



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

March 2021



DOCUMENT CONTROL

Approvals

	Name	Signature	Date
Prepared by	Steve Etherson	s etherson	30/03/2021
Checked by	Kilian Palop	1 17	30/03/2021
Reviewed by	Robbie Dunbar-Smith	Inchest	11/04/2021
Approved by	Teresa Munro	T.Muno	12/04/2021

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



CONTENTS

<u>EX</u>	ECU	ITIVE SUMMARY	10
<u>1</u>	INT	RODUCTION	12
	1.1	Purpose	12
	1.2	Background	12
<u>2</u>	ME	THODOLOGY	13
	2.1	Overview	13
	2.2	Scoping	14
	2.3	Screening	15
	2.4	Preparation Phase	16
	2.5	Evaluation Phase	17
	2.6	Review	17
<u>3</u>	<u>C01</u>	MPARATIVE ASSESSMENT – SCOPING OUTCOME	18
	3.1	Decommissioning Groups	18
<u>4</u>		<u>OUTCOME – GROUP 1 – 24" CONCRETE COATED PIPELINE, SURFACE LAII</u>	D AND
EX		SED (PL1315)	19
	4.1	Group Characteristics	19
	4.2	Decommissioning Options & Screening Outcome	20
	4.3	Decommissioning Options for Evaluation	20
	4.4	Evaluation Summary	21
<u>5</u>		<u>OUTCOME – GROUP 2 – 10" CONCRETE COATED PIPELINE, SURFACE LAII</u>	D AND
EX		SED (PL38)	22
	5.1	Group Characteristics	22
	5.2	Decommissioning Options & Screening Outcome	23
	5.3	Decommissioning Options for Evaluation	23
	5.4	Evaluation Summary	24
<u>6</u>		OUTCOME – GROUP 3 – PIPELINES & UMBILICALS, SURFACE LAID AND	<u>ROCK</u>
CC		RED (PL208, PL1316, PLU4472, PLU4473)	25
	6.1	Group Characteristics	25
	6.2	Decommissioning Options & Screening Outcome	28
	6.3	Decommissioning Options for Evaluation	28
	6.4	Evaluation Summary	29

7 <u>CA OUTCOME – GROUP 4 – PIPELINES, FULLY TRENCHED AND BURIED (PL378, PL2651)</u> 30



	7.3	Decomm Decomm	naracteristics issioning Options & Screening Outcome issioning Options for Evaluation on Summary	30 32 32 33
<u>8</u> PL	<u>CA</u> .648)	OUTCON	IE – GROUP 5 – PIPELINES, PARTIALLY TRENCHED AND BUR	RIED (PL63 & 34
		Decomm	naracteristics issioning Options & Screening Outcome issioning Options for Evaluation	34 35 35
0	8.4	Evaluatio	on Summary	36
<u>9</u> (Pl			<u>ME – GROUP 6 – UMBILICALS & CABLES – TRENCHED A</u> 2652, PLU2653)	IND BURIED
	9.1 9.2 9.3	Group Cl Decomm Decomm	naracteristics issioning Options & Screening Outcome issioning Options for Evaluation on Summary	37 40 40 41
<u>10</u>	<u>SUE</u>	SEA CA	RECOMMENDATIONS	42
	10.2 10.3 10.4 10.5	Group 2 Group 3 Group 4 Group 5	 24" Concrete Coated Pipeline, Surface Laid and Exposed 10" Concrete Coated Pipeline, Surface Laid and Exposed Pipelines & Umbilicals, Surface Laid and Rock Covered Pipelines, Fully Trenched and Buried Pipelines, Partially Trenched and Buried Umbilicals & Cables – Trenched and Buried 	42 42 43 43 43 43
<u>11</u>	<u>REF</u>	ERENCE	S	44
AF	PEN	DIX A E		45
	Appe Appe Appe Appe	endix A.1 endix A.2 endix A.3 endix A.4 endix A.5 endix A.6	CA Evaluation Methodology Differentiating Criteria & Approach to Assessment Differentiator Weighting Option Attributes Option Pair-Wise Comparison Visual Output and Sensitivities	45 45 48 51 51 53
<u>AF</u>	PEN	DIX B	GROUP 1 – DETAILED EVALUATION RESULTS	54
	Appe Appe Appe Appe	endix B.1 endix B.2 endix B.3 endix B.4 endix B.5	Group 1 Attributes Table Group 1 Pairwise Comparison Matrices - Safety Group 1 Pairwise Comparison Matrices – Environment / Technical Group 1 Pairwise Comparison Matrices – Societal / Economic Group 1 Results Chart	54 59 60 61 62
AF	'YEN	<u>DIX C</u>	GROUP 2 – DETAILED EVALUATION RESULTS	63



