury Full Line

As with the 24" line above, following survey of the line, protective mattresses and grout bags shall be removed from the tie-ins and tie-in spools shall be disconnected and removed. A dedicated trenching vessel shall be mobilised to trench the line to 0.6m ToP. Thereafter, the trenching vessel shall demobilise the trencher and remobilise with a backfill tool to backfill the trenched line and achieve a clear seabed. A trawl sweep is expected to be conducted following completion of works.

Option 2c was assessed as the most preferred option against the Safety and Environmental criteria and equally preferred against the Societal criterion. Whilst it is not assessed as being most preferred in the remaining Economic and Technical criteria, it is assessed as relatively attractive against all of these factors.

Should technical difficulties arise during trenching then full removal by cut and lift shall be the chosen fall-back option. In this event Repsol Sinopec Resources UK would liaise with OPRED.

10.3 Group 3 – Pipelines & Umbilicals, Surface Laid and Rock Covered

Option 1 - Leave In-Situ and minimal intervention

Following survey of the lines protective mattresses and grout bags shall be removed from the exposed tie-ins and pipeline tie-in spools and umbilicals shall be disconnected and removed.

The cut ends of the lines shall be made safe. This may include additional rock placement or burial.

Option 1 was assessed as the most preferred option against the Safety, Environmental, Technical and Economic criteria and jointly preferred with both other options against the Societal criterion.

10.4 Group 4 – Pipelines, Fully Trenched and Buried

Option 1 - Leave In-Situ and minimal intervention.

Following survey of the lines protective mattresses and grout bags shall be removed from the exposed tie-ins and pipeline tie-in spools and umbilicals shall be disconnected and removed.

The cut ends of the lines shall be made safe. This may be by lowering the ends into the seabed and may include additional rock placement or burial.

Option 1 was assessed as the most preferred option against the Safety, Environmental, Technical and Economic criteria. It was not the preferred option against the Societal criterion, however, it was still assessed as relatively attractive in this area.

10.5 Group 5 – Pipelines, Partially Trenched and Buried

Option 2b – Rock cover exposed ends and exposures.

Following survey of the lines, protective mattresses and grout bags shall be removed from the exposed pipeline sections which will be cut using remotely operated hydraulic shears, including the trench transition and recovered to shore for processing. The cut ends shall be buried to a target depth of 0.6 m ToP using MFE to mitigate the snag hazard. Thereafter the remaining spans, exposures and areas of insufficient burial shall have rock cover provided to a target depth of 0.6 m ToP in an over-trawlable berm. A trawl sweep is expected to be conducted following completion of works.

Option 2b was assessed as being close to the most preferred option against the Safety criterion, only being marginally less preferred to Option 2c, trench and bury. It was strongly preferred to the other options against the Technical criterion due to the rock cover operations being largely routine. It was less preferred against the Environmental criterion due to the impact from the additional rock cover. It was also less preferred against the Societal criteria due to the impact of the rock cover on fishing operations. However, there is existing rock cover within the Fulmar Area, the additional requirement for these lines is not considered to be significantly detrimental and it is believed that fishing operations could continue largely unimpeded as the rock berm would be designed to be over-trawlable.

10.6 Group 6 – Umbilicals & Cables – Trenched and Buried

Option 1 - Leave In-Situ and minimal intervention.

Following survey of the lines, protective mattresses and grout bags shall be removed from the exposed tie-ins and the umbilicals / cables shall be disconnected and removed.

The cut ends of the lines shall be made safe. This may be by lowering the ends into the seabed and may include additional rock placement or burial.

Option 1 was assessed as the most preferred option against the Safety, Technical and Economic criteria. It was not the preferred option against the Environmental and Societal criteria, however, it was still assessed as comparatively attractive in these areas.

11 REFERENCES

1.	Topsides and Subsea Facilities Decommissioning Programme	Preparation of CA, EIA & DP for Auk, Auk North & Fulmar. Fulmar and Auk North Decommissioning Programme Third Draft – Topsides and Subsea Facilities, Doc No. RP-DTAFUL001-DC-0063, Rev C02, Dated 23/01/2020.
2.	Jacket CA Report	Preparation of CA, EIA and DP for Auk, Auk North & Fulmar. Risk & CA Recommendation Fulmar Jacket, Doc. No.: RP-DTAFUL001-HS-0011, Rev.: C03, Dated: 27/01/20.
3.	OPRED Guidelines	Guidance Notes Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998, Dated: November 2018, Issued by: Department for Business, Energy & Industrial Strategy.
4.	Oil & Gas UK Guidelines	Oil & Gas UK – Guidelines for Comparative Assessment in Decommissioning Programmes, Dated: October 2015, ISBN: 1 903 004 55 1, Issue: 1.
5.	Subsea Material Inventory Report	Preparation of CA, EIA and DP for Auk, Auk North & Fulmar Subsea Material Inventory Study Report, Doc. No.: RP-DTAAUK001-SS-0046, Rev.: C01, Dated: 09/10/2017.
6.	Screening Report	Preparation of CA, EIA and DP for Auk, Auk North & Fulmar Option Screening Study, Doc. No.: SY-DTAAUK001-HS-0053, Rev.: C02, Dated: 23/07/2018.
7.	North Sea Pipeline Decommissioning Guidelines	Decommissioning of Pipelines in the North Sea Region – 2013, Issued by Oil & Gas UK.
8.	Scoping Report	Preparation of CA, EIA and DP for Auk, Auk North & Fulmar Comparative Assessment Scoping Report, Doc. No.: RP-DTAAUK001-HS-0033, Rev.: C02, Dated: 09/10/2017.
9.	Pipeline Status & Historical Review	Preparation of CA, EIA and DP for Auk, Auk North & Fulmar Pipeline Status & Historical Review, Doc. No.: RP-DTAAUK001-SS-0052, Rev.: C02, Dated: 24/11/2017.
10.	Subsea Infrastructure Decommissioning Methodology	Preparation of CA, EIA and DP for Auk, Auk North & Fulmar Subsea Infrastructure Removal Methodology, Doc. No.: RP-DTAAUK001-SS-0054, Rev.: C01, Dated: 13/12/2017
11.	Analytical Hierarchy Process	The Analytical Hierarchy Process by T.L. Saaty, McGraw Hill, 1980.
12.	Subsea HAZID Report	Preparation of CA, EIA and DP for Auk, Auk North & Fulmar Hazard Identification (HAZID), Doc. No.: HAZ-DTAAUK001-HS-0057, Rev.: C01, Dated: 01/05/2018
13.	Risk Analysis of Decommissioning Activities	Joint Industry Project Report “Risk Analysis of Decommissioning Activities” (Safetec 2005) [http://www.hse.gov.uk/research/misc/safetec.pdf]
14.	Risk & Consequence Assessment	Preparation of CA, EIA and DP for Auk, Auk North & Fulmar Risk & Consequence Assessment for Subsea Infrastructure Decommissioned In-Situ, Doc. No.: TN-DTAAUK001-HS-0105, Rev.: C01, Dated: 18/09/2018

APPENDIX A EVALUATION METHODOLOGY

Appendix A.1 CA Evaluation Methodology

Repsol Sinopec Resources UK has selected a Multi Criteria Decision Analysis (MCDA) methodology for the evaluation phase of the CA. This methodology uses a pairwise comparison system based on the methodologies of the Analytical Hierarchy Process (AHP) by T.L. Saaty, described in various publications, such as Analytical Hierarchy Process ref. [11]. This allows the relative importance of each differentiating criteria to be judged against each other in a qualitative way, supported by quantification where appropriate. The key steps for the evaluation phase of the CA are as follows:

- Define Differentiating Criteria – this was completed in October 2017 and listed in Table 11-1 S;
- Define Options – completed as part of CA Screening;
- Pre-populate worksheets for internal CA workshops – based on all the studies undertaken the worksheets were pre-populated in advance of the internal CA workshops;
- Perform internal CA workshop;
- Discuss attributes of each option against each differentiating criteria – the discussion was recorded 'live' during the workshop in order that informed opinion and experience was factored into the decision-making process;
- Perform scoring (see Section Appendix A.5);
- Perform sensitivity analyses to test the decision outcomes;
- Export worksheets as a formal record of the workshop attendees' combined opinion on the current preferred options, the 'Emerging Recommendations';
- Evaluate whether the CA needs to 'recycle' study work (Preparation Phase) to obtain any further information to help inform decision making;
- Discuss Emerging Recommendations with Stakeholders; and
- Recycle process as required prior to decision on the selected options which will be presented in the Decommissioning Programme and assessed in the Environmental Appraisal.

The sections below describe how the MCDA methodology has been applied.

Appendix A.2 Differentiating Criteria & Approach to Assessment

A key step in setting up the CA was agreeing and defining the appropriate criteria that differentiates between each of the tabled options. As a starting point, the criteria used for this CA were taken from the DECC (now OPRED) Guidelines for Decommissioning of Offshore Oil and Gas Installations and Pipelines ref. [3] which are as follows (in no particular order):

- Safety
- Environmental
- Economic
- Technical
- Societal

These differentiating criteria were found to be appropriate for the decommissioning options tabled and were taken forward as the main differentiating criteria for the CA. Additional sub-criteria and definitions were added for clarity and are shown Figure 11-1 alongside the approach used for assessment under each criteria or sub-criteria.

Criteria	Sub-Criteria	Description	Approach to Assessment
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls. Any requirement for handling HazMat / NORM shall also be addressed here.	The HAZID was conducted as a group activity within a workshop format. There were two separate workshops held, Part 1 and Part 2. Part 1 focused on the different activities taking place within the various Screened options. Hazards associated with the activities were identified and any potential Major Accident Hazards (MAH) were identified. An initial risk scoring was applied to each activity / hazard which was further considered within Part 2. The HAZID Part 2 workshop focused on each of the options and applied the results from Part 1 to the circumstances of each option to produce a finalised score for each option that may be utilised directly within the CA Evaluation Phase. The final results were presented within the Repsol Sinopec Resources UK Risk Matrix to allow comparison between options.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel. Any requirement for handling HazMat / NORM shall also be addressed here.	
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels, recreational vessels and military vessels are considered.	
	1.4 Residual Risk	This sub-criterion addresses residual safety risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.	
2. Environmental	2.1 Impact of Decommissioning Operations Offshore	This sub-criterion covers elements such as Noise, Energy & Emissions and Aqueous Discharges. Also, to consider discharges and emissions associated with the disturbance of cuttings, use of explosives etc.	An ENVID was conducted as a group activity within a workshop format to determine the environmental threats applicable to the decommissioning operation options. With an appreciation of the threats industry experience was applied to qualitatively assess each option with respect to the sub-criteria.
	2.2 Processing of Returned Materials	This sub-criterion covers the Processing of Returned Materials resulting in Use of Landfill	
	2.3 Resource Consumption	This sub-criterion relates to the resource consumption for carrying out the decommissioning activity (e.g. Rock placement, but not fuel as that is covered above) and Replacement Materials – e.g. steel)	
	2.4 Disturbance	This sub-criterion relates to the Physical Disturbance to the Seabed during Decommissioning Operations (Short Term)	
	2.5 Loss of Habitat	This sub-criterion relates to the Loss of Habitat (Long Term Legacy)	

Criteria	Sub-Criteria	Description	Approach to Assessment
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as sensitivity of operations to interruption by the weather. Technical Feasibility and Technical Maturity is also considered.	Assessment based on engineering method statements and considers elements such as novelty, risk of failure and availability of technology.
4. Societal	4.1 Impact on Commercial Fisheries	This sub-criterion focuses on exclusion zones, inability to fish in areas and if decommissioning will have resulted in a loss of habitat for target species – e.g. through leaving pipelines in place or rock placement)	A qualitative judgement that provides a narrative (rather than quantification) regarding the influence of each decommissioning option on the availability of the area of seabed for fisheries or any other commercial impacts.
	4.2 Socio-economic impact on communities and amenities	This sub-criterion addresses the impact from any near-shore and onshore operations and end-points (dismantling, transporting, treating, recycling, land filling) on the health, wellbeing, standard of living, structure or coherence of communities or amenities. e.g. business or jobs creation, increases in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads. May be positive or negative (Jobs created; Establishment of track record; Improvements to roads, quaysides etc.).	Assessment of impacts to society is a qualitative narrative considering both positive and negative impacts on waste disposal, recycling, employment and general community impacts.
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Quantified in Subsea Infrastructure Decommissioning Methodology ref. [10].
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	A qualitative judgement that provides a narrative (rather than quantity) regarding the effect of each decommissioning option on the potential liability and future remediation. A separate risk assessment was conducted to consider remediation legacy for any items recommended to be left in situ.

Table 11-1 Sub-criteria Definition

Appendix A.3 Differentiator Weighting

The 5 differentiating criteria all carry a 20% weighting. That is, all criteria are neutral to each other. Figure 11-1 shows the pairwise comparison matrix. Repsol Sinopec Resources UK decided that equal weightings offer the most transparency and a balanced view from all perspectives.

Criteria	1. Safety	2. Environmental	3. Technical	4. Societal	5. Economic	Weighting
1. Safety	N	N	N	N	N	20%
2. Environmental	N	N	N	N	N	20%
3. Technical	N	N	N	N	N	20%
4. Societal	N	N	N	N	N	20%
5. Economic	N	N	N	N	N	20%

Figure 11-1 Example Pairwise Comparison Matrix (N = Neutral)

Weightings for the differentiating sub-criteria were developed using a pair-wise comparison for the sub-criteria. The pair-wise comparison adopted in this case used phrases such as much stronger, stronger, weaker, much weaker, etc. to make qualitative judgements of the relative impact/importance that each of the sub-criteria would have on the overall comparative assessment decision.

Adopting these phrases rather than the more common numerical 'importance scale' from the Analytical Hierarchy Process (AHP) is often more intuitive and representative of the sentiment of a workshop.

One of the challenges of applying the numerical importance scale historically, is that often when scoring a pair of options against each other as a score of 3, delegates implied the comparison was 3 times better, etc. rather than 'slightly better' as the importance scale suggests.

To manage this, Repsol Sinopec Resources UK chose to apply the principles of the AHP by replacing numbers in the pairwise comparison matrix with a narrative or descriptive approach. This is already programmed into the AHP in the importance scale explanations ref. [11]. It was agreed that three positions from equal (and their reciprocals) would be sufficient for this CA. These positions were:

Title	Scope	Relative Preference Ratio
Neutral	Equal Importance, equivalent to 1 in the AHP importance scale.	50 / 50
Stronger (S) / Weaker (W)	Moderate importance of one criteria / option over the other, equivalent to 1.5 in the AHP importance scale.	60 / 40
Much Stronger (MS) / Much Weaker (MW)	Essential / strong importance of one criteria / option over the other equivalent to 5 or 6 in the AHP importance scale.	75 / 25
Very Much Stronger (VMS) / Very Much Weaker (VMW)	Extreme importance of one criteria / option over the other equivalent to 8 or 9 in the AHP importance scale.	90 / 10

Table 11-2 Explanation of Phrasing Adopted for Pairwise Comparison

The pair-wise comparison process for the differentiating sub-criteria resulted in the following sub-criteria weightings:

1. Safety	1.1 Personnel Offshore	1.2 Personnel Onshore	1.3 Other Users	1.4 Residual Risk	Weighting
1.1 Personnel Offshore	N	N	MS	S	33.57%
1.2 Personnel Onshore	N	N	MS	S	33.57%
1.3 Other Users	MW	MW	N	W	12.03%
1.4 Residual Risk	W	W	S	N	20.83%

Figure 11-2 Weighting of Safety Sub-Criteria

2. Environmental	2.1 Impact of Decommissioning Operations Offshore	2.2 Processing of Returned Materials	2.3 Resource Consumption	2.4 Disturbance	2.5 Loss of Habitat	Weighting
2.1 Impact of Decommissioning Operations Offshore	N	S	S	W	MW	15.24%
2.2 Processing of Returned Materials	W	N	S	MW	MW	11.28%
2.3 Resource Consumption	W	W	N	MW	MW	9.59%
2.4 Disturbance	S	MS	MS	N	W	27.17%
2.5 Loss of Habitat	MS	MS	MS	S	N	36.71%

Figure 11-3 Weighting of Environmental Sub-Criteria

Note that as only one sub-criterion is associated with the Technical criterion, Technical Risk the weighting for this sub-criterion is 20%.

4. Societal	4.1 Impact on Commercial Fisheries	4.2 Socio-economic impact on communities and amenities	Weighting
4.1 Impact on Commercial Fisheries	N	S	60.00%
4.2 Socio-economic impact on communities and amenities	W	N	40.00%

Figure 11-4 Weighting of Societal Sub-Criteria

5. Economic	5.1 Short-term Costs	5.2 Long-term Costs	Weighting
5.1 Short-term Costs	N	MS	75.00%
5.2 Long-term Costs	MW	N	25.00%

Figure 11-5 Weighting of Economic Sub-Criteria

Based upon the above sub-criteria comparisons and the weighting of 20% applied to each of the main criteria, the weighting for each of the sub-criteria for the overall comparison is as follows:

- Safety – 1.1. Personnel Offshore: 6.7% (i.e. 33.6% of 20%).
- Safety – 1.2 Personnel Onshore: 6.7%.
- Safety – 1.3 Other Users: 2.4%.
- Safety – 1.4 Residual Risk: 4.2%.
- Environmental – 2.1 Impact of Decommissioning Operations Offshore: 3.0%.
- Environmental – 2.2 Processing of Returned Materials: 2.3%.
- Environmental – 2.3 Resource Consumption: 1.9%.
- Environmental – 2.4 Disturbance: 5.4%.
- Environmental – 2.5 Loss of Habitat: 7.3%.
- Technical – 3.1 Technical Risk: 20.0%.
- Societal – 4.2 Impact on Commercial Fisheries: 12.0%.
- Societal – 4.3 Socio-economic Impact on Communities and Amenities: 8.0%.
- Economic – 5.1 Cost for Decommissioning / Removal Activities: 15.0%.
- Economic – 5.2 Cost for Long Term Monitoring / Remediation Activities: 5.0%.

Appendix A.4 Option Attributes

The next step in the CA process was to describe and discuss the attributes of each option with respect to each of the differentiating criteria. In preparation, all relevant data and information developed during the preparation phase were pre-populated into the attributes table for each option. Appendix B to I contains the completed Attributes Tables.

Any additional discussion around the relative merits of the options was also recorded in the attributes matrix. A summary discussion of why options are considered more or less attractive with respect to each of the differentiating criteria was also recorded.

Appendix A.5 Option Pair-Wise Comparison

Once the option attributes were compiled and discussed, a pair-wise comparison was performed for each of the differentiating criteria where the proposed options were compared against each other. The pairwise comparison adopted in this case used phrases such as stronger, much stronger, weaker, much weaker, etc. to make qualitative judgements (often based on quantitative data) of the options against each other. Adopting these phrases rather than the more common numerical 'importance scale' from the Analytical Hierarchy Process (AHP) is often more intuitive and representative of the sentiment of a workshop.

Using this transposed scoring system made it simpler and, more importantly, more effective at capturing the mind-set and feeling of the attendees at the workshops. Phrases such as 'what are the relative merits of pipeline removal on a project versus rock placement from a safety perspective? Are these Neutral to each other? Are they stronger? If so, how much stronger? If you had to prioritise one over the other, which would it be?' This promoted a collaborative dynamic in the workshop and enabled the collective mind-set of the attendees to be captured. Where there was quantitative data to provide back-up and evidence to support the collective assertions, so much the better.

A summary example of the completed pair-wise comparisons for differentiating criteria versus options are shown in Figure 11-6.

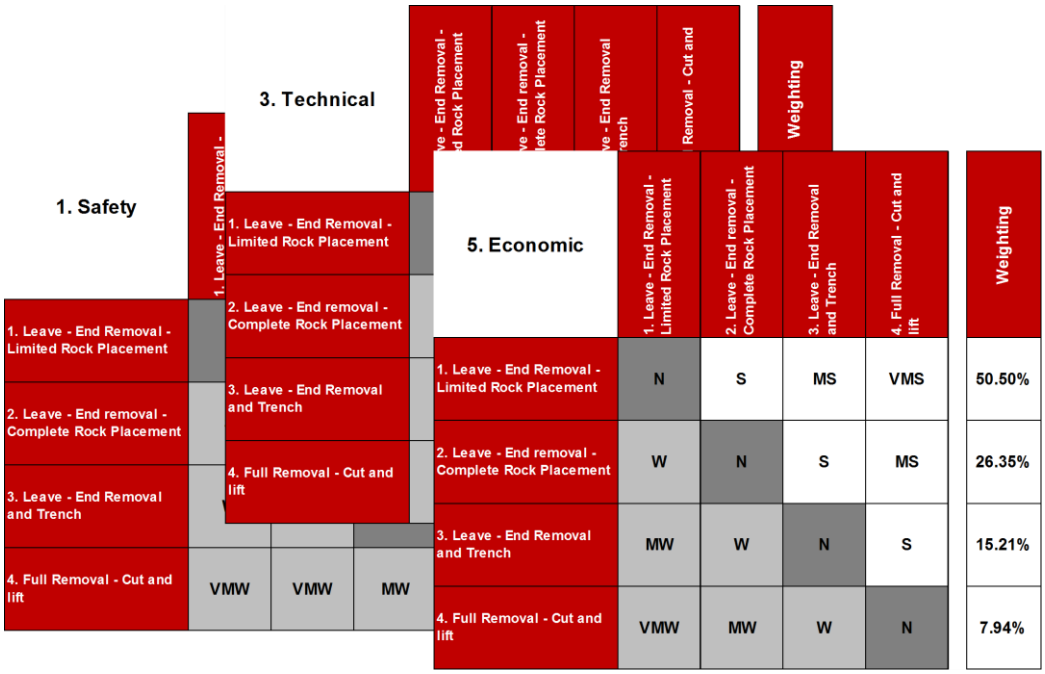


Figure 11-6 Example Option Pair-Wise Comparison

Appendix A.6 Visual Output and Sensitivities

The decision-making tool used the above pairwise comparisons to automatically generate a visual output indicating the highest scoring option i.e. the option which represents the most 'successful' solution in terms of its overall contribution to the set of differentiating criteria. At this stage, an opportunity was provided to test the judgements provided, to ensure that all attendees were happy to endorse the outcome. The visual test outputs from each decision point are included in Appendix B to Appendix H.

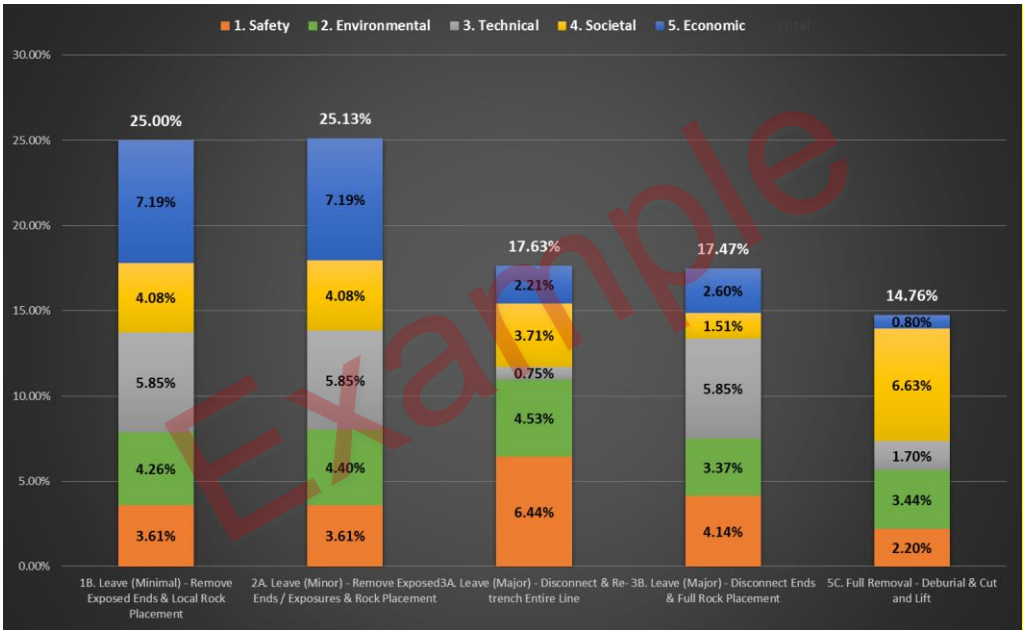


Figure 11-7 A Visual Output Example

The CA output can then easily be stress tested by the workshop attendees by undertaking a sensitivity analysis:

- By applying a modification to the weighting of the criteria – bearing in mind that the base case for this assessment is to have all criteria equally weighted, and / or
- Modifying the pair-wise comparison of the options against each other within the criteria where appropriate.

These sensitivities will help inform workshop attendees as to whether a particular aspect is driving a preferred option, or indeed if the preferred option remains the same when the sensitivities are applied.

APPENDIX B GROUP 1 – DETAILED EVALUATION RESULTS

Appendix B.1 Group 1 Attributes Table

1. Safety

1.1 Personnel Offshore

1 - Minimal intervention - Remove exposed ends						
R = 0 O = 7 Y = 10 G = 2 Total = 19	Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
	5	2				
	4		5			
	3	1	3			
	2	3	6			
	1		1			
	0					

2b - Major intervention - Rock cover full line						
R = 0 O = 6 Y = 12 G = 2 Total = 20	Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
	5	2				
	4		4			
	3		4			
	2	1	8			
	1		1			
	0					

2c - Major intervention - Trench and bury full line						
R = 0 O = 7 Y = 13 G = 4 Total = 24	Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
	5	2				
	4	2	4			
	3	1	3			
	2	3	7		1	
	1		1			
	0					

3a - Full Removal - Cut and recover						
R = 0 O = 9 Y = 7 G = 3 Total = 19	Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
	5	1				
	4		3	1		
	3	1	1	2		
	2	3	3	1	2	
	1			1		
	0					

N	S	MS	S	MS	MS

Summary

The assessment against the Personnel Offshore criterion is based on the results of the HAZID for the various offshore operations for each option and is as follows:
Option 1 is assessed as being neutral to Option 2b as they have a similar risk exposure. Option 1 is assessed as being stronger than Option 2c as it has less risk exposure, a key component of which is the back deck working involved with the trench and bury option.
Option 1 is assessed as being much stronger than Option 3a as it has less risk exposure, with the cut and lift having many lifts and onboarding of cut pipe.
Option 2b is assessed as being stronger than Option 2c as it has less risk exposure as there is minimal back deck working. Option 2b is assessed as being much stronger than Option 3a as it has less risk exposure as there are no cutting, lifting an onboarding operations.
Option 2c is assessed as being much stronger than Option 3a as it has less risk exposure as there are no cutting, lifting or onboarding operations.

Overall, Option 1 and Option 2b are equally preferred options from a risk to Offshore Personnel perspective. Note: No MAH were identified for any options from an offshore operations perspective.

1.2 Personnel Onshore

1 - Minimal intervention - Remove exposed ends						
R = 0 O = 2 Y = 11 G = 2 Total = 15	Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
	5					
	4	4				
	3	2	3			
	2	1		2	2	
	1		1			
	0					

2b - Major intervention - Rock cover full line						
R = 0 O = 1 Y = 11 G = 2 Total = 14	Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
	5					
	4	4	1			
	3	2	3			
	2	1		2	2	
	1		1			
	0					

2c - Major intervention - Trench and bury full line						
R = 0 O = 3 Y = 11 G = 2 Total = 16	Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
	5					
	4	4	1			
	3	2	3			
	2	1		2	2	
	1		1			
	0					

3a - Full Removal - Cut and recover						
R = 1 O = 13 Y = 2 G = 0 Total = 16	Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
	5			1		
	4		1	3		
	3			5		
	2		1		3	1
	1				1	
	0					

N	N	MS	N	MS	MS

Summary

The assessment against the Personnel Onshore criterion is based on the results of the HAZID for the various onshore operations for each option and is as follows:
Option 1 is assessed as being neutral to Option 2b and Option 2c as they have a similar risk exposures. Option 1 is assessed as being much stronger than Option 3a as the risk exposure is much lower due to the risks associated with handling, transporting and processing large quantities of cut pipe (Option 3a also has a potential MAH).
Option 2b is assessed as being neutral to Option 2c as they have a similar risk exposure. Option 2b is assessed as being much stronger than Option 3a as the risk exposure is much lower for similar reasons as above.
Option 2c is assessed as being much stronger than Option 3a as the risk exposure is much lower, again for similar reasons.

Overall, Options 1, 2b and 2c are equally preferred options from a risk to Onshore Personnel perspective.

		1 - Minimal intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover
1. Safety	1.3 Other Users	R = 0 O = 2 Y = 0 G = 0 Total = 0	R = 0 O = 2 Y = 0 G = 0 Total = 0	R = 0 O = 2 Y = 0 G = 0 Total = 0	R = 0 O = 2 Y = 0 G = 0 Total = 0
		N	N	N	N
	Summary	The assessment against the Other Users criterion is based on the results of the HAZID for the various offshore operations for each option and is as follows: All options are assessed as being neutral against each other as the risk exposure to Other Users from on-site and transit operations is similar for all options. Overall, all options are equally preferred from a risk to Other Users perspective. Note: HAZID concluded that the risk profile would be the same for all options as any collision with a vessel is highly unlikely based on the equipment used be all vessels.			
1. Safety	1.4 Residual Risk	R = 2 O = 4 Y = 7 G = 0 Total = 13	R = 0 O = 6 Y = 7 G = 0 Total = 13	R = 0 O = 5 Y = 7 G = 0 Total = 12	R = 0 O = 0 Y = 0 G = 0 Total = 0
		MW	VMW	VMW	W	W	N
	Summary	The assessment against the Residual Risk criterion is based on the results of the HAZID for the legacy operations is as follows: Option 1 is assessed as being much weaker than Option 2b as it has a greater potential for snag hazard and highest burden in terms of man-hours exposure to monitor and remediate the remaining equipment (Option 1 has 2 potential MAH). Option 1 is assessed as being much weaker than Option 2c for similar reasons. Option 1 is assessed as being very much weaker than Option 3a as there is the potential for a snag hazard versus no residual risk with the full removal option. Option 2b is assessed as being weaker than Option 2c as it is considered to have a higher potential for snag hazard than the trench and bury option. There is also a higher burden in terms of man-hours exposure to monitor and remediate the remaining equipment. Option 2b is assessed as being very much weaker than Option 3a as there is the potential for a snag hazard versus no residual risk with the full removal option. Option 2c is assessed as being very much weaker than Option 3a for similar reasons. Overall, Option 3a is the preferred option from a Residual Risk perspective.			
2. Environmental	2.1 Impact of Decommissioning Operations Offshore	Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 245 dB / 3.4 TPa^2s Subsea Cutting: 1 day Vessel Emissions (CO_2): 3,266 tonnes Vessel Fuel Use: 1,030 tonnes	Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 254 dB / 24.2 TPa^2s Subsea Cutting: 1 day Vessel Emissions (CO_2): 5,180 tonnes Vessel Fuel Use: 1,634 tonnes	Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 251 dB / 12.5 TPa^2s Subsea Cutting: 2 days Vessel Emissions (CO_2): 4,246 tonnes Vessel Fuel Use: 1,339 tonnes	Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 251 dB / 12 TPa^2s Subsea Cutting: 27 days Vessel Emissions (CO_2): 17,535 tonnes Vessel Fuel Use: 5,531 tonnes
		N	N	MS	N	MS	MS
	Summary	The assessment against the Impact of Decommissioning Operations Offshore criterion is as follows: Option 1 is assessed as being neutral to Option 2b and Option 3a as, whilst there are differences in the vessel time, emissions, marine noise and discharges for these three options, these are considered insufficient to move from neutral. Option 1 is assessed as being much stronger than Option 3a as it is expected to require much less vessel time (with the associated noise, emissions and discharges) than the complete removal of the pipeline. Option 2b is assessed as being neutral to Option 2c as both will require additional remedial intervention works to deal with exposures etc. Option 2b is assessed as being much stronger than Option 3a as it is expected to require much less vessel time (with the associated noise, emissions and discharges) than the complete removal of the pipeline. Option 2c is assessed as being much stronger than Option 3a for similar reasons. Overall, Option 1 is the preferred option from an Environmental - Impact of Decommissioning Operations Offshore perspective.			

		1 - Minimal intervention - Remove exposed ends			2b - Major intervention - Rock cover full line		2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover
2. Environmental	2.2 Processing of Returned Materials	Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted: Concrete Coated Steel Pipe:- 123 tonnes Concrete Mattresses:- 277 tonnes Grout Bags:- 3 tonnes			Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted: Concrete Coated Steel Pipe:- 123 tonnes Concrete Mattresses:- 277 tonnes Grout Bags:- 3 tonnes		Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted: Concrete Coated Steel Pipe:- 123 tonnes Concrete Mattresses:- 277 tonnes Grout Bags:- 3 tonnes	Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted: Concrete Coated Steel Pipe:- 8,203 tonnes Concrete Mattresses:- 277 tonnes Grout Bags:- 3 tonnes
		N	**N**	**S**	**N**	**S**	**S**	
	Summary	The assessment against the Processing of Returned Materials criterion is as follows: Option 1 is assessed as being neutral to Option 2b and Option 2c as both will result in similar levels of returned material to shore and processing requirements. Option 1 is assessed as being stronger than Option 3a as there is much more returned material to process with Option 3a. Option 2b is assessed as being neutral to Option 2c as both will result in similar levels of returned material to shore and processing requirements. Option 2b is assessed as being stronger than Option 3a for similar reasons to above. Option 2c is assessed as being stronger than Option 3a, again for similar reasons. Overall, Options 1, 2b and 2c are equally preferred options from a Processing of Returned Materials perspective.						
2. Environmental	2.3 Resource Consumption	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock for rock cover: 200 tonnes (cut ends only) Emissions for replacement material (CO_2): 10,976 tonnes Emissions from recovered material (CO_2): 178 tonnes			Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock for rock cover: 203,100 tonnes Emissions for replacement material (CO_2): 10,976 tonnes Emissions from recovered material (CO_2): 178 tonnes		Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock for rock cover: 400 tonnes (cut ends only) Emissions for replacement material (CO_2): 10,976 tonnes Emissions from recovered material (CO_2): 178 tonnes	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock for rock cover: Not required for this full removal option Emissions for replacement material (CO_2): None Emissions from recovered material (CO_2): 5,518 tonnes
		MS	**N**	**W**	**MW**	**VMW**	**W**	
	Summary	The assessment against the Resource Consumption criterion is as follows: Option 1 is assessed as being much stronger than Option 2b as, whilst the amount of replacement material is the same, Option 1 only requires a small amount of rock cover material versus a large amount for Option 2b. Option 1 is assessed as being neutral to Option 2c as the rock cover and replacement materials are largely similar. Option 1 is assessed as being weaker than Option 3a as there is a much higher requirement for replacement material for the remaining pipeline under Option 1. Option 2b is assessed as being much weaker than Option 2c as, whilst the amount of replacement material is the same, Option 2b requires a large amount of rock cover material. Option 2b is assessed as being very much weaker than Option 3a as it requires a large amount of rock cover material and a large amount of replacement material for the remaining pipeline. Option 2c is assessed as being weaker than Option 3a due the large amount of replacement material for the remaining pipeline. Overall, Option 3a is the preferred option from a Resource Consumption perspective.						
2. Environmental	2.4 Disturbance	Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from introducing the rock cover at the exposed ends. The area of impact is as follows: Seabed Disturbance: 100 m^2			Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is an increased environmental impact from rock covering the entire line. The area of impact is as follows: Seabed Disturbance: 77,530 m^2		Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is an increased environmental impact from trenching and burying the entire line. The impact is higher for trenching and burying than cut and lift. The area of impact is as follows: Seabed Disturbance: 15,250 m^2	Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from removing the entire line. The area of impact is as follows: Seabed Disturbance: 15,250 m^2
		MS	**MS**	**S**	**N**	**W**	**W**	
	Summary	The assessment against the Seabed Disturbance (short-term impact) criterion is as follows: Option 1 is assessed as being much stronger than Option 2b as there is much less short-term seabed disturbance than rock covering the entire line. Option 1 is assessed as being much stronger than Option 2c as there is also much less short-term seabed disturbance than trenching and burying the entire line. Option 1 is assessed as being stronger than Option 3a as, whilst the area of impact in Option 3a is high, the level of impact of cut and lift of a surface laid line is expected to be lower than trench and bury or rock cover. Option 2b is assessed as being neutral to Option 2c as, whilst the area associated with rock cover is greater than trench and bury, the short-term disturbance is greater with trench and bury, these cancel each other out. Option 2b is assessed as being weaker than Option 3a as, whilst the area associated with rock cover is greater than cut and lift, the level of impact of performing cut and lift of a surface laid line is expected to be lower than rock cover. Option 2c is assessed as being weaker than Option 3a as whilst the areas impacted are similar, the impact from trench and bury operations are expected to be greater than cutting and lifting of a surface laid pipeline. Overall, Option 1 is the preferred option from a Seabed Disturbance perspective.						

		1 - Minimal intervention - Remove exposed ends			2b - Major intervention - Rock cover full line		2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover
2. Environmental	2.5 Loss of Habitat	Whilst the environmental impact in terms of Loss of Habitat (long-term impact) is assessed as 'low' for this option, there is an impact from introducing rock cover at the pipeline ends which will permanently alter the habitat type and will therefore impact the benthic community. There is also a permanent impact from leaving the pipeline (15km) in-situ. The area of impact is as follows: Rock cover: 100 m^2 Pipeline: 15 km			Whilst the environmental impact in terms of Loss of Habitat (long-term impact) is assessed as 'low' for this option, there is an impact from rock covering the entire line which will permanently alter the habitat type and will therefore impact the benthic community. The area of impact is as follows: Rock cover: 77,530 m^2		There are no long-term impacts or loss of habitats expected from the trench and bury of the pipeline.	There are negligible long-term impacts or loss of habitats expected from the full removal of pipeline by cut and lift.
		MS	**MW**	**MW**	**VMW**	**VMW**	**N**	
	Summary	The assessment against the Loss of Habitat (legacy / long-term) criterion is as follows: Option 1 is assessed as being much stronger than Option 2b as the rock cover will permanently alter the habitat. Option 1 is assessed as being much weaker than Option 2c as the pipeline will remain on the seabed and therefore the long-term habitat change will be greater than the trench and bury option. Option 1 is assessed as being much weaker than Option 3a as the pipeline will remain on the seabed and therefore the long-term habitat change will be greater than the full removal option. Option 2b is assessed as being very much weaker than Option 2c as the rock cover will permanently alter the habitat over a large area. Option 2b is assessed as being very much weaker than Option 3a for similar reasons. Option 2c is assessed as being neutral to Option 3a as there will be no long-term impact / loss of habitat associated with the trench and bury or full removal options. Overall, Option 2c and 3a are equally preferred options from a Loss of Habitat perspective.						
3. Technical	3.1 Technical Risk	**Feasibility:-** High **Concept Maturity:-** High **Availability of Technology:-** High - All vessels and equipment widely available **Track Record:-** High - Operations considered routine **Risk of Failure:-** Low **Consequence of Failure:-** Limited impact to cost and schedule			**Feasibility:-** High **Concept Maturity:-** High **Availability of Technology:-** High - All vessels and equipment widely available **Track Record:-** High - Operations considered routine **Risk of Failure:-** Low **Consequence of Failure:-** Limited impact to cost and schedule		**Feasibility:-** High - Pipelines of this diameter and length have been trenched on numerous occasions **Concept Maturity:-** High - Pipelines of this diameter and length have been trenched on numerous occasions. We know exactly what we need to do to achieve this option. The concept is well developed. **Availability of Technology:-** Medium - Suitable trench and backfill equipment available but limited **Track Record:-** High - Pipelines of this diameter and length have been trenched on numerous occasions. We know exactly what we need to do to achieve this option. The concept is well developed. **Risk of Failure:-** Medium - Considered challenging to accomplish 0.6m DoC over entire length **Consequence of Failure:-** Failure to achieve target DoC would likely result in additional rock placement in that location. Cost and schedule impact.	**Feasibility:-** High - Cutting pipelines has been conducted on numerous occasions. **Concept Maturity:-** High **Availability of Technology:-** Medium - Generally, vessel and equipment would be widely available. However, suitable diverless technology is limited. A specialist lifting tool may be required to recover pipe sections. **Track Record:-** Low - Routine operation on a unit basis, however the track record for the size and length of pipeline does not exist. **Risk of Failure:-** High - Considered challenging over extended distances. May require diver support. Extended subsea works and simultaneous operations. **Consequence of Failure:-** Failure would result in significant cost and schedule impact. Requirement for alternative decommissioning method.
		N	**S**	**MS**	**S**	**MS**	**MS**	
	Summary	The assessment against the Technical Risk criterion is as follows: Option 1 is assessed as being neutral to Option 2b, they are the same apart from rock placement which is a common activity and straightforward to execute. Option 1 is assessed as being stronger than Option 2c, the equipment required for trenching a concrete coated 24" pipeline is limited and the potential for project failure is greater. However, the consequence of failure is limited as un-trenchable sections can either be rock covered or removed. Option 1 is assessed as being much stronger than Option 3a. The low track record for pipeline recovery on this scale along with a high risk of failure with significant consequence are the key differences. Option 2b is assessed as being stronger than Option 2c as rock placement is less challenging than trenching. Option 2b is assessed as being much stronger than Option 3a as rock placement is considerably less challenging than full removal, in addition the high risk of failure with significant consequence are the key differences. Option 2c is assessed as being much stronger than Option 3a as whilst there are challenges with trench and bury, these are considered more manageable than cut and lift of pipeline of this scale. The risk and consequence of failure are the key differences. Overall, Option 1 and Option 2b are equally preferred from a Technical Risk perspective.						
4. Societal	4.1 Impact on Commercial Fisheries	Leaving majority of pipeline in place means that current area lost to fishing operations due to presence of pipeline is maintained.			Whist area impacted from rock covering entire pipeline is greater, it is expected that fishing operations will be performed over a rock covered pipeline.		Trench and bury of the pipeline effectively returns the area lost from having the pipeline in place to the fishing industry for fishing operations.	Removal of the pipeline returns the area lost from having the pipeline in place to the fishing industry for fishing operations.
		W	**MW**	**MW**	**MW**	**MW**	**N**	
	Summary	The assessment against the Impact on Commercial Fisheries criterion is as follows: Option 1 is assessed as weaker than Option 2b as leaving the pipeline in place is considered worse from a fishing operations perspective than the full rock cover option. Option 1 is assessed as being much weaker than Option 2c and Option 3a as the trench and bury and full removal options effectively return the full area to the fishing industry for fishing operations. Option 2b is assessed as being much weaker than Option 2c and Option 3a for similar reasons. Option 2c is assessed as being neutral to Option 3a as they both effectively return the area to the fishing industry for fishing operations. Overall, Option 3a is the preferred option from an Impact on Commercial Fisheries perspective.						

		1 - Minimal intervention - Remove exposed ends			2b - Major intervention - Rock cover full line		2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover
4. Societal	4.2 Socio-economic impact on communities and amenities	Relatively minor quantities of material (123 tonnes of concrete coated steel pipe) being returned to shore for processing results in limited negative impacts on communities. The returned steel is recyclable, there will be a minimal amount of concrete, likely to be placed in landfill. Job creation / retention minimal due to relatively low (around 30,000) man-hours to deliver this this option.			Relatively minor quantities of material (123 tonnes of concrete coated steel pipe) being returned to shore for processing results in limited negative impacts on communities. The returned steel is recyclable, there will be a minimal amount of concrete, likely to be placed in landfill. Job creation / retention minimal due to relatively low (around 48,000) man-hours to deliver this this option.		Relatively minor quantities of material (123 tonnes of concrete coated steel pipe) being returned to shore for processing results in limited negative impacts on communities. The returned steel is recyclable, there will be a minimal amount of concrete, likely to be placed in landfill. Job creation / retention minimal due to relatively low (around 37,000) man-hours to deliver this this option.	Significant quantities of material (around 8,200 tonnes of concrete coated steel pipe) being returned to shore for processing which results in some minor negative impacts on communities. The returned steel is recyclable, there will be some concrete, likely to be placed in landfill. Job creation / retention is more significant than other options (around 145,000 man-hours), which outweighs any negative community impacts.
		N	**N**	**W**	**N**	**W**	**W**	
	Summary	The assessment against the Socio-economic criterion is as follows: Option 1 is assessed as being neutral to Option 2b and Option 2c as they result in similar levels of job creation / retention and negative impacts on communities from material returned to shore for processing. Option 1 is assessed as being weaker than Option 3a as there is significantly more job creation / retention associated with Option 3a. The increased material returned to shore is useful and not considered sufficient to offset the benefits of job creation / retention. Option 2b is assessed as being neutral to Option 2c as both will result in similar levels of job creation / retention and negative impacts on communities from material returned to shore for processing. Option 2b is assessed as being weaker than Option 3a for similar reasons as above. Option 2c is assessed as being weaker than Option 3a, again for similar reason. Overall, Option 3a is the preferred option from a Socio-economic impact on communities and amenities perspective.						
5. Economic	5.1 Short-term Costs	Initial operation cost: £3.7 million			Initial operation cost:- £11.5 million		Initial operation cost:- £5.6 million	Initial operation cost:- £23.0 million
		MS	**S**	**VMS**	**MW**	**MS**	**VMS**	
	Summary	The assessment against the Short-term Costs criterion is as follows: Option 1 is assessed as being much stronger than Option 2b as the costs are around 3 times lower. Option 1 is assessed as being stronger than Option 2c as the costs are almost half. Option 1 is assessed as being very much stronger than Option 3a as the costs are around 6 times lower. Option 2b is assessed as being much weaker than Option 2c as the costs are around double. Option 2b is assessed as being stronger than Option 3a as the costs are half. Option 2c is assessed as being very much stronger than Option 3a as the costs are around a quarter. Overall, Option 1 is the preferred option from a Short-term Costs perspective.						
	5.2 Long-term Costs	Legacy cost (survey & monitoring): £1.5 million Potential legacy cost (remediation): £700,000 Total legacy cost: £2.2 million			Legacy cost (survey & monitoring): £380,000 Potential legacy cost (remediation): £500,000 Total legacy cost: £880,000		Legacy cost (survey & monitoring): £380,000 Potential legacy cost (remediation): £500,000 Total legacy cost: £880,000	Legacy cost (survey & monitoring): N/A Potential legacy cost (remediation): N/A Total legacy cost: N/A There are no legacy costs associated with this full removal option.
		MW	**MW**	**VMW**	**N**	**MW**	**MW**	
	Summary	The assessment against the Long-term Costs criterion is as follows: Option 1 is assessed as being much weaker than Option 2b and Option 2c as the costs are around 60% higher. Option 1 is assessed as being very much weaker than Option 3a as there are no long-term costs associated with the full removal option. Option 2b is assessed as being neutral to Option 2c as the costs are the same. Option 2b is assessed as being much weaker than Option 3a as there are no long-term costs associated with the full removal option. Option 2c is assessed as being much weaker than Option 3a for similar reasons. Overall, Option 3a is the preferred option from a Long-term Costs perspective.						

Appendix B.2 Group 1 Pairwise Comparison Matrices - Safety

1.1 Personnel Offshore	1 - Minimal intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal intervention - Remove exposed ends	N	N	S	MS	33%
2b - Major intervention - Rock cover full line	N	N	S	MS	33%
2c - Major intervention - Trench and bury full line	W	W	N	MS	24%
3a - Full Removal - Cut and recover	MW	MW	MW	N	10%

1.2 Personnel Onshore	1 - Minimal intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal intervention - Remove exposed ends	N	N	N	MS	30%
2b - Major intervention - Rock cover full line	N	N	N	MS	30%
2c - Major intervention - Trench and bury full line	N	N	N	MS	30%
3a - Full Removal - Cut and recover	MW	MW	MW	N	10%

1.3 Other Users	1 - Minimal intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal intervention - Remove exposed ends	N	N	N	N	25%
2b - Major intervention - Rock cover full line	N	N	N	N	25%
2c - Major intervention - Trench and bury full line	N	N	N	N	25%
3a - Full Removal - Cut and recover	N	N	N	N	25%

1.4 Residual Risk	1 - Minimal intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal intervention - Remove exposed ends	N	MW	VMW	VMW	5%
2b - Major intervention - Rock cover full line	MS	N	W	W	21%
2c - Major intervention - Trench and bury full line	VMS	S	N	N	37%
3a - Full Removal - Cut and recover	VMS	S	N	N	37%

Appendix B.3 Group 1 Pairwise Comparison Matrices – Environment / Technical

2.1 Impact of Decommissioning Operations Offshore	1 - Minimal intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal intervention - Remove exposed ends	N	N	N	MS	30%
2b - Major intervention - Rock cover full line	N	N	N	MS	30%
2c - Major intervention - Trench and bury full line	N	N	N	MS	30%
3a - Full Removal - Cut and recover	MW	MW	MW	N	10%

2.2 Processing of Returned Materials	1 - Minimal intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal intervention - Remove exposed ends	N	N	N	S	27%
2b - Major intervention - Rock cover full line	N	N	N	S	27%
2c - Major intervention - Trench and bury full line	N	N	N	S	27%
3a - Full Removal - Cut and recover	W	W	W	N	18%

2.3 Resource Consumption	1 - Minimal intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal intervention - Remove exposed ends	N	MS	N	W	25%
2b - Major intervention - Rock cover full line	MW	N	MW	VMW	7%
2c - Major intervention - Trench and bury full line	N	MS	N	W	25%
3a - Full Removal - Cut and recover	S	VMS	S	N	44%

2.4 Disturbance	1 - Minimal intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal intervention - Remove exposed ends	N	MS	MS	S	44%
2b - Major intervention - Rock cover full line	MW	N	N	W	16%
2c - Major intervention - Trench and bury full line	MW	N	N	W	16%
3a - Full Removal - Cut and recover	W	S	S	N	25%

2.5 Loss of Habitat	1 - Minimal intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal intervention - Remove exposed ends	N	MS	MW	MW	14%
2b - Major intervention - Rock cover full line	MW	N	VMW	VMW	5%
2c - Major intervention - Trench and bury full line	MS	VMS	N	N	41%
3a - Full Removal - Cut and recover	MS	VMS	N	N	41%

3. Technical	1 - Minimal intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal intervention - Remove exposed ends	N	N	S	MS	33%
2b - Major intervention - Rock cover full line	N	N	S	MS	33%
2c - Major intervention - Trench and bury full line	W	W	N	MS	24%
3a - Full Removal - Cut and recover	MW	MW	MW	N	10%

Appendix B.4 Group 1 Pairwise Comparison Matrices – Societal / Economic

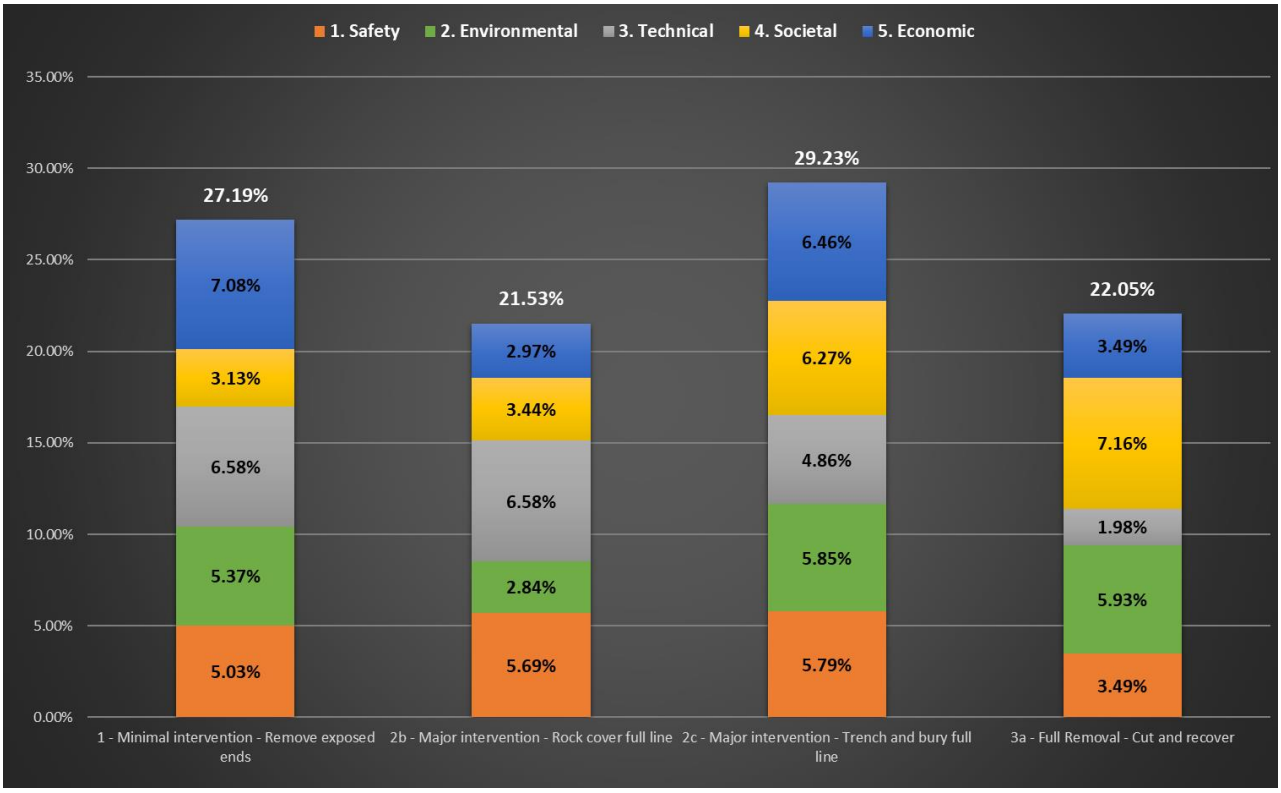
4.1 Impact on Commercial Fisheries	1 - Minimal intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal intervention - Remove exposed ends	N	W	MW	MW	11%
2b - Major intervention - Rock cover full line	S	N	MW	MW	14%
2c - Major intervention - Trench and bury full line	MS	MS	N	N	37%
3a - Full Removal - Cut and recover	MS	MS	N	N	37%

4.2 Socio-economic impact on communities and amenities	1 - Minimal intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal intervention - Remove exposed ends	N	N	N	W	22%
2b - Major intervention - Rock cover full line	N	N	N	W	22%
2c - Major intervention - Trench and bury full line	N	N	N	W	22%
3a - Full Removal - Cut and recover	S	S	S	N	33%

5.1 Short-term Costs	1 - Minimal intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal intervention - Remove exposed ends	N	MS	S	VMS	45%
2b - Major intervention - Rock cover full line	MW	N	MW	MS	14%
2c - Major intervention - Trench and bury full line	W	MS	N	VMS	37%
3a - Full Removal - Cut and recover	VMW	MW	VMW	N	5%

5.2 Long-term Costs	1 - Minimal intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal intervention - Remove exposed ends	N	MW	MW	VMW	6%
2b - Major intervention - Rock cover full line	MS	N	N	MW	19%
2c - Major intervention - Trench and bury full line	MS	N	N	MW	19%
3a - Full Removal - Cut and recover	VMS	MS	MS	N	56%

Appendix B.5 Group 1 Results Chart



APPENDIX C GROUP 2 – DETAILED EVALUATION RESULTS

Appendix C.1 Group 2 Attributes Table

1. Safety

1.1 Personnel Offshore

	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover
	R = 0 O = 7 Y = 10 G = 4 Total = 21	R = 0 O = 6 Y = 10 G = 4 Total = 20	R = 0 O = 6 Y = 12 G = 2 Total = 19	R = 0 O = 7 Y = 8 G = 1 Total = 16
	N	S / MS	S / MS	MS

Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	2				
4		5			
3	1	3			
2	3	6			
1		1			
0					

Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	2				
4		4			
3	1	3			
2	3	6			
1		1			
0					

Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	1				
4	2	4			
3		3			
2	1	7		1	
1		1			
0					

Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	1				
4		3	1		
3		2	1		
2	1	4	1	1	
1			1		
0					

Summary

The assessment against the Personnel Offshore criterion is based on the results of the HAZID for the various offshore operations for each option and is as follows:
Option 1 is assessed as being neutral to Option 2b as they have a similar risk exposure. Option 1 is assessed as being stronger than Option 2c as it has less risk exposure, a key component of which is the back deck working involved with the trench and bury option. Option 1 is assessed as being much stronger than Option 3a as it has less risk exposure, with the cut and lit having many lifts and onboarding of pipe.
Option 2b is assessed as being stronger than Option 2c as it has less risk exposure as it has less back deck working. Option 2b is assessed as being much stronger than Option 3a as it has less risk exposure, with the cut and lift having many lifts and onboarding of pipe.
Option 2c is assessed as being much stronger than Option 3a as it has less risk exposure as there are no cutting, lifting or onboarding operations.

Overall, Option 1 and Option 2b would be equally preferred from a risk to Offshore Personnel perspective. Note: No MAH were identified for any options from an offshore operations perspective.

1. Safety

1.2 Personnel Onshore

	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover
	R = 0 O = 2 Y = 11 G = 2 Total = 15	R = 0 O = 3 Y = 11 G = 2 Total = 16	R = 0 O = 3 Y = 11 G = 2 Total = 16	R = 0 O = 10 Y = 7 G = 0 Total = 17
	N / N / MS	N / MS	MS	MS

Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5					
4	4				
3	2	3			
2	1		2	2	
1		1			
0					

Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5					
4	4	1			
3	2	3			
2	1		2	2	
1		1			
0					

Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5					
4	4	1			
3	2	3			
2	1		2	2	
1		1			
0					

Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5		1			
4	2	1	1		
3		2	3		
2		1	1	3	
1			1		
0					

Summary

The assessment against the Personnel Onshore criterion is based on the results of the HAZID for the various onshore operations for each option and is as follows:
Option 1 is assessed as being neutral to Option 2b and Option 2c as they have a similar risk exposure. Option 1 is assessed as being much stronger than Option 3a as the risk exposure is much lower due to the risks associated with handling, transporting and processing large quantities of cut pipe (Option 3a also has a potential MAH).
Option 2b is assessed as being neutral to Option 2c as they have a similar risk exposure. Option 2b is assessed as being much stronger than Option 3a as the risk exposure is much lower for similar reasons as above.
Option 2c is assessed as being much stronger than Option 3a, against for similar reasons.

Overall, Options 1, 2b and 2c would be equally preferred from a risk to Onshore Personnel perspective.