Appendix C.1 Appendix C.2 Appendix C.3 Appendix C.4 Appendix C.5	Group 2 Pairwise Comparison Matrices – Environment / Technical Group 2 Pairwise Comparison Matrices – Societal / Economic	63 68 69 70 71
APPENDIX D	GROUP 3 – DETAILED EVALUATION RESULTS	72
Appendix D.1 Appendix D.2 Appendix D.3 Appendix D.4 Appendix D.5	Group 3 Pairwise Comparison Matrices – Safety Group 3 Pairwise Comparison Matrices – Environment / Technical Group 3 Pairwise Comparison Matrices – Societal / Economic	72 75 76 77 78
<u>APPENDIX E</u>	GROUP 4 – DETAILED EVALUATION RESULTS	79
Appendix E.1 Appendix E.2 Appendix E.3 Appendix E.4 Appendix E.5	Group 4 Pairwise Comparison Matrices – Safety Group 4 Pairwise Comparison Matrices – Environment / Technical Group 4 Pairwise Comparison Matrices – Societal / Economic	79 82 83 84 85
<u>APPENDIX F</u>	GROUP 5 – DETAILED EVALUATION RESULTS	86
Appendix F.1 Appendix F.2 Appendix F.3 Appendix F.4 Appendix F.5	Group 5 Pairwise Comparison Matrices – Environment / Technical Group 5 Pairwise Comparison Matrices – Societal / Economic	86 90 91 92 93
APPENDIX G	GROUP 6 – DETAILED EVALUATION RESULTS	94
Appendix G.1 Appendix G.2 Appendix G.3 Appendix G.4 Appendix G.5	Group 6 Pairwise Comparison Matrices – Safety Group 6 Pairwise Comparison Matrices – Environment / Technical	94 99 100 101 102
APPENDIX H	GROUP 1 – OPTION DATASHEETS	103
Appendix H.1 Appendix H.2 Appendix H.3 Appendix H.4	2b – Rock cover exposures 2c – Trench and bury exposures	103 105 107 109
<u>APPENDIX I</u> <u>G</u>	ROUP 2 – OPTION DATASHEETS	111
Appendix I.1 Appendix I.2 Appendix I.3 Appendix I.4	 1 – Disconnect / remove ends and minimal remediation 2b – Rock cover exposures 2c – Trench and bury exposures 3a – Cut and Lift – Cut pipe in to small sections and recover 	111 113 115 117



APPENDIX J	BROUP 3 – OPTION DATASHEETS	119
Appendix J.1 Appendix J.2 Appendix J.3	 1 – Disconnect / remove ends and minimal remediation 3a – Cut and Lift – Cut pipe in to small sections and recover 3b – Reverse Installation – Recover pipe using reverse S-lay or reverse reeling 	119 121 123
APPENDIX K	GROUP 4 – OPTION DATASHEETS	125
Appendix K.1 Appendix K.2 Appendix K.3		125 127 129
<u>APPENDIX L</u>	GROUP 5 – OPTION DATASHEETS	131
Appendix L.2	 1 – Disconnect / remove ends and minimal remediation 2a – Cut and remove exposures (including ends) 2b – Rock cover exposures (including ends) 2c – Trench and bury exposures (including ends) 3a – Cut and Lift – Cut pipe in to small sections and recover 	131 133 135 137 139
APPENDIX M	GROUP 6 – OPTION DATASHEETS	141
Appendix M.1 Appendix M.2	 1 – Disconnect / remove ends and minimal remediation 3b – Reverse Installation – Recover pipe using reverse S-lay or reverse reeling 	141 143