	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover
1. Safety — **1.3 Other Users**	R = 0 O = 2 Y = 0 G = 0 Total = 2	R = 0 O = 2 Y = 0 G = 0 Total = 2	R = 0 O = 2 Y = 0 G = 0 Total = 2	R = 0 O = 2 Y = 0 G = 0 Total = 2
	N	**N**	**N**	**N**
Summary	The assessment against the Other Users criterion is based on the results of the HAZID for the various offshore operations for each option and is as follows: All options are assessed as being neutral against each other as the risk exposure to Other Users from on-site and transit operations is similar for all options. Overall, all options are equally preferred from a risk to Other Users perspective. Note: HAZID concluded that the risk profile would be the same for all options as any collision with a vessel is highly unlikely based on the equipment used be all vessels.			
1. Safety — **1.4 Residual Risk**	R = 2 O = 4 Y = 7 G = 0 Total = 13	R = 2 O = 6 Y = 7 G = 0 Total = 15	R = 2 O = 5 Y = 8 G = 0 Total = 13	R = 0 O = 0 Y = 0 G = 0 Total = 0
	MW	**VMW**	**VMW**	**W**	**W**	**N**	**N**
Summary	The assessment against the Residual Risk criterion is based on the results of the HAZID for the legacy operations is as follows: Option 1 is assessed as being much weaker than Option 2b as it has a greater potential for snag hazard and highest burden in terms of man-hours exposure to monitor and remediate the remaining equipment (Option 1 has 2 potential MAH). Option 1 is assessed as being much weaker than Option 2c for similar reasons. Option 1 is assessed as being very much weaker than Option 3a as there is the potential for a snag hazard versus no residual risk with the full removal option. Option 2b is assessed as being weaker than Option 2c as it is considered to have a higher potential for snag hazard than the trench and bury option. There is also a higher burden in terms of man-hours exposure to monitor and remediate the remaining equipment. Option 2b is assessed as being very much weaker than Option 3a as there is the potential for a snag hazard versus no residual risk with the full removal option. Option 2c is assessed as being very much weaker than Option 3a for similar reasons. Overall, Option 3a is the preferred option from a Residual Risk perspective.			
2. Environmental — **2.1 Impact of Decommissioning Operations Offshore**	Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 245 dB / 3.4 TPa^2s Subsea Cutting: 0.25 days Vessel Emissions (CO_2): 2,938 tonnes Vessel Fuel Use: 927 tonnes	Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 245 dB / 3.7 TPa^2s Subsea Cutting: 0.25 days Vessel Emissions (CO_2): 2,993 tonnes Vessel Fuel Use: 944 tonnes	Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 248 dB / 6.4 TPa^2s Subsea Cutting: 0.25 days Vessel Emissions (CO_2): 3,212 tonnes Vessel Fuel Use: 1,013 tonnes	Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 245 dB / 3.0 TPa^2s Subsea Cutting: 3.71 days Vessel Emissions (CO_2): 4,627 tonnes Vessel Fuel Use: 1,460 tonnes
	N	**N**	**N**	**N**	**N**	**N**	**N**
Summary	The assessment against the Impact of Decommissioning Operations Offshore criterion is as follows: All options are assessed as being neutral to each other as the environmental impact of the options are largely similar in terms of emissions, marine noise and fuel consumption. Overall, all options are equally preferred from a Impact of Decommissioning Operations Offshore perspective.			

		1 - Minimal Intervention - Remove exposed ends			2b - Major intervention - Rock cover full line		2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover
2. Environmental	2.2 Processing of Returned Materials	Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted: Concrete Coated Steel Pipe: 10 tonnes Concrete Mattresses: 20 tonnes Grout Bags: 12.5 tonnes			Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted: Concrete Coated Steel Pipe: 10 tonnes Concrete Mattresses: 20 tonnes Grout Bags: 12.5 tonnes		Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted: Concrete Coated Steel Pipe: 10 tonnes Concrete Mattresses: 20 tonnes Grout Bags: 12.5 tonnes	Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted: Concrete Coated Steel Pipe: 534 tonnes Concrete Mattresses: 20 tonnes Grout Bags: 12.5 tonnes
		N	N	S	N	S	S	
	Summary	The assessment against the Processing of Returned Materials criterion is as follows: Option 1 is assessed as being neutral to both Option 2b and Option 2c as both have the same quantities and types of material returned to shore for processing. Option 1 is assessed as being stronger than Option 3a as there is less material returned to shore for processing. Option 2b is assessed as being neutral to Option 2c as both have the same quantities and types of material returned to shore for processing. Option 2b is assessed as being stronger than Option 3a as there is less material returned to shore for processing. Option 2c is assessed as being stronger than Option 3a for similar reasons. Overall, Options 1, 2b and 2c are equally preferred from a Processing of Returned Materials perspective.						
2. Environmental	2.3 Resource Consumption	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock for Rock cover: 200 tonnes (cut ends only) Emissions for replacement material (CO_2): 653 tonnes			Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock for Rock cover: 14,600 tonnes Emissions for replacement material (CO_2): 653 tonnes		Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock for Rock cover: N/A Emissions for replacement material (CO_2): 653 tonnes	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock for Rock cover: N/A Emissions for replacement material (CO_2): 0 tonnes
		MS	N	W	MW	VMW	W	
	Summary	The assessment against the Resource Consumption criterion is as follows: Option 1 is assessed as being much stronger than Option 2b as, whilst the amount of replacement material is the same, Option 1 only requires a small amount of rock cover material versus a large amount for Option 2b. Option 1 is assessed as being neutral to Option 2c as the rock cover and replacement materials are largely similar. Option 1 is assessed as being weaker than Option 3a as there is a much higher requirement for replacement material for the remaining pipeline under Option 1. Option 2b is assessed as being much weaker than Option 2c as, whilst the amount of replacement material is the same, Option 2b requires a large amount of rock cover material. Option 2b is assessed as being very much weaker than Option 3a as it requires a large amount of rock cover material and a large amount of replacement material for the remaining pipeline. Option 2c is assessed as being weaker than Option 3a due the large amount of replacement material for the remaining pipeline. Overall, Option 3a is the preferred option from a Resource Consumption perspective.						
2. Environmental	2.4 Disturbance	Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from introducing the rock cover at the exposed ends. The area of impact is as follows: Seabed Disturbance: 100 m^2			Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from rock covering the entire line. The area of impact is as follows: Seabed Disturbance: 10,425 m^2		Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from trenching and burying the entire line. The impact is higher for trenching and burying than cut and lift. The area of impact is as follows: Seabed Disturbance: 2,125 m^2	Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from removing the entire line. The area of impact is as follows: Seabed Disturbance: 2,125 m^2
		MS	MS	S	N	W	W	
	Summary	The assessment against the Seabed Disturbance (short-term impact) criterion is as follows: Option 1 is assessed as being much stronger than Option 2b as there is much less short-term seabed disturbance than rock covering the entire line. Option 1 is assessed as being much stronger than Option 2c as there is also much less short-term seabed disturbance than trenching and burying the entire line. Option 1 is assessed as being stronger than Option 3a as, whilst the area of impact in Option 3a is high, the level of impact of cut and lift of a surface laid line is expected to be lower than trench and bury. Option 2b is assessed as being neutral to Option 2c as, whilst the area associated with rock cover is greater than trench and bury, the short-term disturbance is greater with trench and bury, these cancel each other out. Option 2b is assessed as being weaker than Option 3a as, whilst the area associated with rock cover is greater than cut and lift, the level of impact of performing cut and lift of a surface laid line is expected to be lower than rock cover. Option 2c is assessed as being weaker than Option 3a as whilst the areas impacted are similar, the impact from trench and bury operations are expected to be greater than cutting and lifting of a surface laid pipeline. Overall, Option 1 is the preferred option from a Disturbance perspective.						

		1 - Minimal Intervention - Remove exposed ends			2b - Major intervention - Rock cover full line		2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover
2. Environmental	2.5 Loss of Habitat	Whilst the environmental impact in terms of Loss of Habitat (long-term impact) is assessed as 'low' for this option, there is an impact from introducing rock cover at the pipeline ends which will permanently alter the habitat type and will therefore impact the benthic community. There is also a permanent impact from leaving the pipeline (2km) in-situ. The area of impact is as follows: Rock cover: 100 m^2 Pipeline: 2 km			Whilst the environmental impact in terms of Loss of Habitat (long-term impact) is assessed as 'low' for this option, there is an impact from rock covering the entire line which will permanently alter the habitat type and will therefore impact the benthic community. The area of impact is as follows: Rock cover: 10,425 m^2		There are no long-term impacts or loss of habitats expected from the trench and bury of the pipeline.	There are negligible long-term impacts or loss of habitats expected from the full removal of pipeline by cut and lift.
		MS	**MW**	**MW**	**VMW**	**VMW**	**N**	
	Summary	The assessment against the Loss of Habitat (legacy / long-term) criterion is as follows: Option 1 is assessed as being much stronger than Option 2b as the rock cover will permanently alter the habitat. Option 1 is assessed as being much weaker than Option 2c as the pipeline will remain on the seabed and therefore the long-term habitat change will be greater than the trench and bury option. Option 1 is assessed as being much weaker than Option 3a as the pipeline will remain on the seabed and therefore the long-term habitat change will be greater than the full removal option. Option 2b is assessed as being very much weaker than Option 2c as the rock cover will permanently alter the habitat over a large area. Option 2b is assessed as being very much weaker than Option 3a for similar reasons. Option 2c is assessed as being neutral to Option 3a as there will be no long-term impact / loss of habitat associated with the trench and bury or full removal options. Overall, Option 2c and Option 3a are equally preferred from a Loss of Habitat perspective.						
3. Technical	3.1 Technical Risk	**Feasibility:-** High **Concept Maturity:-** High **Availability of Technology:-** High - All vessels and equipment widely available **Track Record:-** High - Operations considered routine **Risk of Failure:-** Low **Consequence of Failure:-** Limited impact to cost and schedule			**Feasibility:-** High **Concept Maturity:-** High **Availability of Technology:-** High - All vessels and equipment widely available **Track Record:-** High - Operations considered routine **Risk of Failure:-** Low **Consequence of Failure:-** Limited impact to cost and schedule		**Feasibility:-** High - Pipelines of this diameter and length have been trenched on numerous occasions **Concept Maturity:-** High **Availability of Technology:-** High - Widely Available with multiple contractors with trenching capability **Track Record:-** High - Pipelines of this diameter and length have been trenched on numerous occasions. We know exactly what we need to do to achieve this option. The concept is well developed **Risk of Failure:-** Medium - Considered challenging to accomplish 0.6m DoC over entire length **Consequence of Failure:-** Failure to achieve target DoC would likely result in additional rock placement in that location. Cost and schedule impact.	**Feasibility:-** High - Cutting pipelines has been conducted on numerous occasions. **Concept Maturity:-** High **Availability of Technology:-** High - Widely Available with multiple contractors with cutting and lifting capability **Track Record:-** Medium - Track record for removal of this length of line is limited **Risk of Failure:-** Medium - Step change in comparison to Group 1 as the length is a lot shorter **Consequence of Failure:-** Failure would result in significant cost and schedule impact. Requirement for alternative decommissioning method.
		N	**S**	**S**	**S**	**S**	**N**	
	Summary	The assessment against the Technical Risk criterion is as follows: Option 1 is assessed as being neutral to Option 2b, they are the same apart from rock placement which is a common activity and straightforward to execute. Option 1 is assessed as being stronger than Option 2c as whilst the risk and consequence of failure is greater with Option 2c, in the event that a section was un-trenchable it can be rock covered or removed. Option 1 is also assessed as being stronger than Option 3a as there is little to no track record of removing this quantity of line and as such, the risk and consequences of failure are greater. Option 2b is assessed as being stronger than Option 2c as Rock placement is considerably less challenging than trenching. Option 2b is also assessed as being stronger than Option 3a as Rock placement is considerably less challenging than full removal. Option 2c is assessed as being neutral to Option 3a. The only real difference between these options is in the area of track record, as there is little to no track record for removing this quantity of line. Overall, Option 1 and Option 2b are equally preferred from a Technical Risk perspective.						
4. Societal	4.1 Impact on Commercial Fisheries	Leaving majority of pipeline in place means that current area lost to fishing operations due to presence of pipeline is maintained.			Whist area impacted from rock covering entire pipeline is greater, it is expected that fishing operations will be performed over a rock covered pipeline.		Trench and bury of the pipeline effectively returns the area lost from having the pipeline in place to the fishing industry for fishing operations.	Removal of the pipeline returns the area lost from having the pipeline in place to the fishing industry for fishing operations.
		W	**MW**	**MW**	**MW**	**MW**	**N**	
	Summary	The assessment against the Impact on Commercial Fisheries criterion is as follows: Option 1 is assessed as being weaker than Option 2b as leaving the pipeline in place is considered worse from a fishing operations perspective than the full rock covered option. Option 1 is assessed as being much weaker than both Option 2c and Option 3a as the trench and bury and full removal options effectively return the full area to the fishing industry for fishing operations. Option 2b is assessed as being much weaker than both Option 2c and Option 3a as the rock cover will result in an increase in the loss of habitat versus clear seabed under Option 2c and Option 3a. Option 2c is assessed as being neutral to Option 3a as they both effectively return the area to the fishing industry for fishing operations. Overall, Option 2c and Option 3a are equally preferred from a Impact on Commercial Fisheries perspective.						

		1 - Minimal Intervention - Remove exposed ends			2b - Major intervention - Rock cover full line		2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover
4. Societal	4.2 Socio-economic impact on communities and	Minor quantities of material (10 tonnes of concrete coated steel pipe) being returned to shore for processing results in negligible negative impacts on communities. The returned steel is recyclable, there will be a minimal amount of concrete, likely to be placed in landfill. Job creation / retention minimal due to relatively low (around 26,000) man-hours to deliver this this option.			Minor quantities of material (10 tonnes of concrete coated steel pipe) being returned to shore for processing results in negligible negative impacts on communities. The returned steel is recyclable, there will be a minimal amount of concrete, likely to be placed in landfill. Job creation / retention minimal due to relatively low (around 27,000) man-hours to deliver this this option.		Minor quantities of material (10 tonnes of concrete coated steel pipe) being returned to shore for processing results in negligible negative impacts on communities. The returned steel is recyclable, there will be a minimal amount of concrete, likely to be placed in landfill. Job creation / retention minimal due to relatively low (around 29,000) man-hours to deliver this this option.	Larger quantities of material (around 534 tonnes of concrete coated steel pipe) being returned to shore for processing could result in some minor negative impacts on communities. The returned steel is recyclable, there will be some concrete, likely to be placed in landfill. Job creation / retention is a little higher than other options (around 40,000 man-hours), which offsets any negative community impacts.
		N	**N**	**N**	**N**	**N**	**N**	
	Summary	The assessment against the Socio-economic criterion is as follows: Option 1 is assessed as being neutral to both Option 2b and Option 2c as they result in similar levels of job creation / retention and negative impacts on communities from material returned to shore for processing. Option 1 is also assessed as being neutral to Option 3a as, whilst there is slightly more job creation / retention, there is more negative impacts on communities from material returned to shore for processing which cancel each other out. Option 1 is assessed as being stronger than Option 3a as it will not result in as much disturbance onshore with minimal extra work. Option 2b is assessed as being neutral to Option 2c and Option 3a for similar reasons. Option 2c is assessed as being neutral to Option 3a, again for similar reasons. All options would be equally preferred from a Socio-economic impact on communities and amenities perspective.							
5. Economic	5.1 Short-term Costs	Initial operation cost: £2.9 million			Initial operation cost: £3.7 million		Initial operation cost: £2.8 million	Initial operation cost: £4.5 million
		N	**N**	**S**	**N**	**N**	**S**	
	Summary	The assessment against the Short-term Costs criterion is as follows: Option 1 is assessed as being neutral to Option 2b and Option 2c as the costs are similar. Option 1 is assessed as being stronger than Option 3a as the cost for Option 3a is around 50% higher. Option 2b is assessed as being neutral to Option 2c and Option 3a as, whilst the cost differential is around 20%, this is insufficient to express a preference. Option 2c is assessed as stronger than Option 3a as the cost for Option 3a is around 60% higher. Overall, Option 1 and Option 2c are equally preferred rom a Short-term Costs perspective.							
	5.2 Long-term Costs	Legacy cost (survey & monitoring): £1.25 million Potential legacy cost (remediation): £500,000 Total legacy cost: £1.75 million			Legacy cost (survey & monitoring): £320,000 Potential legacy cost (remediation): £500,000 Total legacy cost: £820,000		Legacy cost (survey & monitoring): £320,000 Potential legacy cost (remediation): £500,000 Total legacy cost: £820,000	Legacy cost (survey & monitoring): N/A Potential legacy cost (remediation): N/A Total legacy cost: N/A There are no legacy costs associated with this full removal option.
		MW	**MW**	**VMW**	**N**	**MW**	**MW**	
	Summary	The assessment against the Long-term Costs criterion is as follows: Option 1 is assessed as being much weaker than both Option 2b and Option 2c as the costs are around double. Option 1 is assessed as being very much weaker than Option 3a as the costs are £1.75 million higher. Option 2b is assessed as being neutral to Option 2c as the costs are the same. Option 2b is assessed as being much weaker than Option 3a as the costs are around £820k lower. Option 2c is assessed as being much weaker than Option 3a for the same reasons. Overall, Option 3a is the preferred option from a Long-term Costs perspective.							

Appendix C.2 Group 2 Pairwise Comparison Matrices – Safety

1.1 Personnel Offshore	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	S	MS	33%
2b - Major intervention - Rock cover full line	N	N	S	MS	33%
2c - Major intervention - Trench and bury full line	W	W	N	MS	24%
3a - Full Removal - Cut and recover	MW	MW	MW	N	10%

1.2 Personnel Onshore	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	N	MS	30%
2b - Major intervention - Rock cover full line	N	N	N	MS	30%
2c - Major intervention - Trench and bury full line	N	N	N	MS	30%
3a - Full Removal - Cut and recover	MW	MW	MW	N	10%

1.3 Other Users	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	N	N	25%
2b - Major intervention - Rock cover full line	N	N	N	N	25%
2c - Major intervention - Trench and bury full line	N	N	N	N	25%
3a - Full Removal - Cut and recover	N	N	N	N	25%

1.4 Residual Risk	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MW	VMW	VMW	5%
2b - Major intervention - Rock cover full line	MS	N	W	W	21%
2c - Major intervention - Trench and bury full line	VMS	S	N	N	37%
3a - Full Removal - Cut and recover	VMS	S	N	N	37%

Appendix C.3 Group 2 Pairwise Comparison Matrices – Environment / Technical

2.1 Impact of Decommissioning Operations Offshore	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	N	N	25%
2b - Major intervention - Rock cover full line	N	N	N	N	25%
2c - Major intervention - Trench and bury full line	N	N	N	N	25%
3a - Full Removal - Cut and recover	N	N	N	N	25%

2.2 Processing of Returned Materials	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	N	S	27%
2b - Major intervention - Rock cover full line	N	N	N	S	27%
2c - Major intervention - Trench and bury full line	N	N	N	S	27%
3a - Full Removal - Cut and recover	W	W	W	N	18%

2.3 Resource Consumption	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MS	N	W	25%
2b - Major intervention - Rock cover full line	MW	N	MW	VMW	7%
2c - Major intervention - Trench and bury full line	N	MS	N	W	25%
3a - Full Removal - Cut and recover	S	VMS	S	N	44%

2.4 Disturbance	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MS	MS	S	44%
2b - Major intervention - Rock cover full line	MW	N	N	W	16%
2c - Major intervention - Trench and bury full line	MW	N	N	W	16%
3a - Full Removal - Cut and recover	W	S	S	N	25%

2.5 Loss of Habitat	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MS	MW	MW	14%
2b - Major intervention - Rock cover full line	MW	N	VMW	VMW	5%
2c - Major intervention - Trench and bury full line	MS	VMS	N	N	41%
3a - Full Removal - Cut and recover	MS	VMS	N	N	41%

3. Technical	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	S	S	30%
2b - Major intervention - Rock cover full line	N	N	S	S	30%
2c - Major intervention - Trench and bury full line	W	W	N	N	20%
3a - Full Removal - Cut and recover	W	W	N	N	20%

Appendix C.4 Group 2 Pairwise Comparison Matrices – Societal / Economic

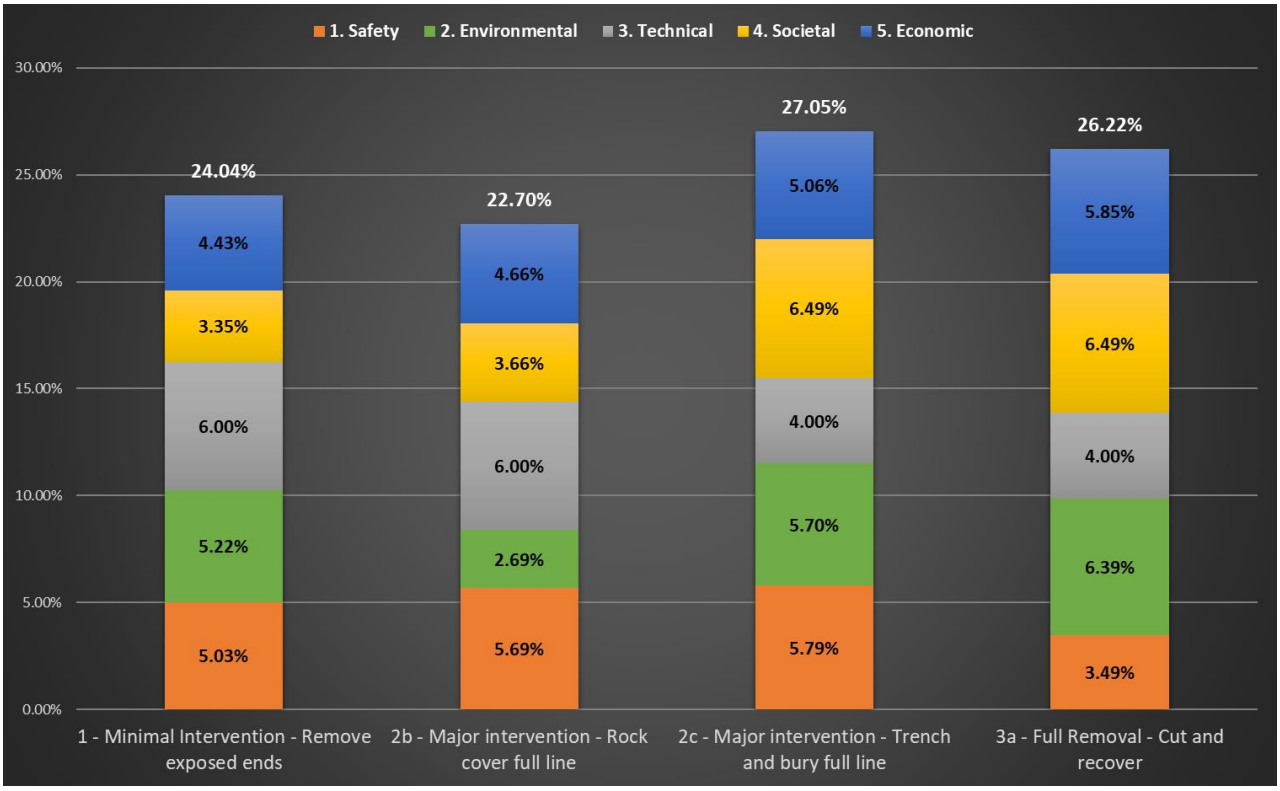
4.1 Impact on Commercial Fisheries	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal Intervention - Remove exposed ends	N	W	MW	MW	11%
2b - Major intervention - Rock cover full line	S	N	MW	MW	14%
2c - Major intervention - Trench and bury full line	MS	MS	N	N	37%
3a - Full Removal - Cut and recover	MS	MS	N	N	37%

4.2 Socio-economic impact on communities and amenities	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	N	N	25%
2b - Major intervention - Rock cover full line	N	N	N	N	25%
2c - Major intervention - Trench and bury full line	N	N	N	N	25%
3a - Full Removal - Cut and recover	N	N	N	N	25%

5.1 Short-term Costs	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	N	S	27%
2b - Major intervention - Rock cover full line	N	N	N	N	25%
2c - Major intervention - Trench and bury full line	N	N	N	S	27%
3a - Full Removal - Cut and recover	W	N	W	N	20%

5.2 Long-term Costs	1 - Minimal Intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MW	MW	VMW	6%
2b - Major intervention - Rock cover full line	MS	N	N	MW	19%
2c - Major intervention - Trench and bury full line	MS	N	N	MW	19%
3a - Full Removal - Cut and recover	VMS	MS	MS	N	56%

Appendix C.5 Group 2 Results Chart



APPENDIX D GROUP 3 – DETAILED EVALUATION RESULTS

Appendix D.1 Group 3 Attributes Table

1. Safety – 1.1 Personnel Offshore

1 - Minimal Intervention - Remove exposed ends

R = 0
O = 7
Y = 10
G = 4
Total = 21

Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	2				
4		5			
3	1	3			
2	3	6			
1		1			
0					

3a - Full Removal - Cut and recover

R = 0
O = 9
Y = 9
G = 1
Total = 19

Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	1				
4		3	3		
3		3	1		
2	1	4	1	1	
1			1		
0					

3b - Full Removal - Reverse installation

R = 0
O = 11
Y = 13
G = 1
Total = 25

Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	2				
4		4	3		
3		5	1		
2	1	4	3	1	
1			1		
0					

MS	MS	W

Summary

The assessment against the Personnel Offshore criterion is based on the results of the HAZID for the various offshore operations for each option and is as follows:
Option 1 is assessed as being much stronger than both Option 3a and Option 3b as the scope of work is much shorter leading to less risk exposure.
Option 3a is assessed as being weaker than Option 3b due to the risk profile associated with the lifting and onboarding operations with Option 3a.

Overall, Option 1 is the preferred option from a risk to Offshore Personnel perspective. Note: No MAH were identified for any options from an offshore operations perspective.

1. Safety – 1.2 Personnel Onshore

1 - Minimal Intervention - Remove exposed ends

R = 0
O = 2
Y = 11
G = 2
Total = 15

Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5					
4	4				
3	2	3			
2	1		2	2	
1		1			
0					

3a - Full Removal - Cut and recover

R = 0
O = 8
Y = 7
G = 0
Total = 15

Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5		1			
4	2	1			
3		2	3		
2		1	1	3	
1			1		
0					

3b - Full Removal - Reverse installation

R = 0
O = 8
Y = 7
G = 0
Total = 15

Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5		1			
4	2	1			
3		2	3		
2		1	1	3	
1			1		
0					

MS	MS	N

Summary

The assessment against the Personnel Onshore criterion is based on the results of the HAZID for the various onshore operations for each option and is as follows:
Option 1 is assessed as being much stronger than both Option 3a and Option 3b as there is less material being returned to shore so small onshore scope leading to less risk exposure than either of these options.
Option 3a is assessed as being neutral to Option 3b as the risk profiles are considered largely similar.

Overall, Option 1 is the preferred option from a risk to Onshore Personnel perspective. Note: No MAH were identified for any options from an onshore operations perspective.

1. Safety – 1.3 Other Users

1 - Minimal Intervention - Remove exposed ends

R = 0
O = 2
Y = 0
G = 0
Total = 2

Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	2				
4					
3					
2					
1					
0					

3a - Full Removal - Cut and recover

R = 0
O = 2
Y = 0
G = 0
Total = 2

Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	2				
4					
3					
2					
1					
0					

3b - Full Removal - Reverse installation

R = 0
O = 2
Y = 0
G = 0
Total = 2

Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	2				
4					
3					
2					
1					
0					

N	N	N

Summary

The assessment against the Other Users criterion is based on the results of the HAZID for the various offshore operations for each option and is as follows:
All options are assessed as being neutral against each other as the risk exposure to Other Users from on-site and transit operations is similar for all options.

Overall, all options are equally preferred from a risk to Other Users perspective. Note: HAZID concluded that the risk profile would be the same for all options as any collision with a vessel is highly unlikely based on the equipment used be all vessels.

1. Safety – 1.4 Residual Risk

1 - Minimal Intervention - Remove exposed ends

R = 0
O = 6
Y = 7
G = 0
Total = 13

Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	4	1			
4	2	1			
3		2			
2		3			
1					
0					

3a - Full Removal - Cut and recover

R = 0
O = 0
Y = 0
G = 0
Total = 0

Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5					
4					
3					
2					
1					
0					

3b - Full Removal - Reverse installation

R = 0
O = 0
Y = 0
G = 0
Total = 0

Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5					
4					
3					
2					
1					
0					

MW	MW	N

Summary

The assessment against the Residual Risk criterion is based on the results of the HAZID for the various legacy elements and is as follows:
Option 1 is assessed as being much weaker than both Option 3a and Option 3b as there is potential for snag hazard and additional burden in terms of man-hours exposure to monitor and remediate the left in-situ pipeline versus the two full removal options.
Option 3a is assessed as being neutral to Option 3b as both are full removal options and therefore have no residual risk.

Overall, both Option 3a and Option 3b would be equally preferred from a Residual Risk perspective.