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
СА	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
ТоР	Top of Pipe
VMS	Very Much Stronger
VMW	Very Much Weaker
W	Weaker



Figures and Tables

List of Figures

Figure 1.1: Auk, Fulmer and Auk North Field Layout	12
Figure 1-1: Auk, Fulmar and Auk North Field Layout	12
Figure 4-1: PL1315 Fulmar AD to Judy Wye 24" Oil Export Pipeline	19
Figure 5-1: PL38 Auk to SALM Base 10" Oil Export Pipeline	22
Figure 6-1: PLU4472 Fulmar AD to Oil Export SSIV Control Umbilical	26
Figure 6-2: PLU4473 Oil Export SSIV to NRV Control Umbilical	26
Figure 6-3: PL208 NRV to Fulmar A 20" Gas Export Pipeline	27
Figure 6-4: PL1316 Fulmar AD to NRV 4-1/2" Gas Import Pipeline	27
Figure 7-1: PL378 Auk to Fulmar A 8" Oil Export Pipeline	30
Figure 7-2: PL2651 Auk North to Fulmar A 8" Production Pipeline	31
Figure 8-1: PL63, PL648 Fulmar AD to SALM Base 16" Pipeline	34
Figure 9-1: PLU4471 Auk to Fulmar A Power Cable	37
Figure 9-2: PLU2652 Fulmar A to Auk North Power Cable	38
Figure 9-3: PLU2653 Fulmar A to Auk North EHC Control Umbilical	39
Figure 11-1 Example Pairwise Comparison Matrix (N = Neutral)	48
Figure 11-2 Weighting of Safety Sub-Criteria	49
Figure 11-3 Weighting of Environmental Sub-Criteria	50
Figure 11-4 Weighting of Societal Sub-Criteria	50
Figure 11-5 Weighting of Economic Sub-Criteria	50
Figure 11-6 Example Option Pair-Wise Comparison	52
Figure 11-7 A Visual Output Example	53

List of Tables

Table 2-1: CA Process Overview and Status	13
Table 2-2: CA Main Criteria	15
Table 2-3: Screening Assessment Categories	15
Table 3-1: Groups and Decommissioning Recommendation	18
Table 4-1: Group 1 Item	19
Table 4-2: Group 1 Decommissioning Options	20
Table 5-1: Group 2 Item	22
Table 5-2: Group 2 Decommissioning Options	23
Table 6-1: Group 3 Items	25
Table 6-2: Group 3 Decommissioning Options	28
Table 7-1: Group 4 Items	30
Table 7-2: Group 4 Decommissioning Options	32
Table 8-1: Group 5 Items	34
Table 8-2: Group 5 Decommissioning Options	35



Table 9-1: Group 6 Items	37
Table 9-2: Group 6 Decommissioning Options	40
Table 11-1 Sub-criteria Definition	47
Table 11-2 Explanation of Phrasing Adopted for Pairwise Comparison	49

Appendices

Appendix	Description	Page
А	Evaluation Methodology	45
В	Group 1 – Detailed Evaluation Results	54
С	Group 2 – Detailed Evaluation Results	63
D	Group 3 – Detailed Evaluation Results	72
E	Group 4 – Detailed Evaluation Results	79
F	Group 5 – Detailed Evaluation Results	86
G	Group 6 – Detailed Evaluation Results	94
Н	Group 1 – Option Datasheets	103
I	Group 2 – Option Datasheets	111
J	Group 3 – Option Datasheets	119
К	Group 4 – Option Datasheets	125
L	Group 5 – Option Datasheets	131
М	Group 6 – Option Datasheets	141



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:

Scoping ->	Screening -	Preparation	Evaluation	Recommendation	Review
\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark

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 Justification Recommendation	
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.