		1 - Minimal Intervention - Remove exposed ends		3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation
2. Environmental	2.1 Impact of Decommissioning Operations Offshore	Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 245 dB / 3.6 TPa^2s Subsea Cutting: 1 day Vessel Emissions (CO_2): 3,000 tonnes Vessel Fuel Use: 946 tonnes		Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 247 dB / 5.1 TPa^2s Subsea Cutting: 7.33 days MFE: 1.71 days Vessel Emissions (CO_2): 6,485 tonnes Vessel Fuel Use: 2,046 tonnes	Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 248 dB / 7.3 TPa^2s Subsea Cutting: 1.08 days MFE: 2.04 days Vessel Emissions (CO_2): 5,909 tonnes Vessel Fuel Use: 1,803 tonnes
		N	**N**	**N**	
	Summary	The assessment against the Impact of Decommissioning Operations Offshore criterion is as follows: All options are assessed as being neutral to each other as, whilst there are differences in the quantities of atmospheric emissions and fuel use, these are insufficient to move from the neutral position. As such, the environmental impact of the options are largely similar in terms of emissions, marine noise and fuel consumption. Overall, all options are equally preferred from an Impact of Decommissioning Operations Offshore perspective.			
2. Environmental	2.2 Processing of Returned Materials	Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted: Concrete Coated Steel Pipe: 12 tonnes Rigid Steel Pipe: 7.5 tonnes Umbilicals: 1.6 tonnes Concrete Mattresses: 256 tonnes		Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted: Concrete Coated Steel Pipe: 641 tonnes Rigid Steel Pipe: 32 tonnes Umbilicals: 35 tonnes Concrete Mattresses: 256 tonnes	Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted: Concrete Coated Steel Pipe: 641 tonnes Rigid Steel Pipe: 32 tonnes Umbilicals: 35 tonnes Concrete Mattresses: 256 tonnes
		S	**S**	**N**	
	Summary	The assessment against the Processing of Returned Materials criterion is as follows: Option 1 is assessed as being stronger than both Option 3a and Option 3b as there is less material being returned onshore for processing / placed in landfill. Option 3a is assessed as being neutral to Option 3b as both will result in the same volume of materials being returned onshore for processing / placed in landfill. Overall, Option 1 is the preferred option from a Processing of Returned Materials perspective.			
2. Environmental	2.3 Resource Consumption	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock for Rock cover: 800 tonnes (cut ends only) Emissions for replacement material (CO_2): 856 tonnes Emissions from recovered material (CO_2): 105 tonnes		Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock for Rock cover: N/A Emissions for replacement material (CO_2): 0 tonnes Emissions from recovered material (CO_2): 510 tonnes	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock for Rock cover: N/A Emissions for replacement material (CO_2): 0 tonnes Emissions from recovered material (CO_2): 510 tonnes
		W	**W**	**N**	
	Summary	The assessment against the Resource Consumption criterion is as follows: Option 1 is assessed as being weaker than both Option 3a and Option 3b as there is a small amount of material required for rock cover and the requirement to replace the material left in-situ. Option 3a is assessed as being neutral to Option 3b as both return all material onshore and do not require material for rock cover. Overall, Option 3a and Option 3b would be equally preferred from a Resource Consumption perspective.			
2. Environmental	2.4 Disturbance	Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from introducing the rock cover over the cut ends of the pipeline. The area of impact is as follows: Seabed Disturbance: 400 m^2		Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from removing the entire line. The area of impact is as follows: Seabed Disturbance: 8,210 m^2	Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from removing the entire line. The area of impact is as follows: Seabed Disturbance: 8,210 m^2
		MS	**S**	**W**	
	Summary	The assessment against the Seabed Disturbance (short-term impact) criterion is as follows: Option 1 is assessed as being much stronger than Option 3a as there is a small area of seabed disturbance versus a much larger area with Option 3a. Option 1 is assessed as being stronger than Option 3b as there is also a small area of seabed disturbance versus a much larger area with Option 3b, however, it is noted that the impact on the seabed from reverse installation of the surface laid lines will be lower than the cut and recover option. Option 3a is assessed as being weaker than Option 3b as, whilst the area of impact is the same, the level of impact from the reverse installation option will be lower than the cut and recover option. Overall, Option 1 is the preferred option from a Disturbance perspective.			
2. Environmental	2.5 Loss of Habitat	Whilst the environmental impact in terms of Loss of Habitat (long-term impact) is assessed as 'low' for this option, there is an impact from introducing rock cover at the pipeline / umbilical ends which will permanently alter the habitat type and will therefore impact the benthic community. There is also a permanent impact from leaving the pipelines (2.4km) and umbilicals (1.7km) in-situ. The area of impact is as follows: Rock cover: 400 m^2 Pipelines: 2.4 km Umbilicals: 1.7 km		There are no long-term impacts or loss of habitats expected from the cut and recover full removal of the pipelines / umbilicals.	There are no long-term impacts or loss of habitats expected from the reverse installation full removal of the pipelines / umbilicals.
		N	**N**	**N**	
	Summary	The assessment against the Loss of Habitat (legacy / long-term) criterion is as follows: All options are assessed as neutral to each other as, whilst there is additional rock introduced to the cut ends under Option 1, this is minimal in comparison to loss of habitat associated with the fully removed lines, which is the same for all options. Overall, all options are equally preferred from a Loss of Habitat perspective.			

		1 - Minimal Intervention - Remove exposed ends		3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation
3. Technical	3.1 Technical Risk	**Feasibility**:- High **Concept Maturity**:- High **Availability of Technology:-** High - All vessels and equipment widely available **Track Record:-** High - Operations considered routine **Risk of Failure:-** Low **Consequence of Failure:-** Limited impact to cost and schedule		**Feasibility:-** High - Removal of rock could be challenging but the Cutting and removal of pipelines has been conducted on numerous occasions. **Concept Maturity:-** High **Availability of Technology:-** High - Numerous contractors offering MFE and numerous contractors offering cut and lift **Track Record:-** Low - Routine operation but the cumulative length of these pipelines have not been conducted in a single project **Risk of Failure:-** High - May require diver support, Extended subsea works and simultaneous operations. **Consequence of Failure:-** Failure would result in significant cost and schedule impact. Requirement for alternative decommissioning method.	**Feasibility:-** High - Removal of rock could be challenging but the reeling of small diameter cables from the seabed is not technically challenging. **Concept Maturity:-** High - We know exactly what the procedural steps would be to complete this operation and the concept is mature. **Availability of Technology:-** High - Numerous contractors offering MFE and numerous contractors offering cut and lift **Track Record:-** Med - Routine installation operation but limited track record of reverse reeling in North Sea for decommissioning over extended distance. Limited track record of deburial works over extended distance. **Risk of Failure:-** Med - Pipeline / umbilical integrity unknown **Consequence of Failure:-** Alternate recovery techniques required / cost and schedule impact.
		MS	**MS**	**W**	
	Summary	The assessment against the Technical Risk criterion is as follows: Option 1 is assessed as being much stronger than both Option 3a and Option 3b as there is limited track record of cut and recover of pipelines / umbilicals or reverse installation of pipelines at this scale versus minimal routine operations for Option 1. Option 3a is assessed as being stronger than Option 3b as there are more challenges associated with the cut and recover option. Overall, Option 1 is the preferred option from a Technical Risk perspective.			
4. Societal	4.1 Impact on Commercial Fisheries	Leaving majority of pipelines / umbilicals in place means that current area lost to fishing operations due to their presence is maintained. It is noted that impact is minimal due to short lengths (2.4km - pipelines / 1.7km - umbilicals).		Removal of the pipelines / umbilicals does not return the area lost to fishing operations as the current rock cover will remain.	Removal of the pipelines / umbilicals does not return the area lost to fishing operations as the current rock cover will remain.
		N	**N**	**N**	
	Summary	The assessment against the Impact on Commercial Fisheries criterion is as follows: All options are assessed as being neutral to each other due to the area currently lost to fishing operations (from lines being rock covered) remaining the case for all options as the existing rock will not be removed even under the full removal options. Overall, all options are equally preferred from a Commercial Fisheries perspective.			
4. Societal	4.2 Socio-economic impact on communities and amenities	Relatively minor quantities of material returned: Concrete coated steel pipe: 12 tonnes Rigid steel pipe: 7.5 tonnes Umbilicals: 1.6 tonnes Concrete Mattresses: 256 tonnes This results in limited negative impacts on communities. The returned steel is recyclable, the concrete mattresses could potentially be reused. Job creation / retention minimal due to relatively low (around 27,000) man-hours to deliver this this option.		Relatively minor quantities of material returned: Concrete coated steel pipe: 641 tonnes Rigid steel pipe: 32 tonnes Umbilicals: 35 tonnes Concrete Mattresses: 256 tonnes This results in limited negative impacts on communities. The returned steel is recyclable, the concrete mattresses could potentially be reused, there would be a small amount of concrete from the pipeline and some of the umbilical placed in landfill. Job creation / retention is notable due to the (around 58,000) man-hours to deliver this this option.	Relatively minor quantities of material returned: Concrete coated steel pipe: 641 tonnes Rigid steel pipe: 32 tonnes Umbilicals: 35 tonnes Concrete Mattresses: 256 tonnes This results in limited negative impacts on communities. The returned steel is recyclable, the concrete mattresses could potentially be reused, there would be a small amount of concrete from the pipeline and some of the umbilical placed in landfill. Job creation / retention is notable due to the (around 46,000) man-hours to deliver this this option.
		N	**N**	**N**	
	Summary	The assessment against the Socio-economic criterion is as follows: All options are assessed as being neutral to each other as the quantities of material returned are insufficient to cause any significant negative impact on communities. Where there are greater quantities returned, this is offset by higher job creation / retention and thus largely balanced. Overall, all options are equally preferred from a Socio-economic impact on communities and amenities perspective.			
5. Economic	5.1 Short-term Costs	Initial operation cost: £3.3 million		Initial operation cost: £8.7 million	Initial operation cost: £7.0 million
		MS	**MS**	**W**	
	Summary	The assessment against the Short-term Costs criterion is as follows: Option 1 is assessed as being much stronger than Option 3a as it is £5.4 million lower cost and much stronger than Option 3b as it is £3.7 million lower cost. Option 3a is assessed as being weaker than Option 3b as it is £1.7 million higher cost. Overall, Option 1 is the preferred option from a Short-term Costs perspective.			
	5.2 Long-term Costs	Legacy cost (survey & monitoring): £330,000 Potential legacy cost (remediation): £500,000 Total legacy cost: £830,000		Legacy cost (survey & monitoring): N/A Potential legacy cost (remediation): N/A Total legacy cost: N/A There are no legacy costs associated with this full removal option.	Legacy cost (survey & monitoring): N/A Potential legacy cost (remediation): N/A Total legacy cost: N/A There are no legacy costs associated with this full removal option.
		MW	**MW**	**N**	
	Summary	The assessment against the Long-term Costs criterion is as follows: Option 1 is assessed as being much weaker than both Option 3a and Option 3b as there are no long-term costs associated with the full removal options. Option 3a is assessed as being neutral to Option 3b for the same reason. Overall, Option 3a and Option 3b would be equally preferred from a Long-term Costs perspective.			

Appendix D.2 Group 3 Pairwise Comparison Matrices – Safety

1.1 Personnel Offshore	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MS	MS	60%
3a - Full Removal - Cut and recover	MW	N	W	17%
3b - Full Removal - Reverse installation	MW	S	N	23%

1.2 Personnel Onshore	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MS	MS	60%
3a - Full Removal - Cut and recover	MW	N	N	20%
3b - Full Removal - Reverse installation	MW	N	N	20%

1.3 Other Users	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	N	33%
3a - Full Removal - Cut and recover	N	N	N	33%
3b - Full Removal - Reverse installation	N	N	N	33%

1.4 Residual Risk	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MW	MW	14%
3a - Full Removal - Cut and recover	MS	N	N	43%
3b - Full Removal - Reverse installation	MS	N	N	43%

Appendix D.3 Group 3 Pairwise Comparison Matrices – Environment / Technical

2.1 Impact of Decommissioning Operations Offshore	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	N	33%
3a - Full Removal - Cut and recover	N	N	N	33%
3b - Full Removal - Reverse installation	N	N	N	33%

2.2 Processing of Returned Materials	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	S	S	43%
3a - Full Removal - Cut and recover	W	N	N	29%
3b - Full Removal - Reverse installation	W	N	N	29%

2.3 Resource Consumption	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	W	W	25%
3a - Full Removal - Cut and recover	S	N	N	38%
3b - Full Removal - Reverse installation	S	N	N	38%

2.4 Disturbance	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MS	S	51%
3a - Full Removal - Cut and recover	MW	N	W	19%
3b - Full Removal - Reverse installation	W	S	N	31%

2.5 Loss of Habitat	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	N	33%
3a - Full Removal - Cut and recover	N	N	N	33%
3b - Full Removal - Reverse installation	N	N	N	33%

3. Technical	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MS	MS	60%
3a - Full Removal - Cut and recover	MW	N	W	17%
3b - Full Removal - Reverse installation	MW	S	N	23%

Appendix D.4 Group 3 Pairwise Comparison Matrices – Societal / Economic

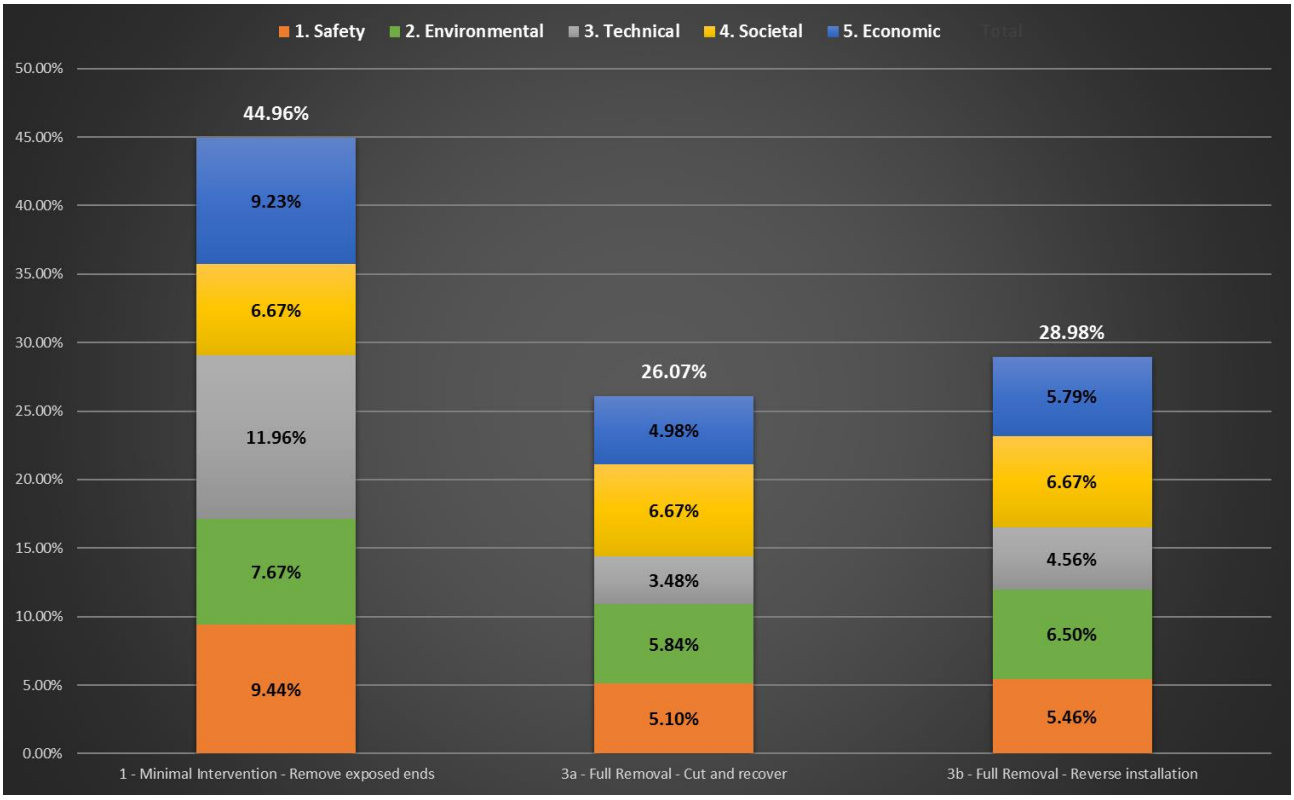
4.1 Impact on Commercial Fisheries	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	N	33%
3a - Full Removal - Cut and recover	N	N	N	33%
3b - Full Removal - Reverse installation	N	N	N	33%

4.2 Socio-economic impact on communities and amenities	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	N	33%
3a - Full Removal - Cut and recover	N	N	N	33%
3b - Full Removal - Reverse installation	N	N	N	33%

5.1 Short-term Costs	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MS	MS	60%
3a - Full Removal - Cut and recover	MW	N	W	17%
3b - Full Removal - Reverse installation	MW	S	N	23%

5.2 Long-term Costs	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	VMW	VMW	5%
3a - Full Removal - Cut and recover	VMS	N	N	47%
3b - Full Removal - Reverse installation	VMS	N	N	47%

Appendix D.5 Group 3 Results Chart



APPENDIX E GROUP 4 – DETAILED EVALUATION RESULTS

Appendix E.1 Group 4 Attributes Table

1. Safety – 1.1 Personnel Offshore

1 - Minimal Intervention - Remove exposed ends

R = 0
O = 7
Y = 10
G = 4
Total = 21

Severity	Likelihood				
	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	2				
4		5			
3	1	3			
2	3	6			
1		1			
0					

3a - Full Removal - Cut and recover

R = 0
O = 9
Y = 9
G = 1
Total = 19

Severity	Likelihood				
	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	1				
4		3	3		
3		3	1		
2	1	4	1	1	
1			1		
0					

3b - Full Removal - Reverse installation

R = 0
O = 11
Y = 13
G = 1
Total = 25

Severity	Likelihood				
	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	2				
4		4	3		
3		5	1		
2	1	4	3	1	
1			1		
0					

MS	MS	W

Summary

The assessment against the Personnel Offshore criterion is based on the results of the HAZID for the various offshore operations for each option and is as follows:
Option 1 is assessed as being much stronger than both Option 3a as it is a minimal scope versus a much larger scope and thus greater risk exposure with Option 3a. Additionally, Option 3a has multiple lifting and onboarding operations, again increasing the risk exposure. Option 1 is also assessed as much stronger than Option 3b as the scope is greater with Option 3b and the reverse installation methods increase the risk exposure.
Option 3a is assessed as being weaker than Option 3b as there is greater scope and lifting and onboarding operations associated with Option 3a leading to higher risk exposure.

Overall, Option 1 is the preferred option from a risk to Offshore Personnel perspective. Note: No MAH were identified for any options from an offshore operations perspective.

1. Safety – 1.2 Personnel Onshore

1 - Minimal Intervention - Remove exposed ends

R = 0
O = 2
Y = 11
G = 2
Total = 15

Severity	Likelihood				
	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5					
4	4				
3	2	3			
2	1		2	2	
1		1			
0					

3a - Full Removal - Cut and recover

R = 1
O = 12
Y = 2
G = 0
Total = 15

Severity	Likelihood				
	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5			1		
4		1	2		
3			5		
2		1		3	1
1				1	
0					

3b - Full Removal - Reverse installation

R = 1
O = 8
Y = 6
G = 0
Total = 15

Severity	Likelihood				
	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5			1		
4	2	1			
3		2	3		
2		1		3	1
1				1	
0					

VMS	VMS	W

Summary

The assessment against the Personnel Onshore criterion is based on the results of the HAZID for the various onshore operations for each option and is as follows:
Option 1 is assessed as being very much stronger than both Option 3a and Option 3b as there is much less material being returned to shore so small onshore scope leading to less risk exposure than either of these options. These full removal options also have a potential MAH identified.
Option 3a is assessed as being weaker than Option 3b as there are multiple lifting operations associated with handling the cut sections of pipeline resulting in higer risk exposure.

Overall, Option 1 is the preferred option from a risk to Onshore Personnel perspective.

1. Safety – 1.3 Other Users

1 - Minimal Intervention - Remove exposed ends

R = 0
O = 2
Y = 0
G = 0
Total = 0

Severity	Likelihood				
	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	2				
4					
3					
2					
1					
0					

3a - Full Removal - Cut and recover

R = 0
O = 2
Y = 0
G = 0
Total = 0

Severity	Likelihood				
	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	2				
4					
3					
2					
1					
0					

3b - Full Removal - Reverse installation

R = 0
O = 2
Y = 0
G = 0
Total = 0

Severity	Likelihood				
	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	2				
4					
3					
2					
1					
0					

N	N	N

Summary

The assessment against the Other Users criterion is based on the results of the HAZID for the various offshore operations for each option and is as follows:
The localised and transient obstruction to fishing vessels and shipping will be present in all options. The results of the HAZID for the impact to other users for each option is as follows:
All options are assessed as being neutral against each other as the risk exposure to other users is similar for all options.

Overall, all options are equally preferred from a risk to Other Users perspective. Note: HAZID concluded that the risk profile would be the same for all options as any collision with a vessel is highly unlikely based on the equipment used be all vessels.

1. Safety – 1.4 Residual Risk

1 - Minimal Intervention - Remove exposed ends

R = 0
O = 5
Y = 8
G = 0
Total = 13

Severity	Likelihood				
	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	5				
4	3				
3		2			
2		3			
1					
0					

3a - Full Removal - Cut and recover

R = 0
O = 0
Y = 0
G = 0
Total = 0

Severity	Likelihood				
	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5					
4					
3					
2					
1					
0					

3b - Full Removal - Reverse installation

R = 0
O = 0
Y = 0
G = 0
Total = 0

Severity	Likelihood				
	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5					
4					
3					
2					
1					
0					

W	W	N

Summary

The assessment against the Residual Risk criterion is based on the results of the HAZID for the legacy operations is as follows:
Option 1 is assessed as being weaker than both Option 3a and Option 3b as the risk exposure is higher due to the potential for a snag hazard associated with the equipment left in-situ versus no potential for a snag hazard from the full removal options. Option 1 also has a legacy risk exposure associated with the requirement to monitor and potentially remediate the equipment left in-situ.
Option 3a is assessed as being neutral to Option 3b as there is no residual risk associated with these full removal options.

Overall, both Option 3a and Option 3b would be equally preferred from a Residual Risk perspective.

		1 - Minimal Intervention - Remove exposed ends		3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation
2. Environmental	2.1 Impact of Decommissioning Operations Offshore	Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 245 dB / 3.5 TPa^2s Subsea Cutting: 0.5 days Vessel Emissions (CO_2): 3,347 tonnes Vessel Fuel Use: 1,056 tonnes		Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 253 dB / 18.3 TPa^2s Subsea Cutting: 40.13 days MFE: 9.61 days Vessel Emissions (CO_2): 21,797 tonnes Vessel Fuel Use: 6,876 tonnes	Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 250 dB / 10.8 TPa^2s Subsea Cutting: 0.5 days MFE: 9.61 days Vessel Emissions (CO_2): 5,387 tonnes Vessel Fuel Use: 1,699 tonnes
		S	**N**	**W**	
	Summary	The assessment against the Impact of Decommissioning Operations Offshore criterion is as follows: Option 1 is assessed as being stronger than Option 3a as it requires significantly less fuel and generates significantly lower atmospheric emissions. Option 1 is assessed as neutral to Option 3b as, whilst there are differences, these are deemed insufficient to move from neutral. Option 3a is assessed as being weaker than Option 3b as it requires significantly more fuel and generates significantly higher atmospheric emissions. Overall, Option 1 is the preferred option from an Impact of Decommissioning Operations Offshore perspective.			
2. Environmental	2.2 Processing of Returned Materials	Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted: Concrete Coated Steel Pipe: 16 tonnes Rigid Steel Pipe: 4.5 tonnes Concrete Mattresses: 230 tonnes Grout Bags: 3.3 tonnes		Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted: Concrete Coated Steel Pipe: 16 tonnes Rigid Steel Pipe: 1,958 tonnes Concrete Mattresses: 230 tonnes Grout Bags: 3.3 tonnes	Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted: Concrete Coated Steel Pipe: 16 tonnes Rigid Steel Pipe: 1,958 tonnes Concrete Mattresses: 230 tonnes Grout Bags: 3.3 tonnes
		MS	**MS**	**N**	
	Summary	The assessment against the Processing of Returned Materials criterion is as follows: Option 1 is assessed as being much stronger than both Option 3a and Option 3b as there much less material being returned onshore for processing / placed in landfill. Option 3a is assessed as being neutral to Option 3b as both will result in the same volume of material being returned onshore for processing / placed in landfill. Overall, Option 1 would be the preferred option from a Processing of Returned Materials perspective.			
2. Environmental	2.3 Resource Consumption	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock for Rock cover: 400 tonnes (cut ends only) Emissions for replacement material (CO_2): 3,489 tonnes Emissions from recovered material (CO_2): 105 tonnes		Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock for Rock cover: N/A Emissions for replacement material (CO_2): 0 tonnes Emissions from recovered material (CO_2): 1,948 tonnes	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock for Rock cover: N/A Emissions for replacement material (CO_2): 0 tonnes Emissions from recovered material (CO_2): 1,948 tonnes
		MW	**MW**	**N**	
	Summary	The assessment against the Resource Consumption criterion is as follows: Option 1 is assessed as being much weaker than both Option 3a and Option 3b as there is a requirement to replace the left in-situ pipeline material and there is also a small amount of rock required for the rock cover. Option 3a is assessed as being neutral to Option 3b as there is no requirement for replacement material or rock for rock cover under the full removal options. Overall, Option 3a and Option 3b would be equally preferred from a Resource Consumption perspective.			
2. Environmental	2.4 Disturbance	Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from introducing the rock cover over the cut ends of the pipeline. The area of impact is as follows: Seabed Disturbance: 200 m^2		Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from removing the entire line. The area of impact is as follows: Seabed Disturbance: 46,120 m^2	Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from removing the entire line. The area of impact is as follows: Seabed Disturbance: 46,120 m^2
		MS	**S**	**W**	
	Summary	The assessment against the Seabed Disturbance (short-term impact) criterion is as follows: Option 1 is assessed as being much stronger than Option 3a due to limited seabed disturbance associated with removing the line ends and leaving the remainder of the lines in-situ (already trenched and buried) versus the significant seabed disturbance from the deburial and cutting of lines into short sections and removal. Option 1 is assessed as being stronger than Option 3b for similar reasons, however the seabed disturbance from reverse installation of the lines is expected to be lower than cut and recover. Option 3a is assessed as being weaker than Option 3b as there will be less seabed disturbance from reverse installation than the cutting and removal option. Overall, Option 1 is the preferred option from a Disturbance perspective.			
2. Environmental	2.5 Loss of Habitat	Whilst the environmental impact in terms of Loss of Habitat (long-term impact) is assessed as 'low' for this option, there is an impact from introducing rock cover at the pipeline ends which will permanently alter the habitat type and will therefore impact the benthic community. There is no additional permanent impact from leaving the pipelines in place as they are already trenched and buried. The area of impact is as follows: Rock cover: 200 m^2		There are no long-term impacts or loss of habitats expected from the cut and recover full removal of the pipelines.	There are no long-term impacts or loss of habitats expected from the reverse installation full removal of the pipelines.
		W	**W**	**N**	
	Summary	The assessment against the Loss of Habitat (legacy / long-term) criterion is as follows: Option 1 is assessed as being weaker than both Option 3a and Option 3b as there will be a small amount of permanent habitat loss from the rock cover introduced at the cut ends of the pipelines versus the full removal options. Option 3a is assessed as being neutral to Option 3b as there is no habitat loss associated with the full removal options. Overall, Option 3a and Option 3b would be equally preferred from a Loss of Habitat perspective.			