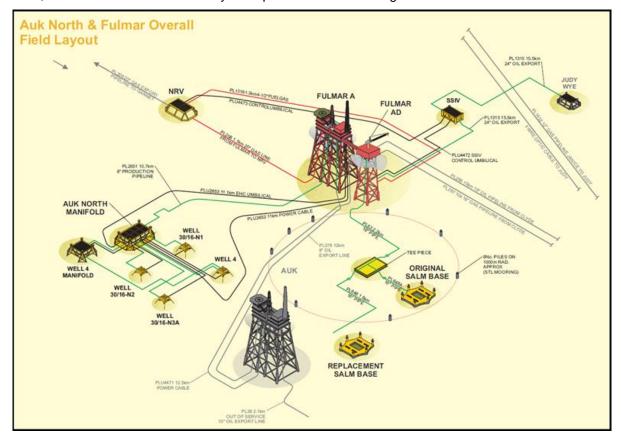


Figure 1-1: Auk, Fulmar and Auk North Field Layout



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) 7 th 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, nonbinding, 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

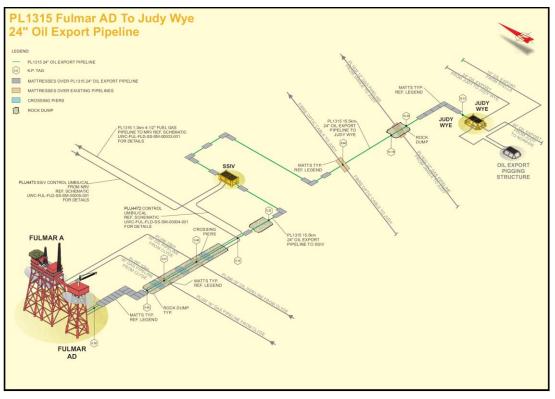


Table 4-1: Group 1 Item

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.		
	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.		
Leave in-situ (remedial intervention)	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.		
	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.		
Full removal	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

			ete Coated Pipeline, Surface Laid and Ex				
Screening	1 ·	 Minimal intervention: Remove exposed ends only. 	2a – Minor intervention: Remove exposures.	2b – Major intervention: Rock cover full line.			
Scre	2c – Major intervention: Trench a bury full line.		3a – Full Removal: Cut and recover.	3b – Full Removal: Reverse Installation.			
		Note: for full	attributes tables and assessment see Appe	endix C			
		risk exposure of back deck workin	y preferred options from a risk to Offshore g associated with Options 2c and 3a being v preferred options from a risk to Onshore	-			
	Safety	associated with handling, transpor	ting and processing large quantities of cut ers during the project, all options are consi	pipe associated with Option 3a.			
			on 3a is preferred being that the infrastruct the preferred option against the Safety crite	-			
	rent	vessel time (with the associated no Options 1, 2b and 2c are equally p the recovery of the entire pipeline		ther options. aterials perspective, as Option 3a involves			
	Environment	represents the maximum amount of Option 1 is preferred from a Seable	source Consumption perspective as rock of material available to be recycled. ad Disturbance perspective as it represents	the least disturbance.			
Evaluation	ū	associated with Option 1, the pipe to the seabed habitat.	erred options from a Loss of Habitat persp ine will remain on the seabed. Option 2b r and associated weightings. Option 2c is a	represents a significant permanent change			
Ē	Technical	Overall, considering all sub-criteria and associated weightings, Option 2c is assessed as the preferred option. 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.					
	Societal	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.					
	Economic						
	bury	all, Option 2c, trench and is to be taken forward as 35.00%	1. Safety 2. Environmental 3. Tech				
	This	elected option. option was deemed to be safest overall and it	27.19%	<u>6.46%</u>			
ح	minin main	nises future liability whilst taining cost	7.08%	6.27% 22.05% 3.49%			
Summary	consi howe	idered achievable, ever, should technical ^{15.00%}	3.13%	4.86%			
0	exec buryi	ng, leave in situ with	6.58% 5.37% 2.84%	5.85%			
	cons optio		5.03% 5.69%	5.79% 3.49%			
		ulted on any proposed of additional rock.	1 - Minimal intervention 2b - Major intervention - - Remove exposed ends Rock cover full line	2c - Major intervention - 3a - Full Removal - Cut Trench and bury full line and recover			



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 $2 - 10^{\circ}$ 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

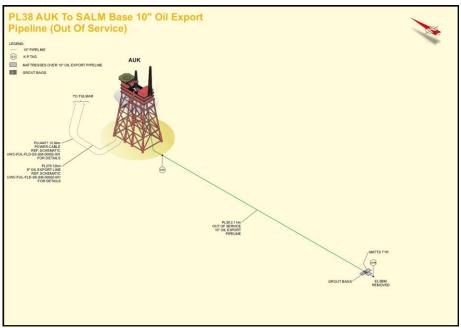


Table 5-1: Group 2 Item

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.		
	2a – Cut and remove	The option will involve disconnection of the pipeline ends, cut and removal of any exposures.		
Leave in-situ	exposures (including ends)	This option was screened out as the entire line is exposed, therefore it is the same as Option 3a.		
(remedial intervention)	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.		
	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.		
Full removal	3b – Reverse Installation – Recover pipe using reverse	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.		
	S-lay or reverse reeling.	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

5.4												
		Group 2 – 10" Co	oncrete Co	ated Pipeline	e, Surface La	id and Ex	(PL38)					
Screening	1 –	Minimal intervention: Remove exposed ends only.	2a –	Minor interve exposu	ntion: Remov res.	е		ntion: Rock cover full ne.				
Scre	2c –	Major intervention: Trench and bury full line.	3a – F	ull Removal:	Cut and recov	er.	3b – Full Removal: Reverse Install					
		Note: for full attributes tables and assessment see Appendix D										
	Option 1 and Option 2b are equally preferred options from a risk to Offshore Personnel perspective, with 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 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.											
Evaluation	With respect to Impact of Decommissioning Operations Offshore all options are assessed as being neutral to each as the environmental impact of the options are largely similar in terms of emissions, marine noise and fuel consump Options 1, 2b and 2c are equally preferred from a Processing of Returned Materials perspective as Option 3a investigation of the entire pipeline. Option 3a is preferred from a Resource Consumption perspective as rock placement is not required, and Option 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, Option and 3a are preferred equally from a Loss of Habitat perspective. Although minimal new material is associated with C 1, the pipeline will remain on the seabed, Option 2b represents a significant permanent change to the seabed habit Overall, considering all sub-criteria and associated weightings, Option 3a is assessed as the preferred option.											
Evalu	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 the each represent a clear seabed. From a Socio-economic impact on communities and amenities perspective all options are considered equally prefer 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/o 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.										
	prefe This	all, Option 2c is selected as the erred option. option was the most preferred ast the Safety and Environmental	30.00%	1. Safety	2. Environmen	tal ∎3. T	echnical 🗖 4. Societal 27.05%					
	the S most	ia and equally preferred against Societal criterion. It was not the preferred against the Technical	25.00%	24.04%	;	2.70%	5.06%	26.22%				
Summary	prefe	rion, however this was ficient to offset other erences. Option 2c was the most erred option prior to economic	20.00% 15.00%	3.35%		4.66%	6.49% 4.00%	6.49%				
Sun	cons rema	ideration being applied and	10.00%	6.00% 5.22%		6.00% 2.69%	5.70%	4.00%				
	How due	ever, if this cannot be achieved to difficulties in executing	5.00% 0.00%	5.03%		5.69%	5.79%	3.49%				
	place be cons	ching and burying, then spot rock ement or full rock armouring may considered. OPRED will be ulted on any proposed use of ional rock		1 - Minim Intervention - F exposed er	Remove - Rock		on 2c - Major interventi e - Trench and bury fu line	on 3a - Full Removal - Cut Ill and recover				