		1 - Minimal Intervention - Remove exposed ends		3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation
3. Technical	3.1 Technical Risk	**Feasibility:-** High **Concept Maturity:-** High **Availability of Technology:-** High - All vessels and equipment widely available **Track Record:-** High - Operations considered routine **Risk of Failure:-** Low **Consequence of Failure:-** Limited impact to cost and schedule		**Feasibility:-** Medium **Concept Maturity:-** High **Availability of Technology:-** High - Numerous contractors offering MFE and numerous contractors offering cut and lift **Track Record:-** Low - Routine operation but track record low for size and length of pipeline that is already trenched & buried **Risk of Failure:-** High - Considered challenging over large distance. May require diver support. Extended subsea works & simultaneous operations. **Consequence of Failure:-** Failure would result in significant cost and schedule impact / requirement for alternative decommissioning method	**Feasibility:-** High - Deburial could be challenging (if required) but the reeling of cables pipelines from the seabed is feasible, subject to line integrity. **Concept Maturity:-** High - We know exactly what the procedural steps would be to complete this operation and the concept is mature **Availability of Technology:-** High - Numerous contractors offering MFE; deck carousel may be used for 8" un-weight coated pipe, reel vessel not necessary **Track Record:-** Med - Routine installation operation but limited track record of reverse reeling in North Sea for decommissioning over extended distance. Limited track record of MFE unburial over extended distance. **Risk of Failure:-** Med - Pipeline / umbilical integrity unknown **Consequence of Failure:-** Failure would result in significant cost and schedule impact / requirement for alternative decommissioning method
		MS	**MS**	**W**	
	Summary	The assessment against the Technical Risk criterion is as follows: Option 1 is assessed as being much stronger than both Option 3a and Option 3b as removing the ends of the lines is much less technically challenging than performing either cut and lift or reverse installation of lines at this scale. Option 3a is assessed as being weaker than Option 3b as cut and lift is considered more technically challenging than reverse reel. Overall, Option 1, is the preferred option from a Technical Risk perspective.			
4. Societal	4.1 Impact on Commercial Fisheries	Whilst the majority of the pipelines will be left in-situ, theses are currently trenched and buried. As such, the area returned for fishing operations is that current occupied by the exposed ends of the pipelines.		Whilst full removal of the pipelines returns the full area for fishing operations, the current impact is minimal as the pipelines are trenched and buried.	Whilst full removal of the pipelines returns the full area for fishing operations, the current impact is minimal as the pipelines are trenched and buried.
		N	**N**	**N**	
	Summary	The assessment against the Impact on Commercial Fisheries criterion is as follows: All options are assessed as being neutral to each other. This is due to the full area being returned for commercial fishing operations under all options. Overall, all options are equally preferred from an Impact on Commercial Fisheries perspective.			
4. Societal	4.2 Socio-economic impact on communities and amenities	Relatively minor quantities of material returned: Concrete Coated Steel Pipe: 16 tonnes Rigid Steel Pipe: 4.5 tonnes Concrete Mattresses: 230 tonnes Grout Bags: 3.3 tonnes This results in limited negative impacts on communities. The returned steel is recyclable, the concrete mattresses could potentially be reused, the grout bags and a small amount of concrete from the pipeline coating likely to go to landfill. Job creation / retention minimal due to relatively low (around 30,000) man-hours to deliver this this option.		Mainly minor quantities of material returned, large quantity of rigid steel pipe: Concrete Coated Steel Pipe: 16 tonnes Rigid Steel Pipe: 1,958 tonnes Concrete Mattresses: 230 tonnes Grout Bags: 3.3 tonnes This results in moderate negative impacts on communities, largely relating to the transportation and handling of the rigid pipe. The returned steel is recyclable, the concrete mattresses could potentially be reused, the grout bags and a small amount of concrete from the pipeline coating likely to go to landfill. Job creation / retention is notable due to the (around 206,000) man-hours to deliver this option.	Mainly minor quantities of material returned, large quantity of rigid steel pipe: Concrete Coated Steel Pipe: 16 tonnes Rigid Steel Pipe: 1,958 tonnes Concrete Mattresses: 230 tonnes Grout Bags: 3.3 tonnes This results in minor negative impacts on communities as whilst there is a large quantity of rigid pipe being retuned, this is handled on reel(s), thus the transportation impact will be more limited. The returned steel is recyclable, the concrete mattresses could potentially be reused, the grout bags and a small amount of concrete from the pipeline coating likely to go to landfill. Job creation / retention is minimal due to the low (around 55,000) man-hours to deliver this this option.
		W	**S**	**S**	
	Summary	The assessment against the Socio-economic criterion is as follows: Option 1 is assessed as being weaker than Option 3a as, whilst there is a higher negative impact from the return and transportation of large quantities of materials with Option 3a, this is more than offset by the benefits associated with job creation and retention from the delivery of this option. Option 1 is assessed as being stronger than Option 3b as there is lower negative impact as less material is returned. Option 3a is assessed as being stronger than Option 3b as, whilst the negative impact from the returned material is higher (more transportation loads), this is more than offset by the benefits associated with job creation and retention from the delivery of this option. Overall, Option 3a is the preferred option from a Socio-economic impact on communities and amenities perspective.			
5. Economic	5.1 Short-term Costs	Initial operation cost: £3.2 million		Initial operation cost: £41.5 million	Initial operation cost: £17.1 million
		VMS	**VMS**	**MW**	
	Summary	The assessment against the Short-term Costs criterion is as follows: Option 1 is assessed as being very much stronger than Option 3a as the costs are more than 10 times higher. Option 1 is assessed as being very much stronger than Option 3b as the costs are more than five times higher. Option 3a is assessed as being much weaker than Option 3b as the costs are around 4 times higher. Overall, Option 1, would be the preferred option from a Short-term Costs perspective.			
	5.2 Long-term Costs	Legacy cost (survey & monitoring): £420,000 Potential legacy cost (remediation): £500,000 Total legacy cost: £920,000		Legacy cost (survey & monitoring): N/A Potential legacy cost (remediation): N/A Total legacy cost: N/A There are no legacy costs associated with this full removal option.	Legacy cost (survey & monitoring): N/A Potential legacy cost (remediation): N/A Total legacy cost: N/A There are no legacy costs associated with this full removal option.
		MW	**MW**	**N**	
	Summary	The assessment against the Long-term Costs criterion is as follows: Option 1 is assessed as being much weaker than both Option 3a and Option 3b as there are legacy costs associated with monitoring the equipment left in-situ versus no long-term costs associated with the full removal options. Option 3a is assessed as being neutral to Option 3b as there are no long-term costs associated with the full removal options. Overall, Option 3a and Option 3b would be equally preferred options from a Long-term Costs perspective.			

Appendix E.2 Group 4 Pairwise Comparison Matrices – Safety

1.1 Personnel Offshore	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MS	MS	60%
3a - Full Removal - Cut and recover	MW	N	W	17%
3b - Full Removal - Reverse installation	MW	S	N	23%

1.2 Personnel Onshore	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	VMS	VMS	82%
3a - Full Removal - Cut and recover	VMW	N	W	8%
3b - Full Removal - Reverse installation	VMW	S	N	10%

1.3 Other Users	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	N	33%
3a - Full Removal - Cut and recover	N	N	N	33%
3b - Full Removal - Reverse installation	N	N	N	33%

1.4 Residual Risk	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	W	W	25%
3a - Full Removal - Cut and recover	S	N	N	38%
3b - Full Removal - Reverse installation	S	N	N	38%

Appendix E.3 Group 4 Pairwise Comparison Matrices – Environment / Technical

2.1 Impact of Decommissioning Operations Offshore	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	S	N	38%
3a - Full Removal - Cut and recover	W	N	W	25%
3b - Full Removal - Reverse installation	N	S	N	38%

2.2 Processing of Returned Materials	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MS	MS	60%
3a - Full Removal - Cut and recover	MW	N	N	20%
3b - Full Removal - Reverse installation	MW	N	N	20%

2.3 Resource Consumption	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MW	MW	14%
3a - Full Removal - Cut and recover	MS	N	N	43%
3b - Full Removal - Reverse installation	MS	N	N	43%

2.4 Disturbance	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MS	S	51%
3a - Full Removal - Cut and recover	MW	N	W	19%
3b - Full Removal - Reverse installation	W	S	N	31%

2.5 Loss of Habitat	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	W	W	25%
3a - Full Removal - Cut and recover	S	N	N	38%
3b - Full Removal - Reverse installation	S	N	N	38%

3. Technical	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MS	MS	60%
3a - Full Removal - Cut and recover	MW	N	W	17%
3b - Full Removal - Reverse installation	MW	S	N	23%

Appendix E.4 Group 4 Pairwise Comparison Matrices – Societal / Economic

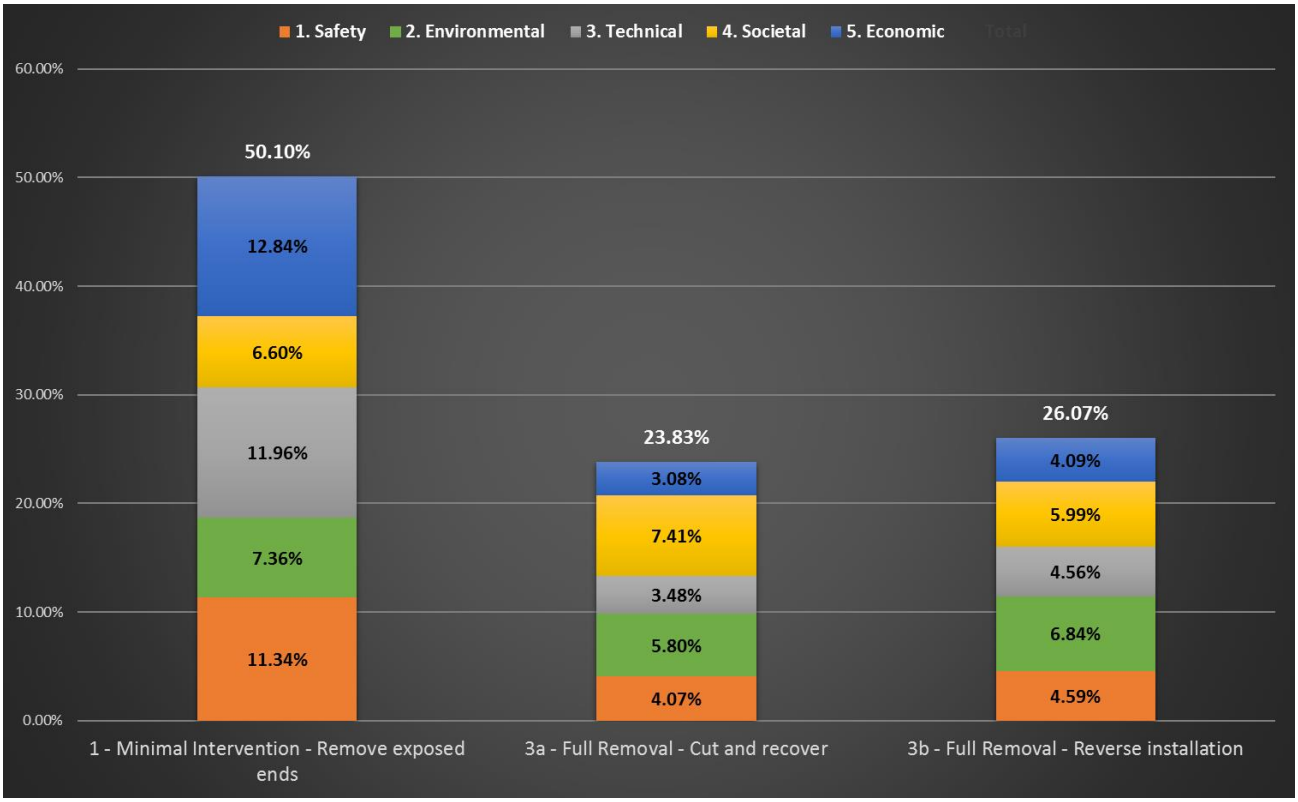
4.1 Impact on Commercial Fisheries	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	N	33%
3a - Full Removal - Cut and recover	N	N	N	33%
3b - Full Removal - Reverse installation	N	N	N	33%

4.2 Socio-economic impact on communities and amenities	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	W	S	33%
3a - Full Removal - Cut and recover	S	N	S	43%
3b - Full Removal - Reverse installation	W	W	N	25%

5.1 Short-term Costs	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	VMS	VMS	81%
3a - Full Removal - Cut and recover	VMW	N	MW	6%
3b - Full Removal - Reverse installation	VMW	MS	N	13%

5.2 Long-term Costs	1 - Minimal Intervention - Remove exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MW	MW	14%
3a - Full Removal - Cut and recover	MS	N	N	43%
3b - Full Removal - Reverse installation	MS	N	N	43%

Appendix E.5 Group 4 Results Chart



APPENDIX F GROUP 5 – DETAILED EVALUATION RESULTS

Appendix F.1 Group 5 Attributes Table

1. Safety

1.1 Personnel Offshore

	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover
R	0	0	0	0	0
O	6	9	7	8	8
Y	10	9	10	13	8
G	4	3	4	4	1
Total	20	21	21	25	17

Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	1				
4		5			
3	1	3			
2	3	6			
1		1			
0					

1 - Remove exposed ends				2a - Remove exposed ends & exposures			2b - Rock cover exposed ends & exposures		2c - Trench and bury exposed ends & exposures		3a - Full Removal - Cut and recover
S	N	S	S	W	W	N	S	S	S		

Summary

The assessment against the Personnel Offshore criterion is based on the results of the HAZID for the various offshore operations for each option and is as follows:
Option 1 is assessed as being stronger than Option 2a as it has less risk exposure due to smaller offshore scope. Option 1 is assessed as being neutral to Option 2b as they have similar risk exposure due to similar offshore scopes. Option 1 is assessed as being stronger than Option 2c as it has less risk exposure due to smaller offshore scope.
Option 1 is assessed as being stronger than Option 3a as it has less risk exposure due to smaller offshore scope and the additional risk exposure associated with the lifting and onboarding operations with Option 3a..
Option 2a is assessed as being weaker than both Option 2b and Option 2c as the risk exposure is higher due to greater offshore scope. Option 2a is assessed as being neutral to Option 3a as the risk exposure is similar.
Option 2b is assessed as being stronger than both Option 2c and Option 3a as the risk exposure is lower due to smaller offshore scope.
Option 2c is assessed as being stronger than Option 3a as it has less risk exposure due to the lifting and onboarding operations associated with Option 3a.

Overall, Option 1 and Option 2b would be equally preferred options from a risk to Offshore Personnel perspective. Note: No MAH were identified for any options from an offshore operations perspective.

1.2 Personnel Onshore

	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover
R	0	0	0	0	0
O	2	8	2	2	8
Y	11	7	11	11	7
G	2	0	2	2	0
Total	15	15	15	15	15

Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5					
4	4				
3	2	3			
2	1		2	2	
1		1			
0					

1 - Remove exposed ends				2a - Remove exposed ends & exposures			2b - Rock cover exposed ends & exposures		2c - Trench and bury exposed ends & exposures		3a - Full Removal - Cut and recover
S	N	N	S	W	W	N	N	S	S		

Summary

The assessment against the Personnel Onshore criterion is based on the results of the HAZID for the various onshore operations for each option and is as follows:
Option 1 is assessed as being stronger than Option 2a as it has less risk exposure due to smaller scope. Option 1 is assessed as being neutral to both Option 2b and Option 2c as the risk exposure is similar due to similar onshore scopes. Option 1 is assessed as being stronger than Option 3a as it the risk exposure is lower due to smaller onshore scope.
Option 2a is assessed as being weaker than both Option 2b and Option 2c as the risk exposure is higher due to greater onshore scope. Option 2a is assessed as being neutral to Option 3a as the risk exposure is similar due to similar onshore scopes.
Option 2b is assessed as being neutral to Option 2c as the risk exposure is similar due to similar onshore scopes. Option 2b is assessed as being stronger than Option 3a as the risk exposure is lower due to smaller onshore scope.
Option 2c is also assessed as being stronger than Option 3a as the risk exposure is lower due to smaller onshore scope.

Overall, Options 1, 2b and 2c would be equally preferred options from a risk to Onshore Personnel perspective.

1.3 Other Users

	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover
R	0	0	0	0	0
O	2	2	2	2	2
Y	0	0	0	0	0
G	0	0	0	0	0
Total	2	2	2	2	2

Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	2				
4					
3					
2					
1					
0					

1 - Remove exposed ends				2a - Remove exposed ends & exposures			2b - Rock cover exposed ends & exposures		2c - Trench and bury exposed ends & exposures		3a - Full Removal - Cut and recover
N	N	N	N	N	N	N	N	N	N		

Summary

The assessment against the Other Users criterion is based on the results of the HAZID for the various offshore operations for each option and is as follows:
All option are assessed as being neutral to each other as the risk to other users is considered the same for all options.

Overall, all options are equally preferred from a risk to Other Users perspective. Note: HAZID concluded that the risk profile would be the same for all options as any collision with a vessel is highly unlikely based on the equipment used by all vessels.

1. Safety — 1.4 Residual Risk

1 - Remove exposed ends

R = 2
O = 4
Y = 7
G = 0
Total = 13

Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	🟧 4	🟧	🟥 1	🟥	🟥
4	🟨 2	🟧	🟧	🟥 1	🟥
3	🟨	🟨 2	🟧	🟧	🟥
2	🟩	🟨 3	🟨	🟧	🟧
1	🟩	🟩	🟨	🟨	🟧
0	🟩	🟩	🟩	🟩	🟩

2a - Remove exposed ends & exposures

R = 0
O = 5
Y = 8
G = 0
Total = 13

Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	🟧 5	🟧	🟥	🟥	🟥
4	🟨 3	🟧	🟧	🟥	🟥
3	🟨	🟨 2	🟧	🟧	🟥
2	🟩	🟨 3	🟨	🟧	🟧
1	🟩	🟩	🟨	🟨	🟧
0	🟩	🟩	🟩	🟩	🟩

2b - Rock cover exposed ends & exposures

R = 1
O = 5
Y = 7
G = 0
Total = 13

Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	🟧 4	🟧 1	🟥	🟥	🟥
4	🟨 2	🟧	🟧	🟥 1	🟥
3	🟨	🟨 2	🟧	🟧	🟥
2	🟩	🟨 3	🟨	🟧	🟧
1	🟩	🟩	🟨	🟨	🟧
0	🟩	🟩	🟩	🟩	🟩

2c - Trench and bury exposed ends & exposures

R = 0
O = 5
Y = 8
G = 0
Total = 13

Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	🟧 5	🟧	🟥	🟥	🟥
4	🟨 3	🟧	🟧	🟥	🟥
3	🟨	🟨 2	🟧	🟧	🟥
2	🟩	🟨 3	🟨	🟧	🟧
1	🟩	🟩	🟨	🟨	🟧
0	🟩	🟩	🟩	🟩	🟩

3a - Full Removal - Cut and recover

R = 0
O = 0
Y = 0
G = 0
Total = 0

Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	🟧	🟧	🟥	🟥	🟥
4	🟨	🟧	🟧	🟥	🟥
3	🟨	🟨	🟧	🟧	🟥
2	🟩	🟨	🟨	🟧	🟧
1	🟩	🟩	🟨	🟨	🟧
0	🟩	🟩	🟩	🟩	🟩

W	N	MW	MW	S	W	MW	W	MW	W

Summary

The assessment against the Residual Risk criterion is based on the results of the HAZID for the legacy operations is as follows:
Option 1 is assessed as being weaker than Option 2a due to the increased residual risk from higher amounts of rock cover. Note: Option 1 has 2 potential MAH, Option 2a has none. Option 1 is assessed as being Neutral to Option 2b as the residual risk from the rock cover is considered similar. Note: Option 1 has 2 potential MAH, Option 2b has 1.
Option 1 is assessed as being much weaker than Option 2c due to the residual risk from the rock cover being higher. Note: Option 1 has 2 potential MAH, Option 2c has none. Option 1 is assessed as being much weaker than Option 3a due to the residual risk from the rock cover being higher than the full removal option where the residual risk is zero.
Option 2a is assessed as being stronger than Option 2b due to the residual risk from the rock cover being lower. Note: Option 2a has no potential MAH, Option 2b has 1. Option 2a is assessed as being weaker than Option 2c due to the residual risk from the rock cover being higher. Option 2a is assessed as being much weaker than Option 3a as the residual risk is higher than the full removal option.
Option 2b is assessed as being weaker than Option 2c as the residual risk from rock cover is higher than the trenched and buried option. Note: Option 2b has 1 potential MAH, Option 2c has none. Option 2b is assessed as being much weaker than Option 3a due to the residual risk from the rock cover being higher than the full removal option where the residual risk is zero.
Option 2c is assessed as being weaker than Option 3a due to the residual risk from fully trenched and buried lines being higher than the full removal option where the residual risk is zero.

Overall, Option 3a is the preferred option from a Residual Risk perspective.

2. Environmental — 2.1 Impact of Decommissioning Operations Offshore

1 - Remove exposed ends

Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted:

Vessel Noise: 245 dB / 3.6 TPa^2s
Subsea Cutting: 0.5 days

Vessel Emissions (CO_2): 2,938 tonnes

Vessel Fuel Use: 927 tonnes

2a - Remove exposed ends & exposures

Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted:

Vessel Noise: 247 dB / 5.2 TPa^2s
Subsea Cutting: 5.96 days

Vessel Emissions (CO_2): 3,666 tonnes

Vessel Fuel Use: 1,156 tonnes

2b - Rock cover exposed ends & exposures

Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted:

Vessel Noise: 245 dB / 3.6 TPa^2s
Subsea Cutting: 0.5 days

Vessel Emissions (CO_2): 2,938 tonnes

Vessel Fuel Use: 927 tonnes

2c - Trench and bury exposed ends & exposures

Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted:

Vessel Noise: 248 dB / 6.1 TPa^2s
Subsea Cutting: 0.5 days
Trenching Ops:- 1 day

Vessel Emissions (CO_2): 3,211 tonnes

Vessel Fuel Use: 1,013 tonnes

3a - Full Removal - Cut and recover

Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted:

Vessel Noise: 247 dB / 4.6 TPa^2s
Subsea Cutting: 7.17 days
MFE Ops:- 1.71 days

Vessel Emissions (CO_2): 6,717 tonnes

Vessel Fuel Use: 2,119 tonnes

N	N	N	S	N	N	S	N	S	S

Summary

The assessment against the Impact of Decommissioning Operations Offshore criterion is as follows:
Option 1 is assessed as being neutral to Option 2a, Option 2b and Option 2c as, whilst there are differences in the quantities of environmental impacts, these are considered insufficient to differentiate. Option 1 is assessed as being stronger than Option 3a as the increased impact (whilst still low) associated with Option 3a is considered sufficient to indicate a minor preference.
Option 2a is assessed as being neutral to Option 2b and Option 2c and stronger than Option 3a for similar reasons.
Option 2b is assessed as being neutral to Option 2c and stronger than Option 3a for similar reasons.
Option 2c is assessed as being stronger than Option 3a for similar reasons.

Overall, Options 1, 2a, 2b and 2c would be equally preferred options from a Impact of Decommissioning Operations Offshore perspective.

2. Environmental — 2.2 Processing of Returned Materials

1 - Remove exposed ends

Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted:

Concrete Coated Steel Pipe: 108 tonnes
Concrete Mattresses: 108 tonnes
Grout Bags: 5 tonnes

2a - Remove exposed ends & exposures

Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted:

Concrete Coated Steel Pipe: 408 tonnes
Concrete Mattresses: 108 tonnes
Grout Bags: 5 tonnes

2b - Rock cover exposed ends & exposures

Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted:

Concrete Coated Steel Pipe: 108 tonnes
Concrete Mattresses: 108 tonnes
Grout Bags: 5 tonnes

2c - Trench and bury exposed ends & exposures

Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted:

Concrete Coated Steel Pipe: 108 tonnes
Concrete Mattresses: 108 tonnes
Grout Bags: 5 tonnes

3a - Full Removal - Cut and recover

Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted:

Concrete Coated Steel Pipe: 1,487 tonnes
Concrete Mattresses: 108 tonnes
Grout Bags: 5 tonnes

N	N	N	S	N	N	S	N	S	S

Summary

The assessment against the Processing of Returned Materials criterion is as follows:
Option 1 is assessed as being neutral to Option 2a, Option 2b and Option 2c as similar quantities of material will be returned to shore for processing. Option 1 is assessed as being stronger than Option 3a as a lower volume of material will be returned for processing than the full removal option.
Option 2a is assessed as being neutral to Option 2b and Option 2c as similar quantities of material will be returned to shore for processing. Option 2a is assessed as being stronger than Option 3a as a lower volume of material will be returned for processing than the full removal option.
Option 2b is assessed as being neutral to Option 2c as these options will return the same volumes of material for processing. Option 2b is assessed as being stronger than Option 3a as a lower volume of material will be returned for processing than the full removal option.
Option 2c is assessed as being much stronger than Option 3a for similar reasons.

Overall, Option 1, Option 2a, Option 2b and Option 2c would be equally preferred options from a Processing of Returned Materials perspective.

		1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover
2. Environmental	2.3 Resource Consumption	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: No rock cover. Emissions for replacement material (CO_2): 1,844 tonnes Emissions from recovered material (CO_2): 75 tonnes	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: No rock cover. Emissions for replacement material (CO_2): 1,292 tonnes Emissions from recovered material (CO_2): 326 tonnes	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock cover: 21,500 tonnes Emissions for replacement material (CO_2): 1,844 tonnes Emissions from recovered material (CO_2): 75 tonnes	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: No rock cover. Emissions for replacement material (CO_2): 1,844 tonnes Emissions from recovered material (CO_2): 75 tonnes	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: No rock cover. Emissions for replacement material (CO_2): 0 tonnes Emissions from recovered material (CO_2): 934 tonnes
		N / S / N / W	S / N / W	W / MW	W	
	Summary	The assessment against the Resource Consumption criterion is as follows: Option 1 is assessed as being neutral to Option 2a and Option 2c as neither requires rock cover and they have a similar amounts of material that needs to be replaced. Option 1 is assessed as being stronger than Option 2b as, whilst both have similar amounts of replacement material, Option 2b requires rock cover. Option 1 is assessed as being weaker than Option 3a as there is much more pipeline material needing replaced when compared to the full removal option. Option 2a is assessed as being stronger than Option 2b as, whilst both have similar amounts of replacement material, Option 2b needs rock cover. Option 2a is assessed as being neutral to Option 2c as neither requires rock cover and they have a similar amounts of material that needs to be replaced. Option 2a is assessed as being weaker than Option 3a as there is much more pipeline material needing replaced when compared to the removal option. Option 2b is assessed as being weaker than Option 2c as, whilst both have the same amounts of replacement material, Option 2b needs rock cover. Option 2b is assessed as being much weaker than Option 3a as there is much more pipeline material needing replaced when compared to the removal option and a requirement for rock cover. Option 2c is assessed as being weaker than Option 3a as there is much more pipeline material needing replaced when compared to the removal option. Overall, Option 3a would be the preferred option from a Resource Consumption perspective.				
2. Environmental	2.4 Disturbance	Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from performing the burial operations with the MFE at the cut pipeline ends and the spans. The area of impact is as follows: Seabed Disturbance (MFE): 1,556 m^2	Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from performing the burial operations with the MFE at the cut pipeline ends and where the exposures have been removed. The area of impact is as follows: Seabed Disturbance (MFE): 3,464 m^2	Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from rock covering the spans, exposures and areas of low burial cover. There is further impact from performing the burial operations with the MFE at the cut pipeline ends. The area of impact is as follows: Seabed Disturbance (Rock): 17,057 m^2 Seabed Disturbance (MFE): 952 m^2	Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from performing the burial operations with the MFE at the cut pipeline ends and exposures. The impact is higher for trenching and burying than cut and lift. The area of impact is as follows: Seabed Disturbance (MFE): 3,464 m^2	Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from performing the deburial operations with the MFE to remove the entire line. The area of impact is as follows: Seabed Disturbance (MFE): 7,932 m^2
		S / MS / S / MS	S / N / S	W / W	S	
	Summary	The assessment against the Seabed Disturbance (short-term impact) criterion is as follows: Option 1 is assessed as being stronger than Option 2a and Option 2c due to the smaller area of seabed impacted by the MFE operations. Option 1 is assessed as being much stronger than Option 2b as, whilst the area of MFE operations is greater, this is offset by the additional disturbance caused by the area of rock cover associated with Option 2b. Option 1 is assessed as being much stronger than Option 3a as the cut and lift operations of the full removal option will result in greater seabed disturbance with MFE operations over a greater area. Option 2a is assessed as being stronger than Option 2b as, whilst the area of MFE operations is greater, this is offset by the additional disturbance caused by the area of rock cover associated with Option 2b. Option 2a is assessed as being neutral to Option 2c as the area impacted by MFE operations is the same. Option 2a is assessed as being stronger than Option 3a as the cut and lift operations of the full removal option will result in greater seabed disturbance with MFE operations over a greater area. Option 2b is assessed as being weaker than Option 2c as the smaller area of seabed impacted by MFE operations is offset by the additional disturbance caused by the area of rock cover. Option 2b is assessed as being weaker than Option 3a as the cut and lift operations of the full removal option will result in greater seabed disturbance with MFE operations over a greater area. Option 2c is assessed as being stronger than Option 3a again due to the MFE operations impacting a wider area. Overall, Option 1 is the preferred option from a Disturbance perspective.				
2. Environmental	2.5 Loss of Habitat	There is no long-term environmental impact in terms of Loss of Habitat for this option.	There is no long-term environmental impact in terms of Loss of Habitat for this option.	Whilst the environmental impact in terms of Loss of Habitat (long-term impact) is assessed as 'low' for this option, there is an impact from introducing rock cover at the spans, exposures and areas of low burial cover which will permanently alter the habitat type and will therefore impact the benthic community. The area of impact is as follows: Rock cover: 17,057 m^2	There is no long-term environmental impact in terms of Loss of Habitat for this option.	There is no long-term environmental impact in terms of Loss of Habitat for this option.
		N / MS / N / N	MS / N / N	MW / MW	N	
	Summary	The assessment against the Loss of Habitat (legacy / long-term) criterion is as follows: Option 1, Option 2a, Option 2c and Option 3a are assessed as being neutral to each other as there is no long-term impact or loss of habitat associated with these options. Option 2b is assessed as being much weaker than all other options due to the long-term impact and loss of habitat from the rock cover associated with this option. Overall, Option 1, Option 2a, Option 2c and Option 3a would be equally preferred option from a Loss of Habitat perspective.				
3. Technical	3.1 Technical Risk	**Feasibility:-** High **Concept Maturity:-** High **Availability of Technology:-** High - All vessels and equipment widely available **Track Record:-** High - Operations considered routine **Risk of Failure:-** Low **Consequence of Failure:-** Limited impact to cost and schedule	**Feasibility:-** High **Concept Maturity:-** High **Availability of Technology:-** High - All vessels and equipment widely available **Track Record:-** High - Operations considered routine **Risk of Failure:-** Low **Consequence of Failure:-** Limited impact to cost and schedule	**Feasibility:-** High **Concept Maturity:-** High **Availability of Technology:-** High - All vessels and equipment widely available **Track Record:-** High - Operations considered routine **Risk of Failure:-** Low **Consequence of Failure:-** Limited impact to cost and schedule	**Feasibility:-** Medium - due to mostly buried state of lines **Concept Maturity:-** High **Availability of Technology:-** High - Jetting equipment widely available and trenching widely available **Track Record:-** High - Good track record for jetting and good track record for trenching **Risk of Failure:-** High - Considered challenging to accomplish 0.6m DoC over entire length **Consequence of Failure:-** Failure to achieve target DoC would likely result in additional rock placement in that location. Cost and schedule impact.	**Feasibility:-** Medium - due to mostly buried state of lines **Concept Maturity:-** High **Availability of Technology:-** High - Jetting equipment widely available and cutting and lifting equipment widely available **Track Record:-** Medium -Routine operation but the accumulative length of these pipelines have not been conducted in a single project **Risk of Failure:-** High - Considered challenging over large distance. May require diver support. Extended subsea works & simultaneous operations. **Consequence of Failure:-** Failure would result in significant cost and schedule impact / requirement for alternative decommissioning method.
		N / W / N / S	W / S / S	MS / MS	S	
	Summary	The assessment against the Technical Risk criterion is as follows: Option 1 is assessed as being neutral to Option 2a and Option 2c as the key technical risk relates to the ability to achieve sufficient lowering and burial of the cut ends of the pipeline using MFE techniques which applies to each of these options. Option 1 is assessed as being weaker than the rock cover option as there is no requirement for lowering and burial of the pipeline under this option. Option 1 is assessed as stronger than Option 3a as the technical risk associated with the extended but unproven operations and the potential for requiring an alternative decommissioning method is greater than achieving sufficient lowering and burial of the cut ends of the pipeline using MFE techniques. Option 2a is assessed as being weaker than Option 2b due to the risk associated with achieving sufficient lowering and burial of the cut ends of the pipeline using MFE techniques. Option 2a is assessed as being stronger than Option 2c as the risk of achieving sufficient lowering and burial of the pipeline using MFE techniques where the spans are not removed is greater than where the spans are removed. Option 2a is assessed as being stronger than Option 3a due to the technical risk associated with the extended but unproven operations and the potential for requiring an alternative decommissioning method. Option 2b is assessed as being much stronger than Option 2c and Option 3a as the rock cover option is the least technically risky of the options. Option 2c is assessed as being stronger than Option 3a as, whilst achieving sufficient lowering and burial of the pipeline using MFE techniques is challenging, it is less challenging than the extended but unproven operations and the potential for requiring an alternative decommissioning method. Overall, Options 1, Option 2a and Option 2b are equally preferred from a Technical Risk perspective.				

		1 - Remove exposed ends				2a - Remove exposed ends & exposures			2b - Rock cover exposed ends & exposures		2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover
4. Societal	4.1 Impact on Commercial Fisheries	Whilst the majority of the pipelines will be left in-situ, theses are currently trenched and buried. As such, the area returned for fishing operations is that currently occupied by the exposed ends of the pipelines. Existing exposures will remain but will be managed - assumed that fishing operations are currently performed over this line and will continue despite presence of exposures. The spans will be buried.				Whilst the majority of the pipelines will be left in-situ, these are currently trenched and buried. The area returned for fishing operations is that currently occupied by the exposed ends and exposures of the pipeline which will be removed. It is assumed fishing operations will continue over the remaining pipeline.			Whilst the majority of the pipelines will be left in-situ, these are currently trenched and buried. The area returned for fishing operations is that currently occupied by the exposed ends and exposures of the pipeline. It is assumed fishing operations will continue over rock covered areas.		Removal of the exposed pipeline ends and burial of the spans and exposures effectively returns the full area for fishing operations.	Full removal of the pipelines effectively returns the full area for fishing operations.
		W	**W**	**W**	**W**	**S**	**N**	**W**	**W**	**W**	**W**	
	Summary	The assessment against the Impact on Commercial Fisheries criterion is as follows: Option 1 is assessed as being weaker than all other options as, whilst the exposed pipeline ends will be removed and the existing spans buried with MFE, the remixing status would be considered less attractive to commercial fishing operations that the other options. Option 2a is assessed as being stronger than Option 2b as the rock covered pipeline is expected to be less attractive from a commercial fishing operations perspective than leaving the pipeline buried with ends, spans and exposures removed. Option 2a is assessed as being neutral to Option 2c as the as left status if largely similar. Option 2a is assessed as weaker than Option 3a as the line is fully removed. Option 2b is assessed as being weaker than Option 2c and Option 3a due to the line being fully removed. Option 2c is assessed as being weaker than Option 3a for similar reasons. Overall, Option 2a and Option 2c would be equally preferred options from a Impact on Commercial Fisheries perspective.										
4. Societal	4.2 Socio-economic impact on communities and amenities	Relatively minor quantities of material returned: Concrete Coated Steel Pipe: 28 tonnes Concrete Mattresses: 162 tonnes Grout Bags: 4.5 tonnes This results in limited negative impacts on communities. The returned steel is recyclable, the concrete mattresses could potentially be reused, the grout bags and a small amount of concrete from the pipeline coating likely to go to landfill. Job creation / retention minimal due to relatively low (around 26,000) man-hours to deliver this this option.				Relatively minor quantities of material returned: Concrete Coated Steel Pipe: 400 tonnes Concrete Mattresses: 162 tonnes Grout Bags: 4.5 tonnes This results in limited negative impacts on communities. The returned steel is recyclable, the concrete mattresses could potentially be reused, the grout bags and a small amount of concrete from the pipeline coating likely to go to landfill. Job creation / retention minimal due to relatively low (around 40,000) man-hours to deliver this this option.			Relatively minor quantities of material returned: Concrete Coated Steel Pipe: 28 tonnes Concrete Mattresses: 162 tonnes Grout Bags: 4.5 tonnes This results in limited negative impacts on communities. The returned steel is recyclable, the concrete mattresses could potentially be reused, the grout bags and a small amount of concrete from the pipeline coating likely to go to landfill. Job creation / retention minimal due to relatively low (around 27,000) man-hours to deliver this this option.		Relatively minor quantities of material returned: Concrete Coated Steel Pipe: 28 tonnes Concrete Mattresses: 162 tonnes Grout Bags: 4.5 tonnes This results in limited negative impacts on communities. The returned steel is recyclable, the concrete mattresses could potentially be reused, the grout bags and a small amount of concrete from the pipeline coating likely to go to landfill. Job creation / retention minimal due to relatively low (around 30,000) man-hours to deliver this this option.	Quantities of material returned: Concrete Coated Steel Pipe: 1,524 tonnes Concrete Mattresses: 162 tonnes Grout Bags: 4.5 tonnes This results in some negative impacts on communities from handling and transporting the returned pipeline. The returned steel is recyclable, the concrete mattresses could potentially be reused, the grout bags and a small amount of concrete from the pipeline coating likely to go to landfill. Job creation / retention higher than other options (around 58,000) man-hours but still relatively low.
		N	**N**	**N**	**S**	**N**	**N**	**S**	**N**	**S**	**S**	
	Summary	The assessment against the Socio-economic criterion is as follows: Option 1, Option 2a, Option 2b and Option 2c are all assessed as being neutral to each other as they all result in similar quantities of material being returned for treatment / dismantling / transport and similar levels of job creation / retention. Option 1, Option 2a, Option 2b and Option 2c are all assessed as being stronger than Option 3a as there is less negative impact on communities than from the transportation of larger quantities of returned material under Option 3a. There is insufficient job creation / retention with Option 3a to offset this negative impact. Overall, Option 1, Option 2a, Option 2b and Option 2c would be equally preferred options from a Socio-economic impact on communities and amenities perspective.										
5. Economic	5.1 Short-term Costs	Initial operation cost: £2.3 million				Initial operation cost: £3.7 million			Initial operation cost: £2.8 million		Initial operation cost: £2.5 million	Initial operation cost: £5.2 million
		MS	**N**	**N**	**VMS**	**W**	**W**	**S**	**N**	**MS**	**VMS**	
	Summary	The assessment against the Short-term Costs criterion is as follows: Option 1 is assessed as being much stronger than Option 2a as the costs are 60% higher. Option 1 is assessed as being neutral to Option 2b and Option2c as the costs are similar. Option 1 is assessed as being very much stronger than Option 3a as the costs are more than double. Option 2a is assessed as being weaker than Option 2b and Option 2c as the costs are around a third higher. Option 2a is assessed as being stronger than Option 3a as the costs are 40% higher. Option 2b is assessed as being neutral to Option 2c as the costs are similar. Option 2b is assessed as being much stronger than Option 3a as the costs are almost double. Option 2c is assessed as being very much stronger than Option 3a as the costs are more than double. Overall, Option 2b would be the preferred option from a Short-term Costs perspective.										
	5.2 Long-term Costs	Legacy cost (survey & monitoring): £330,000 Potential legacy cost (remediation): £500,000 Total legacy cost: £830,000				Legacy cost (survey & monitoring): £330,000 Potential legacy cost (remediation): £500,000 Total legacy cost: £830,000			Legacy cost (survey & monitoring): £330,000 Potential legacy cost (remediation): £500,000 Total legacy cost: £830,000		Legacy cost (survey & monitoring): £330,000 Potential legacy cost (remediation): £500,000 Total legacy cost: £830,000	Legacy cost (survey & monitoring): N/A Potential legacy cost (remediation): N/A Total legacy cost: N/A There are no legacy costs associated with this full removal option.
		N	**N**	**N**	**MW**	**N**	**N**	**MW**	**N**	**MW**	**MW**	
	Summary	The assessment against the Long-term Costs criterion is as follows: Option 1 is assessed as being neutral to Option 2a, Option 2b and Option 2c as the legacy and potential remediation costs are the same. Option 1 is assessed as being much weaker than Option 3a as there are no legacy or potential remediation costs associated with the full removal option. Option 2a is assessed as being neutral to Option 2b and Option 2c as the legacy and potential remediation costs are the same. Option 2a is assessed as being much weaker than Option 3a as there are no legacy or potential remediation costs associated with the full removal option. Option 2b is assessed as being neutral to Option 2c and much weaker than Option 3a for similar reasons as above. Option 2c is assessed as being much weaker than Option 3a as there are no legacy or potential remediation costs associated with the full removal option. Overall, Option 3a would be the preferred option from a Long-term Costs perspective.										

Appendix F.2 Group 5 Pairwise Comparison Matrices – Safety

1.1 Personnel Offshore	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover	Weighting
1 - Remove exposed ends	N	S	N	S	S	25%
2a - Remove exposed ends & exposures	W	N	W	W	N	15%
2b - Rock cover exposed ends & exposures	N	S	N	S	S	25%
2c - Trench and bury exposed ends & exposures	W	S	W	N	S	20%
3a - Full Removal - Cut and recover	W	N	W	W	N	15%

1.2 Personnel Onshore	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover	Weighting
1 - Remove exposed ends	N	S	N	N	S	23%
2a - Remove exposed ends & exposures	W	N	W	W	N	15%
2b - Rock cover exposed ends & exposures	N	S	N	N	S	23%
2c - Trench and bury exposed ends & exposures	N	S	N	N	S	23%
3a - Full Removal - Cut and recover	W	N	W	W	N	15%

1.3 Other Users	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover	Weighting
1 - Remove exposed ends	N	N	N	N	N	20%
2a - Remove exposed ends & exposures	N	N	N	N	N	20%
2b - Rock cover exposed ends & exposures	N	N	N	N	N	20%
2c - Trench and bury exposed ends & exposures	N	N	N	N	N	20%
3a - Full Removal - Cut and recover	N	N	N	N	N	20%

1.4 Residual Risk	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover	Weighting
1 - Remove exposed ends	N	W	N	MW	MW	11%
2a - Remove exposed ends & exposures	S	N	S	W	MW	16%
2b - Rock cover exposed ends & exposures	N	W	N	W	MW	12%
2c - Trench and bury exposed ends & exposures	MS	S	S	N	W	24%
3a - Full Removal - Cut and recover	MS	MS	MS	S	N	37%

Appendix F.3 Group 5 Pairwise Comparison Matrices – Environment / Technical

2.1 Impact of Decommissioning Operations Offshore	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover	Weighting
1 - Remove exposed ends	N	N	N	N	S	21%
2a - Remove exposed ends & exposures	N	N	N	N	S	21%
2b - Rock cover exposed ends & exposures	N	N	N	N	S	21%
2c - Trench and bury exposed ends & exposures	N	N	N	N	S	21%
3a - Full Removal - Cut and recover	W	W	W	W	N	14%

2.2 Processing of Returned Materials	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover	Weighting
1 - Remove exposed ends	N	N	N	N	S	21%
2a - Remove exposed ends & exposures	N	N	N	N	S	21%
2b - Rock cover exposed ends & exposures	N	N	N	N	S	21%
2c - Trench and bury exposed ends & exposures	N	N	N	N	S	21%
3a - Full Removal - Cut and recover	W	W	W	W	N	14%

2.3 Resource Consumption	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover	Weighting
1 - Remove exposed ends	N	N	S	N	W	19%
2a - Remove exposed ends & exposures	N	N	S	N	W	19%
2b - Rock cover exposed ends & exposures	W	W	N	W	MW	12%
2c - Trench and bury exposed ends & exposures	N	N	S	N	W	19%
3a - Full Removal - Cut and recover	S	S	MS	S	N	30%

2.4 Disturbance	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover	Weighting
1 - Remove exposed ends	N	S	MS	S	MS	34%
2a - Remove exposed ends & exposures	W	N	S	N	S	20%
2b - Rock cover exposed ends & exposures	MW	W	N	W	W	12%
2c - Trench and bury exposed ends & exposures	W	N	S	N	S	20%
3a - Full Removal - Cut and recover	MW	W	S	W	N	14%

2.5 Loss of Habitat	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover	Weighting
1 - Remove exposed ends	N	N	MS	N	N	23%
2a - Remove exposed ends & exposures	N	N	MS	N	N	23%
2b - Rock cover exposed ends & exposures	MW	MW	N	MW	MW	8%
2c - Trench and bury exposed ends & exposures	N	N	MS	N	N	23%
3a - Full Removal - Cut and recover	N	N	MS	N	N	23%

3. Technical	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover	Weighting
1 - Remove exposed ends	N	N	W	N	S	19%
2a - Remove exposed ends & exposures	N	N	W	S	S	20%
2b - Rock cover exposed ends & exposures	S	S	N	MS	MS	34%
2c - Trench and bury exposed ends & exposures	N	W	MW	N	S	15%
3a - Full Removal - Cut and recover	W	W	MW	W	N	12%

Appendix F.4 Group 5 Pairwise Comparison Matrices – Societal / Economic

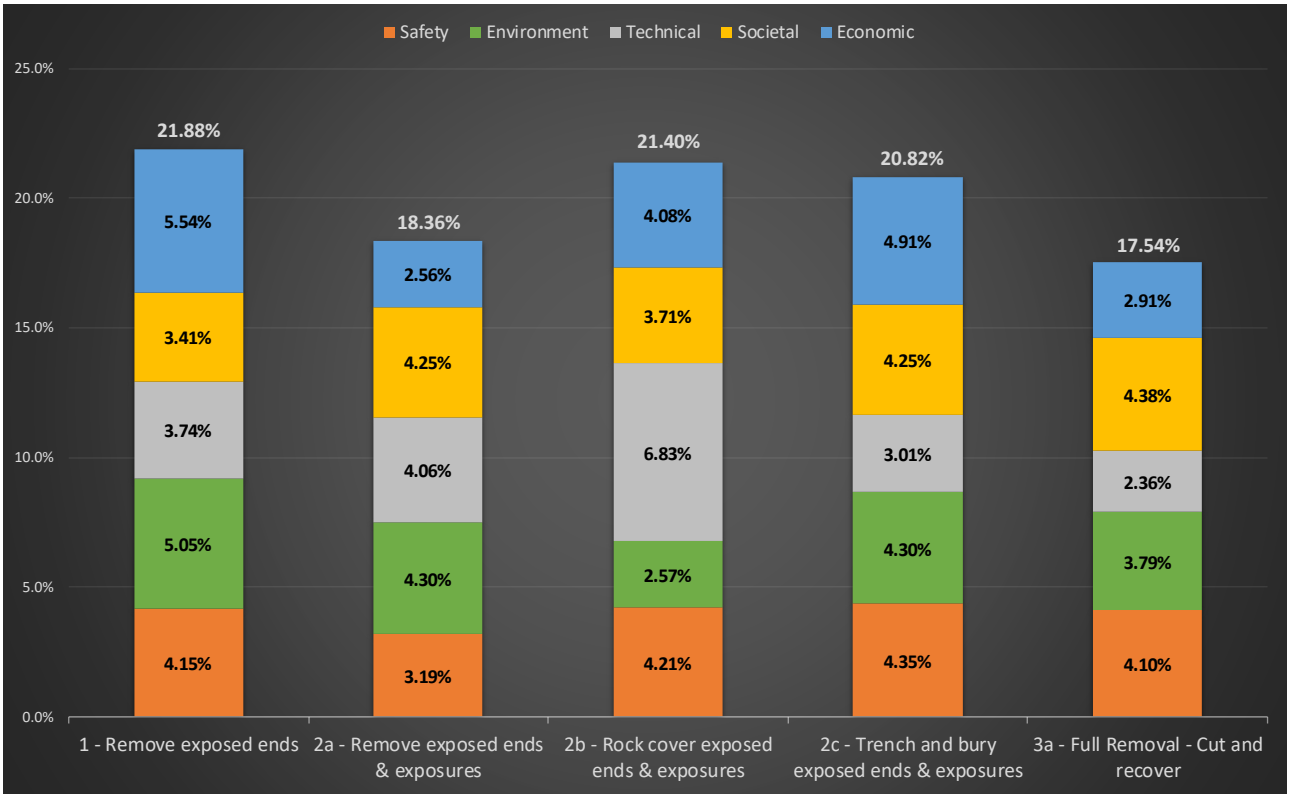
4.1 Impact on Commercial Fisheries	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover	Weighting
1 - Remove exposed ends	N	W	W	W	W	14%
2a - Remove exposed ends & exposures	S	N	S	N	W	21%
2b - Rock cover exposed ends & exposures	S	W	N	W	W	17%
2c - Trench and bury exposed ends & exposures	S	N	S	N	W	21%
3a - Full Removal - Cut and recover	S	S	S	S	N	27%

4.2 Socio-economic impact on communities and amenities	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover	Weighting
1 - Remove exposed ends	N	N	N	N	S	21%
2a - Remove exposed ends & exposures	N	N	N	N	S	21%
2b - Rock cover exposed ends & exposures	N	N	N	N	S	21%
2c - Trench and bury exposed ends & exposures	N	N	N	N	S	21%
3a - Full Removal - Cut and recover	W	W	W	W	N	14%

5.1 Short-term Costs	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover	Weighting
1 - Remove exposed ends	N	MS	N	N	VMS	32%
2a - Remove exposed ends & exposures	MW	N	W	W	S	12%
2b - Rock cover exposed ends & exposures	N	S	N	N	MS	22%
2c - Trench and bury exposed ends & exposures	N	S	N	N	VMS	28%
3a - Full Removal - Cut and recover	VMW	W	MW	VMW	N	5%

5.2 Long-term Costs	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover	Weighting
1 - Remove exposed ends	N	N	N	N	MW	14%
2a - Remove exposed ends & exposures	N	N	N	N	MW	14%
2b - Rock cover exposed ends & exposures	N	N	N	N	MW	14%
2c - Trench and bury exposed ends & exposures	N	N	N	N	MW	14%
3a - Full Removal - Cut and recover	MS	MS	MS	MS	N	43%

Appendix F.5 Group 5 Results Chart



APPENDIX G GROUP 6 – DETAILED EVALUATION RESULTS

Appendix G.1 Group 6 Attributes Table

		1 - Minimal Intervention - Remove exposed ends						3b - Full Removal - Reverse Reeling					
1. Safety	1.1 Personnel Offshore	R = 0 O = 7 Y = 10 G = 4 Total = 21	Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)	R = 0 O = 11 Y = 13 G = 1 Total = 25	Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
			5	2						5	2				
			4		5					4		4	3		
			3	1	3					3		5	1		
			2	3	6					2	1	4	3	1	
			1		1					1			1		
			0							0					
		MS													
Summary		The assessment against the Personnel Offshore criterion is based on the results of the HAZID for the various offshore operations for each option and is as follows: Option 1 is assessed as being much stronger than Option 3b as the scope of work is much shorter leading to less risk exposure. Overall, Option 1 is the preferred option from a risk to Offshore Personnel perspective. Note: No MAH were identified for any options.												
1. Safety	1.2 Personnel Onshore	R = 0 O = 2 Y = 11 G = 2 Total = 15	Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)	R = 1 O = 8 Y = 6 G = 0 Total = 15	Severity	Likelihood: Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
			5							5			1		
			4	4						4	2	1			
			3	2	3					3		2	3		
			2	1		2	2			2		1		3	1
			1		1					1				1	
			0							0					
		MS													
Summary		The assessment against the Personnel Onshore criterion is based on the results of the HAZID for the various onshore operations for each option and is as follows: Option 1 is assessed as being very much stronger than Option 3b as there is less material being returned to shore so small onshore scope leading to less risk exposure than either of these options. Option 3b also has the risk associated with offloading of the reeled lines. Overall, Option 1 would be the preferred option from a risk to Onshore Personnel perspective. Note: Option 3b has one potential MAH.												

		1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling
1. Safety	1.3 Other Users	R = 0 O = 2 Y = 0 G = 0 Total = 2	R = 0 O = 2 Y = 0 G = 0 Total = 2

Severity	Likelihood				
	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	2				
4					
3					
2					
1					
0					

	N
Summary	The assessment against the Other Users criterion is based on the results of the HAZID for the various offshore operations for each option and is as follows: All options are assessed as being neutral against each other as the risk exposure to Other Users from on-site and transit operations is similar for all options. Overall, all options are equally preferred from a risk to Other Users perspective. Note: HAZID concluded that the risk profile would be the same for all options as any collision with a vessel is highly unlikely based on the equipment used be all vessels.

1. Safety	1.4 Residual Risk	R = 0 O = 5 Y = 8 G = 0 Total = 13	

Severity	Likelihood				
	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	5				
4	3				
3		2			
2		3			
1					
0					

	W
Summary	The assessment against the Residual Risk criterion is based on the results of the HAZID for the legacy operations is as follows: Option 1 is assessed as being weaker than Option 3b as there is potential for snag hazard and additional burden in terms of man-hours exposure to monitor and remediate the left in-situ umbilicals / cables versus the full removal option. Overall, Option 3b, is the preferred option from a Residual Risk perspective.

2. Environmental	2.1 Impact of Decommissioning Operations Offshore	Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 246 dB / 4.4 TPa^2s Subsea Cutting: 3.63 days Vessel Emissions (CO_2): 4,417 tonnes Vessel Fuel Use: 1,393 tonnes	Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 251 dB / 11.5 TPa^2s Subsea Cutting: 0.25 day MFE: 14.24 days Vessel Emissions (CO_2): 6,092 tonnes Vessel Fuel Use: 1,922 tonnes

	N
Summary	The assessment against the Impact of Decommissioning Operations Offshore criterion is as follows: Option 1 is assessed as being stronger than Option 3b as, whilst there are differences, these are deemed insufficient to move from neutral. Overall, Option 1 is the preferred option from a Impact of Decommissioning Operations Offshore perspective.

		1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling
2. Environmental	2.2 Processing of Returned Materials	Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted: Umbilicals / Cables: 64 tonnes Concrete Mattresses: 1,445 tonnes Grout Bags: 10 tonnes	Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted: Umbilicals / Cables: 1,107 tonnes Concrete Mattresses: 1,445 tonnes Grout Bags: 10 tonnes
		S	
	Summary	The assessment against the Processing of Returned Materials criterion is as follows: Option 1 is assessed as being stronger than Option 3b as there much less material being returned onshore for processing / placed in landfill. Overall, Option 1 is the preferred option from a Processing of Returned Materials perspective.	
2. Environmental	2.3 Resource Consumption	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock for Rock cover: 600 tonnes (cut ends only) Emissions for replacement material (CO_2): 2,260 tonnes Emissions from recovered material (CO_2): 549 tonnes	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted: Rock for Rock cover: N/A Emissions for replacement material (CO_2): 0 tonnes Emissions from recovered material (CO_2): 1,348 tonnes
		W	
	Summary	The assessment against the Resource Consumption criterion is as follows: Option 1 is assessed as being weaker than Option 3b as there is a requirement to replace the left in-situ pipeline material and there is also a small amount of rock required for the rock cover. Overall, Option 3b is the preferred option from a Resource Consumption perspective.	
2. Environmental	2.4 Disturbance	Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from introducing the rock cover over the cut ends of the umbilicals / cables. The area of impact is as follows: Seabed Disturbance: 300 m^2	Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from full removal of the umbilicals / cables by reverse reeling. The area of impact is as follows: Seabed Disturbance: 64,500 m^2
		S	
	Summary	The assessment against the Seabed Disturbance (short-term impact) criterion is as follows: Option 1 is assessed as being Stronger than Option 3b due to limited seabed disturbance associated with removing the umbilical / cable ends and leaving the remainder in-situ (already trenched and buried) versus the significant seabed disturbance from the reverse reeling option. Overall, Option 1 is the preferred option from a Disturbance perspective.	
2. Environmental	2.5 Loss of Habitat	Whilst the environmental impact in terms of Loss of Habitat (long-term impact) is assessed as 'low' for this option, there is an impact from introducing rock cover at the umbilical / cable ends which will permanently alter the habitat type and will therefore impact the benthic community. There is no additional permanent impact from leaving the umbilicals / cables in place as they are already trenched and buried. The area of impact is as follows: Rock cover: 300 m^2	There are no long-term impacts or loss of habitats expected from the full removal of the umbilicals / cables by reverse reeling.
		W	
	Summary	The assessment against the Loss of Habitat (legacy / long-term) criterion is as follows: Option 1 is assessed as being weaker than Option 3b as there will be a small amount of permanent habitat loss from the rock cover introduced at the cut ends of the umbilicals / cables versus the full removal option. Overall, Option 3b is the preferred option from a Loss of Habitat perspective.	

		1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling
3. Technical	3.1 Technical Risk	**Feasibility:-** High **Concept Maturity:-** High **Availability of Technology:-** High - All vessels and equipment widely available **Track Record:-** High - Operations considered routine **Risk of Failure:-** Low **Consequence of Failure:-** Limited impact to cost and schedule	**Feasibility:-** High **Concept Maturity:-** High **Availability of Technology:-** Med - Generally, vessels and equipment available. MFE spread required. Reel vessel required. **Track Record:-** Med - Routine installation operation but limited track record of reverse reeling in North Sea for decommissioning over extended distance. **Risk of Failure:-** Med – Umbilical / cable integrity unknown **Consequence of Failure:-** Alternate recovery techniques required / cost and schedule impact.
		MS	
	Summary	The assessment against the Technical Risk criterion is as follows: Option 1 is assessed as being much stronger than Option 3b as there is limited track record of reverse reeling umbilicals / cables at this scale and the potential for integrity failure of lines during reverse reeling versus minimal and routine operations for Option 1. There are also uncertainties Overall, Option 1 is the preferred option from a Technical Risk perspective.	
4. Societal	4.1 Impact on Commercial Fisheries	Whilst the majority of the umbilicals / cables will be left in-situ, these are currently trenched and buried. As such, the area returned for fishing operations is that currently occupied by the exposed ends of the pipelines.	Whilst full removal of the umbilicals / cables returns the full area for fishing operations, the current impact is minimal as the umbilicals / cables are trenched and buried.
		W	
	Summary	The assessment against the Impact on Commercial Fisheries criterion is as follows: Option 1 is assessed as weaker than Option 3b as whilst the full area is available for commercial fishing operations under both options, the line is removed under Option 3b. Overall, Option 3b is the preferred option from an Impact on Commercial Fisheries perspective.	
4. Societal	4.2 Socio-economic impact on communities and amenities	Quantities of material returned are: Umbilicals / Cables: 64 tonnes Concrete Mattresses: 1,445 tonnes Grout Bags: 10 tonnes This results in negative impacts on communities, largely driven by the transportation and disposal of the large quantity of concrete mattresses, although these could potentially be reused. The grout bags and a significant percentage of the returned umbilicals / cables are likely to go to landfill. Job creation / retention minimal due to relatively low (around 50,000) man-hours to deliver this this option.	Quantities of material returned are: Umbilicals / Cables: 1,107 tonnes Concrete Mattresses: 1,445 tonnes Grout Bags: 10 tonnes This results in negative impacts on communities from the transportation and disposal of the large quantity of umbilicals / cables and concrete mattresses, although the mattresses could potentially be reused. The grout bags and a significant percentage of the returned umbilicals / cables are likely to go to landfill. Job creation / retention minimal due to relatively low (around 59,000) man-hours to deliver this this option.
		S	
	Summary	The assessment against the Socio-economic criterion is as follows: Option 1 is assessed as being stronger than Option 3b driven by the larger quantity of Umbilical / Cable returned with Option 3b, although the additional impact is expected to minimal due to transporting reeled umbilicals / cables. Overall, Option 1 is the preferred option from a Socio-economic impact on communities and amenities perspective.	

		1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling
5. Economic	5.1 Short-term Costs	Initial operation cost: £7.6 million	Initial operation cost: £9.2 million
		S	
	Summary	The assessment against the Short-term Costs criterion is as follows: Option 1 is assessed as being stronger than Option 3b as the costs are £1.6 million lower. Overall, Option 1 is the preferred option from a Short-term Costs perspective.	
5. Economic	5.2 Long-term Costs	Legacy cost (survey & monitoring): £490,000 Potential legacy cost (remediation): £500,000 Total legacy cost: £990,000	Legacy cost (survey & monitoring): N/A Potential legacy cost (remediation): N/A Total legacy cost: N/A There are no legacy costs associated with this full removal option.
		MW	
	Summary	The assessment against the Long-term Costs criterion is as follows: Option 1 is assessed as being much weaker than Option 3b as there are no legacy or potential remediation costs with Option 3b. Overall, Option 3b would be preferred from a Long-term Costs perspective.	