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)
	Fulmar to Oil Export SSIV Umbilical J-tube Section	Fulmar	2	200	4
PLU4472	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 F		Fulmar	4.5	1,182 ⁶	28
	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



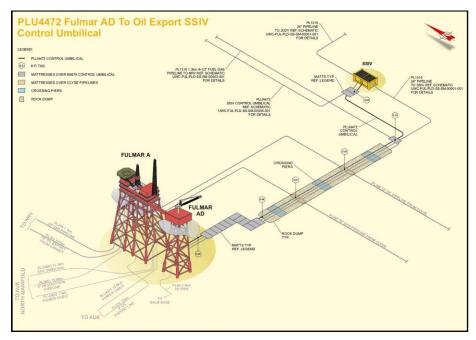


Figure 6-1: PLU4472 Fulmar AD to Oil Export SSIV Control Umbilical

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].

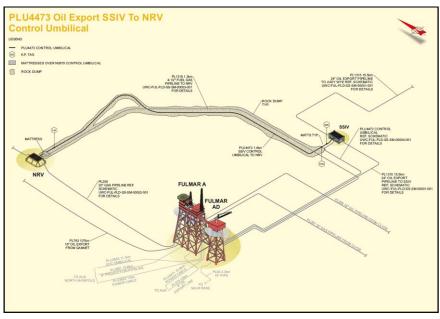


Figure 6-2: PLU4473 Oil Export SSIV to NRV Control Umbilical

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.



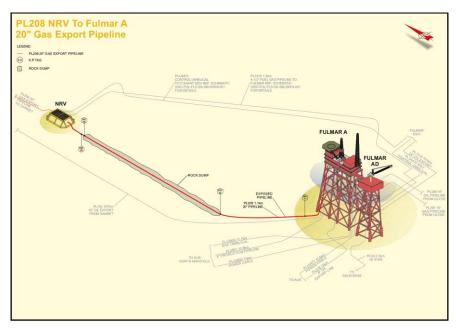


Figure 6-3: PL208 NRV to Fulmar A 20" Gas Export Pipeline

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

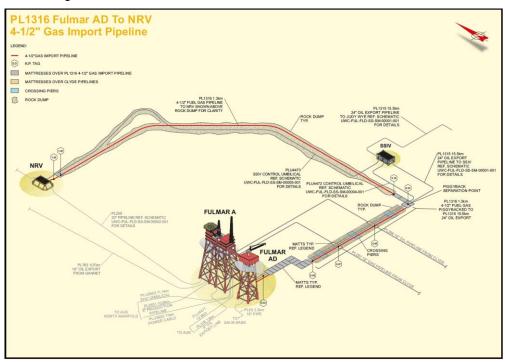


Figure 6-4: PL1316 Fulmar AD to NRV 4-1/2" Gas Import Pipeline



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.				
	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.				
Leave in-situ (remedial intervention)	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.				
	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.				
Full removal	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

	Group 3 – Pipelines & Umbilicals, Surface Laid and Rock Covered (PL208, PL1316, PLU4472, PLU4473)										
Screening	1	 Minimal intervention: Remov exposed ends only. 	e 2a		rvention: Remov s and ends.	'e 2b -	- Major intervention: Ro exposures and end				
Scre	2c	 Major intervention: Trench and bury exposures and ends. 	3a –		al: Cut and recov	/er.	3b – Full Removal: Re Installation.	verse			
	Note: for full attributes tables and assessment see Appendix E										
		Option 1 is preferred from a r									
	Safety	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.									
	Sa	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	•	•	referred as both	result in the li	les being fully remove	J.			
		All options are equally pre-			f Docommissis	ning Oppratio	ne Offebora paranad	ivo as the			
	Environment	environmental impact of the c Option 1 is preferred from a F shore. Options 3a and 3b are preferr	ions, marine r ve as this invo	ioise and fuel consump lives the least material	otion. returned to						
u	Envir	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.									
atio		Overall, Option 1 is assessed	as the preferr	red option.							
Evaluation	Technical	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.									
	Societal	options are equally preferred The quantities of material retu are greater quantities return balanced.	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.								
	Economic	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.									
				1. Safety 🔳	2. Environmental	3. Technical	🗖 4. Societal 🛛 🗖 5. Eco	onomic			
			50.00%								
	Over		45.00%	44.96%							
		not a mail a mail a m	40.00%	9.23%							
2		he lines are rock covered	35.00% ———	6.67%		26.07%	28.98%				
Summary	woul	d not present any clear	30.00% ——— 25.00% ———			20.07%	5.79%				
muš		as the lock would	20.00% ——	11.96%		4.98%	6.67%				
			15.00%	7 6704		6.67%	4.56%				
	liabil	ity, however, that would	10.00% ———	7.67%		3.48%	6.50%				
	be th	e case in any event.	5.00% ——	9.44%		5.84%	5.46%				
			0.00%								
				/linimal Interver move exposed		ll Removal - Cut a recover	nd 3b - Full Removal - F installation	everse			



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)

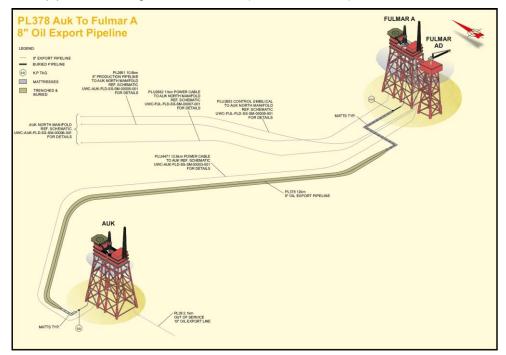


Figure 7-1: PL378 Auk to Fulmar A 8" Oil Export Pipeline

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].

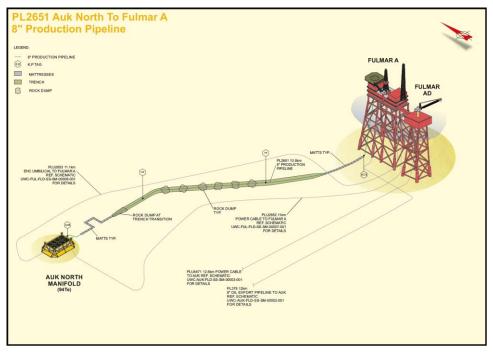


Figure 7-2: PL2651 Auk North to Fulmar A 8" Production Pipeline



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.			
	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.			
Leave in-situ (remedial intervention)	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.			
Fuillemoval	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 remova 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