Appendix G.2 Group 6 Pairwise Comparison Matrices – Safety

1.1 Personnel Offshore	1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MS	75%
3b - Full Removal - Reverse Reeling	MW	N	25%

1.2 Personnel Onshore	1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MS	75%
3b - Full Removal - Reverse Reeling	MW	N	25%

1.3 Other Users	1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	50%
3b - Full Removal - Reverse Reeling	N	N	50%

1.4 Residual Risk	1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling	Weighting
1 - Minimal Intervention - Remove exposed ends	N	W	40%
3b - Full Removal - Reverse Reeling	S	N	60%

Appendix G.3 Group 6 Pairwise Comparison Matrices – Environment / Technical

2.1 Impact of Decommissioning Operations Offshore	1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling	Weighting
1 - Minimal Intervention - Remove exposed ends	N	N	50%
3b - Full Removal - Reverse Reeling	N	N	50%

2.2 Processing of Returned Materials	1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling	Weighting
1 - Minimal Intervention - Remove exposed ends	N	S	60%
3b - Full Removal - Reverse Reeling	W	N	40%

2.3 Resource Consumption	1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling	Weighting
1 - Minimal Intervention - Remove exposed ends	N	W	40%
3b - Full Removal - Reverse Reeling	S	N	60%

2.4 Disturbance	1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling	Weighting
1 - Minimal Intervention - Remove exposed ends	N	S	60%
3b - Full Removal - Reverse Reeling	W	N	40%

2.5 Loss of Habitat	1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling	Weighting
1 - Minimal Intervention - Remove exposed ends	N	W	40%
3b - Full Removal - Reverse Reeling	S	N	60%

3. Technical	1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MS	75%
3b - Full Removal - Reverse Reeling	MW	N	25%

Appendix G.4 Group 6 Pairwise Comparison Matrices – Societal / Economic

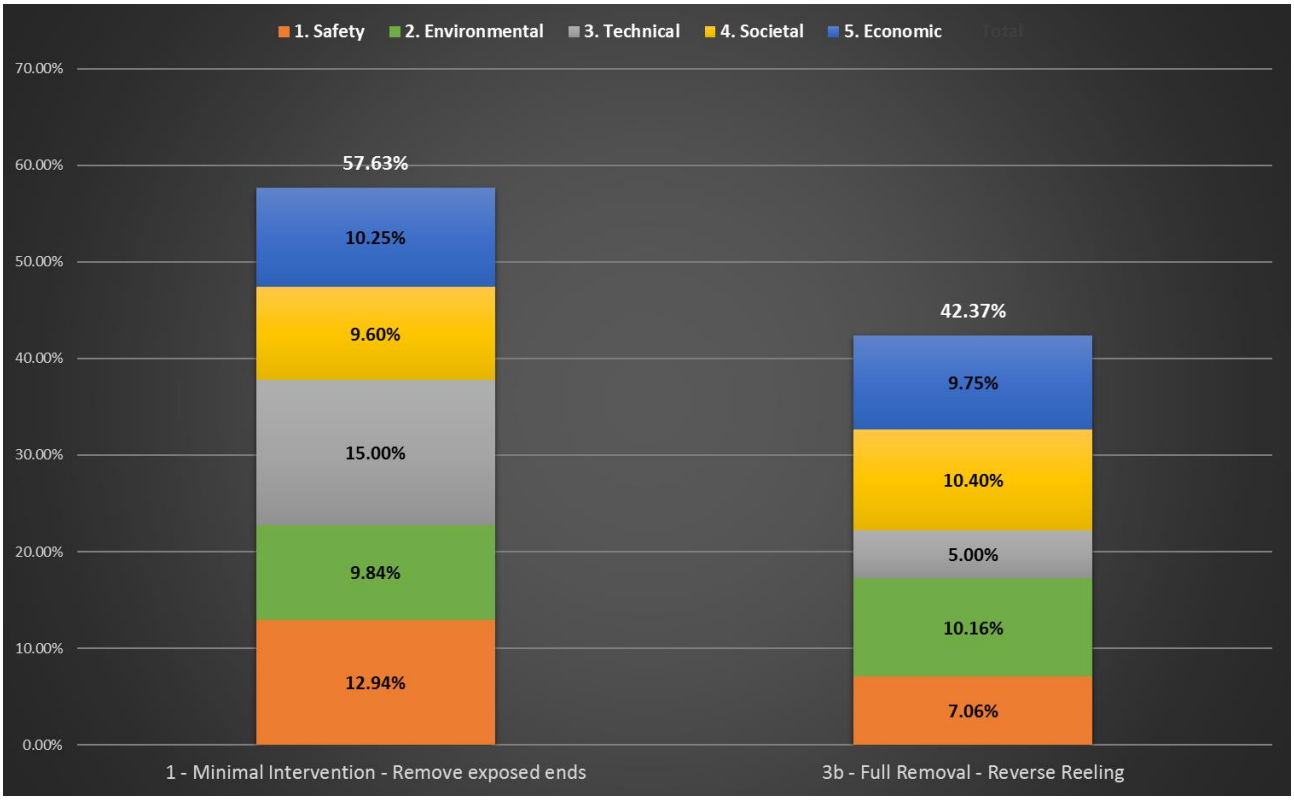
4.1 Impact on Commercial Fisheries	1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling	Weighting
1 - Minimal Intervention - Remove exposed ends	N	W	40%
3b - Full Removal - Reverse Reeling	S	N	60%

4.2 Socio-economic impact on communities and amenities	1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling	Weighting
1 - Minimal Intervention - Remove exposed ends	N	S	60%
3b - Full Removal - Reverse Reeling	W	N	40%

5.1 Short-term Costs	1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling	Weighting
1 - Minimal Intervention - Remove exposed ends	N	S	60%
3b - Full Removal - Reverse Reeling	W	N	40%

5.2 Long-term Costs	1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling	Weighting
1 - Minimal Intervention - Remove exposed ends	N	MW	25%
3b - Full Removal - Reverse Reeling	MS	N	75%

Appendix G.5 Group 6 Results Chart



APPENDIX H GROUP 1 – OPTION DATASHEETS

Appendix H.1 1 – Disconnect / remove ends and minimal remediation

Area	**Fulmar**
Decision / Group	**Group 1: 24" Concrete Coated Pipeline Surface Laid Exposed (PL1315)**
Option	**Option 1: Leave in Situ – Minimal Intervention**

SAFETY				
Offshore Personnel	Number	192	Man Hours	19,728
Diver Requirement	Number	6	Man Hours	1,296
Onshore Personnel	Number	20	Man Hours	2,312
Legacy Risk	Number	76	Man Hours	7,296
Impact to Other Users of the Sea (operational)	Number of Vessels Used	4	Duration of Operations	29
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	8
Potential for High Consequence Events	Low	**Comments**	Routine operations; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	1.48E-03		
Operational Risk Diver	PLL	1.26E-03		
Operational Risk Onshore	PLL	1.40E-05		
Legacy Risk (Post Decomm)	PLL	5.47E-04		
Overall Risk	**ΣPLL**	**3.30E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	9	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	1	5	Rock Placement
	Survey Vessel	1	10	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	1	8	Survey Works
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	245.3	3.4	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	1030.4 Te	3266.3 Te	60.8 Te	12.4 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	14,420 Te			

ENVIRONMENTAL				
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	100	200Te of rockdump	
	MFE	N/A	N/A	
	Trenching	N/A	N/A	
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Concrete Coated Steel Pipe	Recovered	123.0	220
		Remaining	8079.7	15,286
	Concrete Mattresses	Recovered	276.8	N/A
	Grout Bags	Recovered	3.0	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	N/A	N/A	
	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL				
Technical Considerations	**Feasibility**	High	**Concept Maturity**	High
	Availability of Technology	High - All vessels and equipment widely available		
	Track Record	High - Operations considered routine		
	Risk of Failure	Low		
	Consequence of Failure	Limited impact to cost and schedule		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Low - Limited additional area lost.
	Socio Economic	Low - Minor benefit due to small amount of returned material

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£2.72 M	
	Comparative Cost Legacy		£0.38 M	
	Comparative Cost Total (inc. contingency)		£4.03 M	
Economic Risk	**Cost Risk**	Low	**Factors**	High degree of achievability; Legacy management required.

Appendix H.2 2b – Rock cover exposures

Area	**Fulmar**
Decision / Group	**Group 1: 24" Concrete Coated Pipeline Surface Laid Exposed (PL1315)**
Option	**Option 2b: Leave in Situ – Major Intervention (Blanket Rock Placement)**

SAFETY				
Offshore Personnel	Number	192	Man Hours	28,128
Diver Requirement	Number	6	Man Hours	1,296
Onshore Personnel	Number	20	Man Hours	11,336
Legacy Risk	Number	76	Man Hours	7,296
Impact to Other Users of the Sea (operational)	Number of Vessels Used	4	Duration of Operations	64
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	8
Potential for High Consequence Events	Low	**Comments**	Routine operations; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	2.11E-03		
Operational Risk Diver	PLL	1.26E-03		
Operational Risk Onshore	PLL	5.01E-05		
Legacy Risk (Post Decomm)	PLL	5.47E-04		
Overall Risk	**ΣPLL**	**3.96E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	9	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	1	40	Rock Placement
	Survey Vessel	1	10	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	1	8	Survey Works
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	253.8	24.2	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	1634.1 Te	5180.2 Te	96.4 Te	19.6 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	16,334 Te			
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	77530	203100Te of rockdump	
	MFE	N/A	N/A	
	Trenching	N/A	N/A	

ENVIRONMENTAL				
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Concrete Coated Steel Pipe	Recovered	123.0	220
		Remaining	8079.7	15,286
	Concrete Mattresses	Recovered	276.8	N/A
	Grout Bags	Recovered	3.0	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	Flushed & Cleaned	Flushed & Cleaned	
	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL				
Technical Considerations	**Feasibility**	High	**Concept Maturity**	High
	Availability of Technology	High - All vessels and equipment widely available		
	Track Record	High - Operations considered routine		
	Risk of Failure	Low		
	Consequence of Failure	Limited impact to cost and schedule		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	High - Significant area of natural seabed permanently lost
	Socio Economic	Low - Minor benefit due to small amount of returned material

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£11.88 M	
	Comparative Cost Legacy		£0.38 M	
	Comparative Cost Total (inc. contingency)		£15.94 M	
Economic Risk	**Cost Risk**	Med	**Factors**	High degree of achievability; Legacy management required; Responsible for maintaining significant length of rock berm.

Appendix H.3 2c – Trench and bury exposures

Area	**Fulmar**
Decision / Group	**Group 1: 24" Concrete Coated Pipeline Surface Laid Exposed (PL1315)**
Option	**Option 2c - Leave in Situ – Major Intervention (Trench and Bury)**

SAFETY				
Offshore Personnel	Number	212	Man Hours	23,568
Diver Requirement	Number	6	Man Hours	1,296
Onshore Personnel	Number	20	Man Hours	5,296
Legacy Risk	Number	76	Man Hours	7,296
Impact to Other Users of the Sea (operational)	Number of Vessels Used	5	Duration of Operations	45
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	8
Potential for High Consequence Events	Med	**Comments**	3rd party pipeline crossing in working vicinity; Trenching / backfilling routine operation; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	1.77E-03		
Operational Risk Diver	PLL	1.26E-03		
Operational Risk Onshore	PLL	2.59E-05		
Legacy Risk (Post Decomm)	PLL	5.47E-04		
Overall Risk	**ΣPLL**	**3.60E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	9	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	1	5	Rock Placement
	Survey Vessel	1	10	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	1	16	Trench / Backfill
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	1	8	Survey Works
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	251.0	12.5	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	1339.4 Te	4245.8 Te	79 Te	16.1 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	15,400 Te			
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	200	400Te of rockdump	
	MFE	N/A	N/A	
	Trenching	15250	Trenching Spread	

ENVIRONMENTAL				
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Concrete Coated Steel Pipe	Recovered	123.0	220
		Remaining	8079.7	15,286
	Concrete Mattresses	Recovered	276.8	N/A
	Grout Bags	Recovered	3.0	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	Flushed & Cleaned	Flushed & Cleaned	
	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL				
Technical Considerations	**Feasibility**	Med	**Concept Maturity**	Low
	Availability of Technology	Med - Suitable trench/backfill equipment available but limited for size of pipe.		
	Track Record	Med - Routine operation but limited in decommissioning for size and length. Crossings and debris add complexity.		
	Risk of Failure	High - Considered challenging to accomplish 0.6m DoC over entire length.		
	Consequence of Failure	Failure to achieve target DoC would likely result in requirement for additional rock placement in that location. Cost and schedule impact.		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Med - Significant area of natural seabed temporarily lost. Area would recover to natural condition
	Socio Economic	Low - Minor benefit due to small amount of returned material

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**			£5.95 M
	Comparative Cost Legacy			£0.38 M
	Comparative Cost Total (inc. contingency)			£8.24 M
Economic Risk	**Cost Risk**	Med	**Factors**	Considered achievable but concept maturity low at this stage. Geotechnical studies would need to be performed to ensure feasibility and suitable trenching / backfilling tools specified. Legacy management required.

Appendix H.4 3a – Cut and Lift – Cut pipe in to small sections and recover

Area	**Fulmar**
Decision / Group	**Group 1: 24" Concrete Coated Pipeline Surface Laid Exposed (PL1315)**
Option	**Option 3a: Full Removal – Cut and Lift**

SAFETY				
Offshore Personnel	Number	268	Man Hours	117,408
Diver Requirement	Number	6	Man Hours	8,784
Onshore Personnel	Number	20	Man Hours	18,608
Legacy Risk	Number	0	Man Hours	0
Impact to Other Users of the Sea (operational)	Number of Vessels Used	8	Duration of Operations	198
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	0	Duration of Operations	0
Potential for High Consequence Events	High	**Comments**	3rd party pipeline crossing in working vicinity; Potential diver works; Extensive subsea operations; Significant lifting required; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	7.78E-03		
Operational Risk Diver	PLL	8.52E-03		
Operational Risk Onshore	PLL	3.35E-04		
Legacy Risk (Post Decomm)	PLL	0.00E+00		
Overall Risk	**ΣPLL**	**1.66E-02**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	4	89	Material Transport
	CSV	1	33	Subsea Works
	DSV	1	61	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	0	0	N/A
	Survey Vessel	1	10	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	0	0	N/A
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	250.8	12.0	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	5531.4 Te	17534.5 Te	326.4 Te	66.4 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	23,052 Te			

ENVIRONMENTAL				
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	200	400Te of rockdump	
	MFE	N/A	N/A	
	Trenching	N/A	N/A	
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Concrete Coated Steel Pipe	Recovered	8202.7	15,506
		Remaining	0.0	0
	Concrete Mattresses	Recovered	276.8	N/A
	Grout Bags	Recovered	3.0	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	N/A	Flushed & Cleaned	
	Hydrocarbon	N/A	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL				
Technical Considerations	**Feasibility**	Med	**Concept Maturity**	High
	Availability of Technology	Med - Generally, vessels and equipment widely available. Suitable diverless technology limited. Special lifting tool may be required		
	Track Record	Low - Routine operation but track record low for size and length of pipeline.		
	Risk of Failure	High - Considered challenging over extended distances. May require diver support. Extended subsea works & simultaneous operations.		
	Consequence of Failure	Failure would result in significant cost and schedule impact / requirement for alternative decommissioning method.		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Med - Significant area of natural seabed temporarily lost. However, the area would recover to natural condition.
	Socio Economic	Med - Benefit due to large amount of returned material, transportation of material may negatively impact.

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£23.00 M	
	Comparative Cost Legacy		£0.00 M	
	Comparative Cost Total (inc. contingency)		£29.91 M	
Economic Risk	**Cost Risk**	High	**Factors**	Increased technical and safety risk associated with extended subsea operations.

APPENDIX I GROUP 2 – OPTION DATASHEETS

Appendix I.1 1 – Disconnect / remove ends and minimal remediation

Area	**Auk**
Decision / Group	**Group 2: 10" Concrete Coated Pipeline Surface Laid and Exposed (PI38)**
Option	**Option 1: Leave in Situ – Minimal Intervention**

SAFETY				
Offshore Personnel	Number	192	Man Hours	16,992
Diver Requirement	Number	6	Man Hours	1,008
Onshore Personnel	Number	20	Man Hours	1,832
Legacy Risk	Number	76	Man Hours	6,384
Impact to Other Users of the Sea (operational)	Number of Vessels Used	4	Duration of Operations	26
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	7
Potential for High Consequence Events	Low	**Comments**	Routine operations; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	1.27E-03		
Operational Risk Diver	PLL	9.78E-04		
Operational Risk Onshore	PLL	8.28E-06		
Legacy Risk (Post Decomm)	PLL	4.79E-04		
Overall Risk	**ΣPLL**	**2.74E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	7	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	1	5	Rock Placement
	Survey Vessel	1	9	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	1	7	Survey Works
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	245.3	3.4	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	926.9 Te	2938.2 Te	54.7 Te	11.1 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	3,609 Te			

ENVIRONMENTAL				
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	100	200Te of rockdump	
	MFE	N/A	N/A	
	Trenching	N/A	N/A	
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Concrete Coated Steel Pipe	Recovered	10.1	40
		Remaining	523.9	2,085
	Concrete Mattresses	Recovered	20.3	N/A
	Grout Bags	Recovered	12.5	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	Flushed & Cleaned	Flushed & Cleaned	
	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL				
Technical Considerations	**Feasibility**	High	**Concept Maturity**	High
	Availability of Technology	High - All vessels and equipment widely available		
	Track Record	High - Operations considered routine		
	Risk of Failure	Low		
	Consequence of Failure	Limited impact to cost and schedule		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Low - Limited additional area lost.
	Socio Economic	Low - Minor benefit due to small amount of returned material

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£2.14 M	
	Comparative Cost Legacy		£0.32 M	
	Comparative Cost Total (inc. contingency)		£3.20 M	
Economic Risk	**Cost Risk**	Low	**Factors**	High degree of achievability; Legacy management required.

Appendix I.2 2b – Rock cover exposures

Area	**Auk**
Decision / Group	**Group 2: 10" Concrete Coated Pipeline Surface Laid and Exposed (PI38)**
Option	**Option 2b: Leave in Situ – Major Intervention (Blanket Rock Placement)**

SAFETY				
Offshore Personnel	Number	192	Man Hours	17,232
Diver Requirement	Number	6	Man Hours	1,008
Onshore Personnel	Number	20	Man Hours	2,352
Legacy Risk	Number	76	Man Hours	6,384
Impact to Other Users of the Sea (operational)	Number of Vessels Used	4	Duration of Operations	27
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	7
Potential for High Consequence Events	Low	**Comments**	Routine operations; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	1.29E-03		
Operational Risk Diver	PLL	9.78E-04		
Operational Risk Onshore	PLL	1.04E-05		
Legacy Risk (Post Decomm)	PLL	4.79E-04		
Overall Risk	**ΣPLL**	**2.76E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	7	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	1	6	Rock Placement
	Survey Vessel	1	9	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	1	7	Survey Works
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	245.7	3.7	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	944.1 Te	2992.9 Te	55.7 Te	11.3 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	3,664 Te			
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	10,425	14600Te of rockdump	
	MFE	N/A	N/A	
	Trenching	N/A	N/A	

ENVIRONMENTAL				
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Concrete Coated Steel Pipe	Recovered	10.1	40
		Remaining	523.9	2,085
	Concrete Mattresses	Recovered	20.3	N/A
	Grout Bags	Recovered	12.5	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	Flushed & Cleaned	Flushed & Cleaned	
	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL				
Technical Considerations	**Feasibility**	High	**Concept Maturity**	High
	Availability of Technology	High - All vessels and equipment widely available.		
	Track Record	High - Operations considered routine.		
	Risk of Failure	Low		
	Consequence of Failure	Limited impact to cost and schedule		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	High - Significant area of natural seabed permanently lost.
	Socio Economic	Low - Minor benefit due to small amount of returned material.

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£2.78 M	
	Comparative Cost Legacy		£0.32 M	
	Comparative Cost Total (inc. contingency)		£4.03 M	
Economic Risk	**Cost Risk**	Med	**Factors**	High degree of achievability; Legacy management required; Responsible for maintenance of significant length of rock berm.

Appendix I.3 2c – Trench and bury exposures

Area	**Auk**
Decision / Group	**Group 2: 10" Concrete Coated Pipeline Surface Laid and Exposed (PL38)**
Option	**Option 2c - Leave in Situ – Major Intervention (Trench and Bury)**

SAFETY				
Offshore Personnel	Number	192	Man Hours	18,192
Diver Requirement	Number	6	Man Hours	1,008
Onshore Personnel	Number	20	Man Hours	3,504
Legacy Risk	Number	76	Man Hours	6,384
Impact to Other Users of the Sea (operational)	Number of Vessels Used	4	Duration of Operations	31
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	7
Potential for High Consequence Events	Low	**Comments**	Trenching / backfilling routine operation; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	1.36E-03		
Operational Risk Diver	PLL	9.78E-04		
Operational Risk Onshore	PLL	1.50E-05		
Legacy Risk (Post Decomm)	PLL	4.79E-04		
Overall Risk	**ΣPLL**	**2.84E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	7	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	0	0	N/A
	Survey Vessel	1	9	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	1	10	Trench / Backfill
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	1	7	Survey Works
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	248.1	6.4	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	1013.1 Te	3211.6 Te	59.8 Te	12.2 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	3,883 Te			
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	N/A	N/A	
	MFE	N/A	N/A	
	Trenching	2125	Trenching Spread	

ENVIRONMENTAL				
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Concrete Coated Steel Pipe	Recovered	10.1	40
		Remaining	523.9	2,085
	Concrete Mattresses	Recovered	20.3	N/A
	Grout Bags	Recovered	12.5	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	Flushed & Cleaned	Flushed & Cleaned	
	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL				
Technical Considerations	**Feasibility**	Med	**Concept Maturity**	Low
	Availability of Technology	Med - Suitable trench/backfill equipment available.		
	Track Record	Med - Routine operation but limited in decommissioning. Debris adds complexity.		
	Risk of Failure	High - Considered challenging to accomplish 0.6m DoC over entire length.		
	Consequence of Failure	Failure to achieve target DoC would likely result in additional rock placement. Cost and schedule impact.		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Med - Significant area of natural seabed temporarily lost. However, area would recover to natural condition.
	Socio Economic	Low - Minor benefit due to small amount of returned material.

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£4.06 M	
	Comparative Cost Legacy		£0.32 M	
	Comparative Cost Total (inc. contingency)		£5.69 M	
Economic Risk	**Cost Risk**	Med	**Factors**	Considered achievable but concept maturity low at this stage. Geotechnical studies would need to be performed to ensure feasibility and suitable trenching / backfilling tools specified. Legacy management required.

Appendix I.4 3a – Cut and Lift – Cut pipe in to small sections and recover

Area	**Auk**
Decision / Group	**Group 2: 10" Concrete Coated Pipeline Surface Laid and Exposed (Pl38)**
Option	**Option 3a: Full Removal – Cut and Lift**

SAFETY				
Offshore Personnel	Number	268	Man Hours	33,504
Diver Requirement	Number	6	Man Hours	2,016
Onshore Personnel	Number	20	Man Hours	3,952
Legacy Risk	Number	0	Man Hours	0
Impact to Other Users of the Sea (operational)	Number of Vessels Used	5	Duration of Operations	50
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	0	Duration of Operations	0
Potential for High Consequence Events	Med	**Comments**	Potential diver works; Extensive subsea operations; Significant lifting required; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	2.29E-03		
Operational Risk Diver	PLL	1.96E-03		
Operational Risk Onshore	PLL	3.29E-05		
Legacy Risk (Post Decomm)	PLL	0.00E+00		
Overall Risk	**ΣPLL**	**4.27E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	1	13	Material Transport
	CSV	1	9	Subsea Works
	DSV	1	14	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	0	0	N/A
	Survey Vessel	1	9	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	0	0	N/A
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	244.8	3.0	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	1459.6 Te	4627 Te	86.1 Te	17.5 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	4,955 Te			

ENVIRONMENTAL				
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	N/A	N/A	
	MFE	N/A	N/A	
	Trenching	N/A	N/A	
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Concrete Coated Steel Pipe	Recovered	533.9	2,125
		Remaining	0.0	0
	Concrete Mattresses	Recovered	20.3	N/A
	Grout Bags	Recovered	12.5	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	N/A	Flushed & Cleaned	
	Hydrocarbon	N/A	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL				
Technical Considerations	**Feasibility**	Med	**Concept Maturity**	High
	Availability of Technology	Med - Generally, vessels and equipment widely available. Suitable diverless technology limited. Special lifting tool may be required		
	Track Record	Med - Routine operation but limited track record of cut and lift over extended distance.		
	Risk of Failure	High - Considered challenging over extended distances. May require diver support. Extended subsea works & simultaneous operations.		
	Consequence of Failure	Failure would result in significant cost and schedule impact / requirement for alternative decommissioning method.		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Med - Significant area of natural seabed temporarily lost. Area would recover to natural condition
	Socio Economic	Med - Benefit due to large amount of returned material, however transportation of material may have negative impact

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£5.10 M	
	Comparative Cost Legacy		£0.00 M	
	Comparative Cost Total (inc. contingency)		£6.63 M	
Economic Risk	**Cost Risk**	High	**Factors**	Increased technical and safety risk associated with extended subsea operations

APPENDIX J GROUP 3 – OPTION DATASHEETS

Appendix J.1 1 – Disconnect / remove ends and minimal remediation

Area	**Fulmar**
Decision / Group	**Group 3: Pipelines & Umbilicals, Surface Laid and Rock Dumped (PL208, PL1316, N0878, N0879)**
Option	**Option 1: Leave in Situ – Minimal Intervention**

SAFETY				
Offshore Personnel	Number	192	Man Hours	17,904
Diver Requirement	Number	6	Man Hours	1,152
Onshore Personnel	Number	20	Man Hours	2,104
Legacy Risk	Number	76	Man Hours	6,384
Impact to Other Users of the Sea (operational)	Number of Vessels Used	4	Duration of Operations	27
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	7
Potential for High Consequence Events	Low	**Comments**	Routine operations; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	1.34E-03		
Operational Risk Diver	PLL	1.12E-03		
Operational Risk Onshore	PLL	9.37E-06		
Legacy Risk (Post Decomm)	PLL	4.79E-04		
Overall Risk	**ΣPLL**	**2.95E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	8	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	1	5	Rock Placement
	Survey Vessel	1	9	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	1	7	Survey Works
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	245.5	3.6	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	946.4 Te	3000 Te	55.8 Te	11.4 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	3,962 Te			

ENVIRONMENTAL				
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	400	800Te of rockdump	
	MFE	N/A	N/A	
	Trenching	N/A	N/A	
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Concrete Coated Steel Pipe	Recovered	12.2	40
		Remaining	628.9	1,029
	Rigid Steel Pipe	Recovered	7.5	40
		Remaining	24.2	1,302
	Umbilicals	Recovered	1.6	80
		Remaining	33.1	1,614
	Concrete Mattresses	Recovered	256.5	N/A
	Grout Bags	Recovered	0.0	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	Flushed & Cleaned	Flushed & Cleaned	
	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned	
	Control Fluids	Flushed	Flushed	

TECHNICAL				
Technical Considerations	**Feasibility**	High	**Concept Maturity**	High
	Availability of Technology	High - All vessels and equipment widely available		
	Track Record	High - Operations considered routine		
	Risk of Failure	Low		
	Consequence of Failure	Limited impact to cost and schedule		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Low - Limited additional area lost.
	Socio Economic	Low - Minor benefit due to small amount of returned material

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£2.42 M	
	Comparative Cost Legacy		£0.33 M	
	Comparative Cost Total (inc. contingency)		£3.58 M	
Economic Risk	**Cost Risk**	Low	**Factors**	High degree of achievability Legacy management required

Appendix J.2 3a – Cut and Lift – Cut pipe in to small sections and recover

Area	**Fulmar**
Decision / Group	**Group 3: Pipelines & Umbilicals, Surface Laid and Rock Dumped (PL208, PL1316, N0878, N0879)**
Option	**Option 3a: Full Removal – Cut and Lift**

SAFETY				
Offshore Personnel	Number	268	Man Hours	48,864
Diver Requirement	Number	6	Man Hours	3,024
Onshore Personnel	Number	20	Man Hours	6,048
Legacy Risk	Number	0	Man Hours	0
Impact to Other Users of the Sea (operational)	Number of Vessels Used	5	Duration of Operations	72
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	0	Duration of Operations	0
Potential for High Consequence Events	Med	**Comments**	Potential diver works; Extensive subsea operations; Significant lifting required; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	3.26E-03		
Operational Risk Diver	PLL	2.93E-03		
Operational Risk Onshore	PLL	2.61E-05		
Legacy Risk (Post Decomm)	PLL	0.00E+00		
Overall Risk	**ΣPLL**	**6.22E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	1	20	Material Transport
	CSV	1	17	Subsea Works
	DSV	1	21	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	0	0	N/A
	Survey Vessel	1	9	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	0	0	N/A
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	247.0	5.1	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	2045.9 Te	6485.4 Te	120.7 Te	24.6 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	6,995 Te			
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	N/A	N/A	
	MFE	8210	MFE Spread	
	Trenching	N/A	N/A	

ENVIRONMENTAL				
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Concrete Coated Steel Pipe	Recovered	641.1	1,069
		Remaining	0.0	0
	Rigid Steel Pipe	Recovered	31.7	1,342
		Remaining	0.0	0
	Umbilicals	Recovered	34.7	1,694
		Remaining	0.0	0
	Concrete Mattresses	Recovered	256.5	N/A
	Grout Bags	Recovered	0.0	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	Flushed & Cleaned	Flushed & Cleaned	
	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned	
	Control Fluids	Flushed	Flushed	

TECHNICAL				
Technical Considerations	**Feasibility**	Med	**Concept Maturity**	High
	Availability of Technology	Med - Generally, vessels and equipment widely available. Suitable diverless technology limited. Special lifting tool may be required		
	Track Record	Low - Routine operation but track record low for cut & lift over extended distance. Low track record of unburial of rockdump over extended distance		
	Risk of Failure	High - Considered challenging over large distance. May require diver support. Extended subsea works & simultaneous operations.		
	Consequence of Failure	Failure would result in significant cost and schedule impact / requirement for alternative decommissioning method.		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Med - Significant area of natural seabed temporarily lost. However, area would be returned to same condition before recovery works.
	Socio Economic	Med - Benefit due to large amount of returned material, transportation of material may have negative impact.

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£6.69	M
	Comparative Cost Legacy		£0.00	M
	Comparative Cost Total (inc. contingency)		£8.69	M
Economic Risk	**Cost Risk**	High	**Factors**	Increased technical and safety risk associated with extended subsea operations

Appendix J.3 3b – Reverse Installation – Recover pipe using reverse S-lay or reverse reeling

Area	**Fulmar**
Decision / Group	**Group 3: Pipelines & Umbilicals, Surface Laid and Rock Dumped (PL208, PL1316, N0878, N0879)**
Option	**Option 3b: Full Removal - Reverse Reeling**

SAFETY				
Offshore Personnel	Number	344	Man Hours	39,840
Diver Requirement	Number	6	Man Hours	1,728
Onshore Personnel	Number	20	Man Hours	4,584
Legacy Risk	Number	0	Man Hours	0
Impact to Other Users of the Sea (operational)	Number of Vessels Used	6	Duration of Operations	54
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	0	Duration of Operations	0
Potential for High Consequence Events	Med	**Comments**	Integrity assumed by engineering only; Cut & lift required for removal of PL208; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	2.76E-03		
Operational Risk Diver	PLL	1.68E-03		
Operational Risk Onshore	PLL	2.02E-05		
Legacy Risk (Post Decomm)	PLL	0.00E+00		
Overall Risk	**ΣPLL**	**4.46E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	1	9	Material Transport
	CSV	1	10	Subsea Works
	DSV	1	12	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	1	9	Reverse Reeling
	Rockdump Vessel	0	0	N/A
	Survey Vessel	1	9	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	0	0	N/A
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	248.6	7.3	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	1802.9 Te	5715.1 Te	106.4 Te	21.6 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	6,225 Te			

ENVIRONMENTAL				
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	N/A	N/A	
	MFE	8210	MFE Spread	
	Trenching	N/A	N/A	
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Concrete Coated Steel Pipe	Recovered	641.1	1,069
		Remaining	0.0	0
	Rigid Steel Pipe	Recovered	31.7	1,342
		Remaining	0.0	0
	Umbilicals	Recovered	34.7	1,694
		Remaining	0.0	0
	Concrete Mattresses	Recovered	256.5	N/A
	Grout Bags	Recovered	0.0	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	N/A	Flushed & Cleaned	
	Hydrocarbon	N/A	Flushed & Cleaned	
	Control Fluids	N/A	Flushed	

TECHNICAL				
Technical Considerations	**Feasibility**	Med	**Concept Maturity**	Med
	Availability of Technology	Med - Generally, vessels and equipment available. MFE spread required. Reel vessel required.		
	Track Record	Med - Routine installation operation but limited track record of reverse reeling in North Sea for decommissioning over extended distance. Limited track record of deburial works over extended distance.		
	Risk of Failure	Med - Pipeline / umbilical integrity unknown		
	Consequence of Failure	Alternate recovery techniques required / cost and schedule impact.		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Med - Significant area of natural seabed temporarily lost. However, area would be returned to same condition as before recovery works.
	Socio Economic	Med - Benefit due to large amount of returned material, however transportation of material may have negative impact

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£5.39 M	
	Comparative Cost Legacy		£0.00 M	
	Comparative Cost Total (inc. contingency)		£7.01 M	
Economic Risk	**Cost Risk**	Med	**Factors**	Med degree of achievability; Opportunity to remove unburial works if engineering study confirms structural integrity of product will allow recovery pulling through rock cover.

APPENDIX K GROUP 4 – OPTION DATASHEETS

Appendix K.1 1 – Disconnect / remove ends and minimal remediation.

Area	**Auk & Auk North**
Decision / Group	**Group 4: Pipelines, Fully Trenched and Buried (PL378, PL2651)**
Option	**Option 1: Leave in Situ – Minimal Intervention**

SAFETY				
Offshore Personnel	Number	192	Man Hours	18,816
Diver Requirement	Number	6	Man Hours	1,008
Onshore Personnel	Number	20	Man Hours	1,952
Legacy Risk	Number	76	Man Hours	8,208
Impact to Other Users of the Sea (operational)	Number of Vessels Used	4	Duration of Operations	28
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	9
Potential for High Consequence Events	Low	**Comments**	Routine operations; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	1.41E-03		
Operational Risk Diver	PLL	9.78E-04		
Operational Risk Onshore	PLL	8.76E-06		
Legacy Risk (Post Decomm)	PLL	6.16E-04		
Overall Risk	**ΣPLL**	**3.01E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	7	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	1	5	Rock Placement
	Survey Vessel	1	11	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	1	9	Survey Works
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	245.4	3.5	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	1055.9 Te	3347.1 Te	62.3 Te	12.7 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	6,942 Te			

ENVIRONMENTAL				
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	200	400Te of rockdump	
	MFE	N/A	N/A	
	Trenching	N/A	N/A	
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Rigid Steel Pipe	Recovered	4.5	40
		Remaining	1986.1	23,020
	Concrete Coated Pipe	Recovered	16.2	66
		Remaining	0	0
	Concrete Mattresses	Recovered	229.5	N/A
	Grout Bags	Recovered	3.3	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	Flushed & Cleaned	Flushed & Cleaned	
	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL				
Technical Considerations	**Feasibility**	High	**Concept Maturity**	High
	Availability of Technology	High - All vessels and equipment widely available		
	Track Record	High - Operations considered routine		
	Risk of Failure	Low		
	Consequence of Failure	Limited impact to cost and schedule		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Low - Limited additional area lost.
	Socio Economic	Low - Minor benefit due to small amount of returned material

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£2.33 M	
	Comparative Cost Legacy		£0.42 M	
	Comparative Cost Total (inc. contingency)		£3.58 M	
Economic Risk	**Cost Risk**	Low	**Factors**	High degree of achievability Legacy management required

Appendix K.2 3a – Cut and Lift – Cut pipe in to small sections and recover

Area	**Auk & Auk North**
Decision / Group	**Group 4: Pipelines, Fully Trenched and Buried (PL378, PL2651)**
Option	**Option 3a: Full Removal – Cut and Lift**

SAFETY				
Offshore Personnel	Number	268	Man Hours	164,208
Diver Requirement	Number	6	Man Hours	12,528
Onshore Personnel	Number	20	Man Hours	23,544
Legacy Risk	Number	0	Man Hours	0
Impact to Other Users of the Sea (operational)	Number of Vessels Used	7	Duration of Operations	253
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	0	Duration of Operations	0
Potential for High Consequence Events	Med	**Comments**	Potential diver works; Extensive subsea operations; Lifting required; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	1.08E-02		
Operational Risk Diver	PLL	1.22E-02		
Operational Risk Onshore	PLL	1.57E-04		
Legacy Risk (Post Decomm)	PLL	0.00E+00		
Overall Risk	**ΣPLL**	**2.32E-02**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	3	94	Material Transport
	CSV	1	56	Subsea Works
	DSV	1	87	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	0	0	N/A
	Survey Vessel	1	11	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	0	0	N/A
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	252.6	18.3	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	6875.9 Te	21796.5 Te	405.7 Te	82.5 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	23,744 Te			

ENVIRONMENTAL				
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	N/A	N/A	
	MFE	46120	MFE Spread	
	Trenching	N/A	N/A	
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Rigid Steel Pipe	Recovered	1958.2	22,994
		Remaining	0	0
	Concrete Coated Pipe	Recovered	16.2	66
		Remaining	0	0
	Concrete Mattresses	Recovered	229.5	N/A
	Grout Bags	Recovered	3.3	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	N/A	Flushed & Cleaned	
	Hydrocarbon	N/A	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL				
Technical Considerations	**Feasibility**	Med	**Concept Maturity**	High
	Availability of Technology	Med - Generally, vessels and equipment widely available. Suitable diverless technology limited. Special lifting tool may be required		
	Track Record	Low - Routine operation but track record low for cut & lift over extended distance. Low track record of unburial over extended distance.		
	Risk of Failure	High - Considered challenging over large distance. May require diver support. Extended subsea works & simultaneous operations.		
	Consequence of Failure	Failure would result in significant cost and schedule impact / requirement for alternative decommissioning method.		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Med - Significant area of natural seabed temporarily lost. However, area would recover to natural condition.
	Socio Economic	Med - Benefit due to large amount of returned material, however transportation of material may have negative impact

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£31.93 M	
	Comparative Cost Legacy		£0.00 M	
	Comparative Cost Total (inc. contingency)		£41.51 M	
Economic Risk	**Cost Risk**	High	**Factors**	Increased technical and safety risk associated with extended subsea operations

Appendix K.3 3b – Reverse Installation – Recover pipe using reverse S-lay or reverse reeling

Area	**Auk & Auk North**
Decision / Group	**Group 4: Pipelines, Fully Trenched and Buried (PL378, PL2651)**
Option	**Option 3b: Full Removal - Reverse Reeling**

SAFETY				
Offshore Personnel	Number	324	Man Hours	42,240
Diver Requirement	Number	6	Man Hours	1,008
Onshore Personnel	Number	20	Man Hours	5,864
Legacy Risk	Number	0	Man Hours	0
Impact to Other Users of the Sea (operational)	Number of Vessels Used	5	Duration of Operations	50
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	0	Duration of Operations	0
Potential for High Consequence Events	Low	**Comments**	Integrity assumed by engineering only; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	2.89E-03		
Operational Risk Diver	PLL	9.78E-04		
Operational Risk Onshore	PLL	8.63E-05		
Legacy Risk (Post Decomm)	PLL	0.00E+00		
Overall Risk	**ΣPLL**	**3.96E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	0	0	N/A
	CSV	1	15	Subsea Works
	DSV	1	7	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	1	12	Reverse Reeling
	Rockdump Vessel	0	0	N/A
	Survey Vessel	1	11	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	0	0	N/A
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	250.3	10.8	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	1699.4 Te	5387 Te	100.3 Te	20.4 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	7,334 Te			

ENVIRONMENTAL				
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	N/A	N/A	
	MFE	46120	MFE Spread	
	Trenching	N/A	N/A	
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Rigid Steel Pipe	Recovered	1958.2	22,994
		Remaining	0	0
	Concrete Coated Pipe	Recovered	16.2	66
		Remaining	0	0
	Concrete Mattresses	Recovered	229.5	N/A
	Grout Bags	Recovered	3.3	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	N/A	Flushed & Cleaned	
	Hydrocarbon	N/A	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL				
Technical Considerations	**Feasibility**	Med	**Concept Maturity**	Med
	Availability of Technology	Med - Generally, vessels and equipment available. MFE spread required. Reel vessel required.		
	Track Record	Med - Routine installation operation but limited track record of reverse reeling in North Sea for decommissioning over extended distance. Limited track record of MFE unburial over extended distance.		
	Risk of Failure	Med - Pipeline / umbilical integrity unknown		
	Consequence of Failure	Alternate recovery techniques required / cost and schedule impact.		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Med - Limited short term impact, area to return to condition prior to recovery works.
	Socio Economic	High – Significant valuable material returned

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£13.16 M	
	Comparative Cost Legacy		£0.00 M	
	Comparative Cost Total (inc. contingency)		£17.10 M	
Economic Risk	**Cost Risk**	Med	**Factors**	Med degree of achievability; Opportunity to remove unburial works if engineering study confirms structural integrity of product will allow recovery pulling through rock cover.

APPENDIX L GROUP 5 – OPTION DATASHEETS

Appendix L.1 1 – Disconnect / remove ends and minimal remediation

Area	**Fulmar**
Decision / Group	**Group 5: Pipelines, Partially Trenched and Buried (PL63, PL648)**
Option	**Option 1: Leave in Situ – Minimal Intervention**

SAFETY				
Offshore Personnel	Number	192	Man Hours	16,992
Diver Requirement	Number	6	Man Hours	1,008
Onshore Personnel	Number	20	Man Hours	2,136
Legacy Risk	Number	76	Man Hours	6,384
Impact to Other Users of the Sea (operational)	Number of Vessels Used	4	Duration of Operations	26
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	7
Potential for High Consequence Events	Low	**Comments**	Routine operations; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	1.27E-03		
Operational Risk Diver	PLL	9.78E-04		
Operational Risk Onshore	PLL	1.04E-05		
Legacy Risk (Post Decomm)	PLL	4.79E-04		
Overall Risk	**ΣPLL**	**2.74E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	7	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	1	5	Rock Placement
	Survey Vessel	1	9	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	1	7	Survey Works
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	245.5	3.6	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	926.9 Te	2938.2 Te	54.7 Te	11.1 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	4,857 Te			

ENVIRONMENTAL				
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	3350	6500Te of rockdump	
	MFE	N/A	N/A	
	Trenching	N/A	N/A	
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Rigid Steel Pipe	Recovered	28.4	80
		Remaining	1495.9	4,007
	Concrete Mattresses	Recovered	162.0	N/A
	Grout Bags	Recovered	4.5	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	Flushed & Cleaned	Flushed & Cleaned	
	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL				
Technical Considerations	**Feasibility**	High	**Concept Maturity**	High
	Availability of Technology	High - All vessels and equipment widely available		
	Track Record	High - Operations considered routine		
	Risk of Failure	Low		
	Consequence of Failure	Limited impact to cost and schedule		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Low - Limited additional area lost.
	Socio Economic	Low - Minor benefit due to small amount of returned material

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£2.51 M	
	Comparative Cost Legacy		£0.33 M	
	Comparative Cost Total (inc. contingency)		£3.69 M	
Economic Risk	**Cost Risk**	Low	**Factors**	High degree of achievability; Legacy management required.

Appendix L.2 2a – Cut and remove exposures (including ends)

Area	**Fulmar**
Decision / Group	**Group 5: Pipelines, Partially Trenched and Buried (PL63, PL648)**
Option	**Option 2a: Leave in Situ – Minor Intervention (Cut Out Exposures)**

SAFETY				
Offshore Personnel	Number	192	Man Hours	26,592
Diver Requirement	Number	6	Man Hours	2,448
Onshore Personnel	Number	20	Man Hours	4,456
Legacy Risk	Number	76	Man Hours	6,384
Impact to Other Users of the Sea (operational)	Number of Vessels Used	4	Duration of Operations	38
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	7
Potential for High Consequence Events	Med	**Comments**	Routine operations; Significant lifting required; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	1.99E-03		
Operational Risk Diver	PLL	2.37E-03		
Operational Risk Onshore	PLL	3.12E-05		
Legacy Risk (Post Decomm)	PLL	4.79E-04		
Overall Risk	**ΣPLL**	**4.88E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	17	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	1	7	Rock Placement
	Survey Vessel	1	9	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	1	7	Survey Works
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	247.1	5.2	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	1156.4 Te	3665.7 Te	68.2 Te	13.9 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	5,283 Te			
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	1200	4800Te of rockdump	
	MFE	N/A	N/A	
	Trenching	N/A	N/A	

ENVIRONMENTAL				
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Rigid Steel Pipe	Recovered	400.3	1,068
		Remaining	1124.0	3,019
	Concrete Mattresses	Recovered	162.0	N/A
	Grout Bags	Recovered	4.5	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	Flushed & Cleaned	Flushed & Cleaned	
	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL				
Technical Considerations	**Feasibility**	High	**Concept Maturity**	Med
	Availability of Technology	High - All vessels and equipment widely available		
	Track Record	High - Operations considered routine		
	Risk of Failure	Med - Short exposure lengths may not be efficient to cut out		
	Consequence of Failure	Additional rockdump required		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Low - Limited additional area lost.
	Socio Economic	Low - Minor benefit due to small amount of returned material

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£4.92 M	
	Comparative Cost Legacy		£0.33 M	
	Comparative Cost Total (inc. contingency)		£6.82 M	
Economic Risk	**Cost Risk**	Low	**Factors**	Considered routine operations; May not be feasible nor efficient to cut out all exposures; Legacy management required.

Appendix L.3 2b – Rock cover exposures (including ends)

Area	**Fulmar**
Decision / Group	**Group 5: Pipelines, Partially Trenched and Buried (PL63, PL648)**
Option	**Option 2b: Leave in Situ – Major Intervention (Blanket Rock Placement)**

SAFETY				
Offshore Personnel	Number	192	Man Hours	16,992
Diver Requirement	Number	6	Man Hours	1,008
Onshore Personnel	Number	20	Man Hours	2,296
Legacy Risk	Number	76	Man Hours	6,384
Impact to Other Users of the Sea (operational)	Number of Vessels Used	4	Duration of Operations	26
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	7
Potential for High Consequence Events	Low	**Comments**	Routine operations; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	1.27E-03		
Operational Risk Diver	PLL	9.78E-04		
Operational Risk Onshore	PLL	1.11E-05		
Legacy Risk (Post Decomm)	PLL	4.79E-04		
Overall Risk	**ΣPLL**	**2.74E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	7	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	1	5	Rock Placement
	Survey Vessel	1	9	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	1	7	Survey Works
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	245.6	3.6	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	926.9 Te	2938.2 Te	54.7 Te	11.1 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	4,857 Te			
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	20435	10800Te of rockdump	
	MFE	N/A	N/A	
	Trenching	N/A	N/A	

ENVIRONMENTAL				
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Rigid Steel Pipe	Recovered	28.4	80
		Remaining	1495.9	4,007
	Concrete Mattresses	Recovered	162.0	N/A
	Grout Bags	Recovered	4.5	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	Flushed & Cleaned	Flushed & Cleaned	
	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL				
Technical Considerations	**Feasibility**	High	**Concept Maturity**	High
	Availability of Technology	High - All vessels and equipment widely available		
	Track Record	High - Operations considered routine		
	Risk of Failure	Low		
	Consequence of Failure	Limited impact to cost and schedule		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	High - Significant area of natural seabed permanently lost
	Socio Economic	Low - Minor benefit due to small amount of returned material

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£2.70 M	
	Comparative Cost Legacy		£0.33 M	
	Comparative Cost Total (inc. contingency)		£3.94 M	
Economic Risk	**Cost Risk**	Med	**Factors**	High degree of achievability; Legacy management required; Responsible for maintenance of significant length of rock berm.

Appendix L.4 2c – Trench and bury exposures (including ends)

Area	**Fulmar**
Decision / Group	**Group 5: Pipelines, Partially Trenched and Buried (PL63, PL648)**
Option	**Option 2c - Leave in Situ – Major Intervention (Trench and Bury)**

SAFETY				
Offshore Personnel	Number	192	Man Hours	18,192
Diver Requirement	Number	6	Man Hours	1,008
Onshore Personnel	Number	20	Man Hours	3,504
Legacy Risk	Number	76	Man Hours	6,384
Impact to Other Users of the Sea (operational)	Number of Vessels Used	4	Duration of Operations	31
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	7
Potential for High Consequence Events	Low	**Comments**	Jet trenching routine operations; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	1.36E-03		
Operational Risk Diver	PLL	9.78E-04		
Operational Risk Onshore	PLL	1.59E-05		
Legacy Risk (Post Decomm)	PLL	4.79E-04		
Overall Risk	**ΣPLL**	**2.84E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	7	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	0	0	N/A
	Survey Vessel	1	9	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	1	10	Trench / Backfill
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	1	7	Survey Works
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	247.8	6.1	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	1013.1 Te	3211.6 Te	59.8 Te	12.2 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	5,130 Te			
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	200	400Te of rockdump	
	MFE	N/A	N/A	
	Trenching	1068	Trenching Spread	

ENVIRONMENTAL				
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Concrete Coated Steel Pipe	Recovered	28.4	80
		Remaining	1495.9	4,007
	Concrete Mattresses	Recovered	162.0	N/A
	Grout Bags	Recovered	4.5	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	Flushed & Cleaned	Flushed & Cleaned	
	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL				
Technical Considerations	**Feasibility**	Med	**Concept Maturity**	Low
	Availability of Technology	Med - Suitable jet trenching equipment available but limited		
	Track Record	Med - Routine operation but limited in decommissioning. Intermittent burial likely to require jet trenching		
	Risk of Failure	High - Considered challenging to accomplish 0.6m DoC over entire length		
	Consequence of Failure	Failure to achieve target DoC would likely result in additional rock placement in that location. Cost and schedule impact.		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Med - Significant area of natural seabed temporarily lost. However, area would recover to natural condition
	Socio Economic	Low - Minor benefit due to small amount of returned material

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£4.19 M	
	Comparative Cost Legacy		£0.33 M	
	Comparative Cost Total (inc. contingency)		£5.87 M	
Economic Risk	**Cost Risk**	Med	**Factors**	Considered achievable but concept maturity low at this stage. Geotechnical studies would need to be performed to ensure feasibility and suitable tooling specified. Legacy management required.

Appendix L.5 3a – Cut and Lift – Cut pipe in to small sections and recover

Area	**Fulmar**
Decision / Group	**Group 5: Pipelines, Partially Trenched and Buried (PL63, PL648)**
Option	**Option 3a: Full Removal – Cut and Lift**

SAFETY				
Offshore Personnel	Number	268	Man Hours	48,000
Diver Requirement	Number	6	Man Hours	3,024
Onshore Personnel	Number	20	Man Hours	6,288
Legacy Risk	Number	0	Man Hours	0
Impact to Other Users of the Sea (operational)	Number of Vessels Used	6	Duration of Operations	74
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	0	Duration of Operations	0
Potential for High Consequence Events	High	**Comments**	Potential diver works; Extensive subsea operations; Significant lifting required; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	3.21E-03		
Operational Risk Diver	PLL	2.93E-03		
Operational Risk Onshore	PLL	7.37E-05		
Legacy Risk (Post Decomm)	PLL	0.00E+00		
Overall Risk	**ΣPLL**	**6.22E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	2	24	Material Transport
	CSV	1	15	Subsea Works
	DSV	1	21	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	0	0	N/A
	Survey Vessel	1	9	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	0	0	N/A
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	246.7	4.6	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	2118.9 Te	6716.8 Te	125 Te	25.4 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	7,651 Te			
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	N/A	N/A	
	MFE	8174	MFE Spread	
	Trenching	N/A	N/A	

ENVIRONMENTAL				
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Concrete Coated Steel Pipe	Recovered	1524.3	4,087
		Remaining	0.0	0
	Concrete Mattresses	Recovered	162.0	N/A
	Grout Bags	Recovered	4.5	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	N/A	Flushed & Cleaned	
	Hydrocarbon	N/A	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL				
Technical Considerations	**Feasibility**	Med	**Concept Maturity**	High
	Availability of Technology	Med - Generally, vessels and equipment widely available. Suitable diverless technology limited. Special lifting tool may be required		
	Track Record	Low - Routine operation but track record low for cut & lift over extended distance. Low track record of unburial over extended distance.		
	Risk of Failure	High - Considered challenging over large distance. May require diver support. Extended subsea works & simultaneous operations.		
	Consequence of Failure	Failure would result in significant cost and schedule impact / requirement for alternative decommissioning method.		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Med - Significant area of natural seabed temporarily lost. However, area would recover to natural condition.
	Socio Economic	Med - Benefit due to large amount of returned material, however transportation of material may have negative impact

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£7.90	M
	Comparative Cost Legacy		£0.00	M
	Comparative Cost Total (inc. contingency)		£10.27	M
Economic Risk	**Cost Risk**	High	**Factors**	Increased technical and safety risk associated with extended subsea operations.

APPENDIX M GROUP 6 – OPTION DATASHEETS

Appendix M.1 1 – Disconnect / remove ends and minimal remediation

Area	**Auk & Auk North**
Decision / Group	**Group 6: Umbilicals & Cables, Trenched and Buried (FAPWC, PLU2652, PLU2653)**
Option	**Option 1: Leave in Situ – Minimal Intervention**

SAFETY				
Offshore Personnel	Number	192	Man Hours	32,496
Diver Requirement	Number	6	Man Hours	3,024
Onshore Personnel	Number	20	Man Hours	5,416
Legacy Risk	Number	76	Man Hours	9,120
Impact to Other Users of the Sea (operational)	Number of Vessels Used	4	Duration of Operations	43
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	10
Potential for High Consequence Events	Low	**Comments**	Routine operation; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	2.44E-03		
Operational Risk Diver	PLL	2.93E-03		
Operational Risk Onshore	PLL	2.45E-05		
Legacy Risk (Post Decomm)	PLL	6.84E-04		
Overall Risk	**ΣPLL**	**6.08E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	21	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	0	0	N/A
	Rockdump Vessel	1	5	Rock Placement
	Survey Vessel	1	12	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	1	10	Survey Works
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	246.4	4.4	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	1393.4 Te	4417 Te	82.2 Te	16.7 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	7,225 Te			

ENVIRONMENTAL				
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	300	600Te of rockdump	
	MFE	N/A	N/A	
	Trenching	N/A	N/A	
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Umbilical / Cable	Recovered	64.0	1,930
		Remaining	1043.2	32,250
	Concrete Mattresses	Recovered	1444.5	N/A
	Grout Bags	Recovered	10.0	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	N/A	N/A	
	Hydrocarbon	N/A	N/A	
	Control Fluids	Flushed	Flushed	

TECHNICAL				
Technical Considerations	**Feasibility**	High	**Concept Maturity**	High
	Availability of Technology	High - All vessels and equipment widely available		
	Track Record	High - Operations considered routine		
	Risk of Failure	Low		
	Consequence of Failure	Limited impact to cost and schedule		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Low - Limited additional area lost.
	Socio Economic	Low - Minor benefit due to small amount of returned material

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**		£5.69 M	
	Comparative Cost Legacy		£0.49 M	
	Comparative Cost Total (inc. contingency)		£8.04 M	
Economic Risk	**Cost Risk**	Low	**Factors**	High degree of achievability; Legacy management required.

Appendix M.2 3b – Reverse Installation – Recover pipe using reverse S-lay or reverse reeling

Area	**Auk & Auk North**
Decision / Group	**Group 6: Umbilicals & Cables, Trenched and Buried (FAPWC, PLU2652, PLU2653)**
Option	**Option 3b: Full Removal - Reverse Reeling**

SAFETY				
Offshore Personnel	Number	324	Man Hours	50,448
Diver Requirement	Number	6	Man Hours	1,584
Onshore Personnel	Number	20	Man Hours	6,728
Legacy Risk	Number	0	Man Hours	0
Impact to Other Users of the Sea (operational)	Number of Vessels Used	5	Duration of Operations	59
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	0	Duration of Operations	0
Potential for High Consequence Events	Low	**Comments**	Integrity assumed by engineering only; For further details from the HAZID, see Ref. 12.	
Operational Risk Offshore	PLL	3.44E-03		
Operational Risk Diver	PLL	1.54E-03		
Operational Risk Onshore	PLL	6.31E-05		
Legacy Risk (Post Decomm)	PLL	0.00E+00		
Overall Risk	**ΣPLL**	**5.04E-03**		

ENVIRONMENTAL				
Marine Impact (Vessels)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Barge / Pipehaul	0	0	N/A
	CSV	1	19	Subsea Works
	DSV	1	11	Subsea Works
	HLV	0	0	N/A
	Reel Vessel	1	12	Reverse Reeling
	Rockdump Vessel	0	0	N/A
	Survey Vessel	1	12	Survey Works
	Trawler	1	5	Trawl Sweep
	Trenching Vessel	0	0	N/A
Marine Impact (Vessel Legacy)	**Vessel Type**	**Number off**	**Duration**	**Activity**
	Survey Vessel (Legacy)	0	0	N/A
Noise (Total = Ops + Legacy)	**Parameter**	**dB re 1mP**	**TPa²s**	
	Sound Exposure Level	250.6	11.5	
Energy Use (Total = Ops + Legacy)	**Fuel**	**CO_2**	**NOx**	**SO_2**
	1921.6 Te	6091.6 Te	113.4 Te	23.1 Te
Life Cycle Emissions (Total = Ops + Legacy)	**CO_2**			
	7,439 Te			

ENVIRONMENTAL				
Marine Impact (Seabed)	**Activity**	**Area (m^2)**	**Resources**	
	Rockdumping	N/A	N/A	
	MFE	64500	MFE Spread	
	Trenching	N/A	N/A	
Materials	**Component / Material**	**Parameter**	**Weight (Te)**	**Length (m)**
	Rigid Steel Pipe	Recovered	1107.2	34,180
		Remaining	0.0	0
	Concrete Mattresses	Recovered	1444.5	N/A
	Grout Bags	Recovered	10.0	N/A
Residuals	**Type**	**Left In-Situ**	**Returned**	
	LSA Scale	N/A	N/A	
	Hydrocarbon	N/A	N/A	
	Control Fluids	N/A	Flushed	

TECHNICAL				
Technical Considerations	**Feasibility**	High	**Concept Maturity**	High
	Availability of Technology	Med - Generally, vessels and equipment available. MFE spread required. Reel vessel required.		
	Track Record	Med - Routine installation operation but limited track record of reverse reeling in North Sea for decommissioning over extended distance.		
	Risk of Failure	Med – Umbilical / cable integrity unknown		
	Consequence of Failure	Alternate recovery techniques required / cost and schedule impact.		

SOCIETAL		
Societal Factors	**Commercial Fisheries Impact**	Low - Limited short term impact, area to return to natural condition
	Socio Economic	High – Significant valuable material returned

ECONOMIC				
Economic Considerations	**Comparative Cost Operational**			£7.09 M
	Comparative Cost Legacy			£0.00 M
	Comparative Cost Total (inc. contingency)			£9.22 M
Economic Risk	**Cost Risk**	Low	**Factors**	High degree of achievability; Opportunity to remove unburial works if engineering study confirms integrity of umbilicals / cable.