		Group 4 – Pipe	lines, Fully Trenched and Buried (PL378	8, PL2651)						
Screening	1	 Minimal intervention: Remove exposed ends only. 	2a – Minor intervention: Remove exposures and ends.	2b – Major intervention: Rock cover exposures and ends.						
Scree	2c	 Major intervention: Trench and bury exposures and ends. 	3a – Full Removal: Cut and recover.	3b – Full Removal: Reverse Installation.						
	endix F									
	Safety	Option 1 is preferred from a risk to Option 1 is preferred from a risk and therefore results in the least of All options are equally preferred fr With regards to Residual Risk, Op Overall, Option 1 is assessed as to	volves the least material returning onshore							
ation	Environment	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.								
Evaluation	Technical	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.								
	Societal	clear seabed remains in all cases From a Socio-Economic Impact o onshore manhours relating to job	omic Impact on Communities and Amenities perspective, Option 3a is preferred as there are fewer relating to job creation / retention relating to Option 3b. The quantities of material returned in all nt to cause any significant negative impact on communities.							
	Economic	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.								
	the p	all, Option 1 is selected as referred option.	■ 1. Safety ■ 2. Environmental ■ 00% 50.10% 00% 12.84%	13. Technical 🗧 4. Societal 📑 5. Economic						
Summary	stabl prese This liabili cons	are builded and eremoving them would not ent any clear benefit. 30 does result in an ongoing ity; however, this is idered minimal and ptable (DoB >0.6m). 20	00% 11.96% 2 00% 7.36% 2 00% 11.34% 2	26.07% 3.08% 4.09% 7.41% 5.99% 3.48% 4.56% 5.80% 6.84% 4.07% 4.59%						
			1 - Minimal Intervention - 3a - Full Re	emoval - Cut and 3b - Full Removal - Reverse ecover installation						



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].

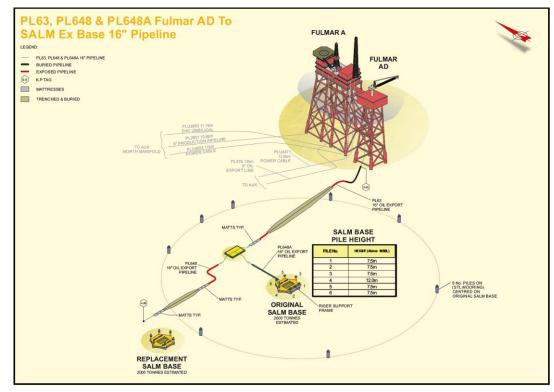


Figure 8-1: PL63, PL648 Fulmar AD to SALM Base 16" Pipeline

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.				
	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.				
Leave in-situ (remedial intervention)	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.				
	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.				
Full removal	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

8.4	5								
		Group 5 – Pipelii	nes, Partially Trenched and Buried (Pl	L63 &PL648)					
Screening	1	 Minimal intervention: Remove exposed ends only. 	2a – Minor intervention: Remove exposures.	2b – Major intervention: Rock cover exposed ends and exposures					
Scre	2c	 Major intervention: Trench and bury full line. 	3a – Full Removal: Cut and recover.	3b – Full Removal: Reverse Installation.					
		Note: for full a	ttributes tables and assessment see Ap	pendix G					
		least exposure for personnel.		ersonnel perspective as these represent the					
	Safety	associated with handling, transport With regard to the risk to Other Use	ing and processing large quantities of cuers, all options are considered equally pr	referable to each other.					
		Considering all sub-criteria and ass	on 3a is preferred being that the infrastru sociated weightings, Option 2c is assess	ed as the preferred option.					
ation	Environment	the associated noise, emissions an Options 1, 2a, 2b and 2c are equinvolves the recovery of the entire p Option 3a is, however, preferred fr 3a represents the maximum amoun Option 1 is preferred from a Seabe	d discharges are neutral and around hal ally preferred from a Processing of Re pipeline. om a Resource Consumption perspective of material available to be recycled. d Disturbance perspective as it has the s	eturned Materials perspective, as Option 3a					
Evaluation	Technical	Overall, considering all sub-criteria and associated weightings, Option 1 is assessed as the preferred option. 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.							
	Societal	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.							
	Economic								
		rall Option 2b is selected as the erred option.	Safety Environment 🔳	Technical 🗧 Societal 🔳 Economic					
Summary	prefe criter than was Tech suffic prefe and t the n econ appli	s close to being the most erred option against the Safety rion (marginally less preferred the most preferred option). It heavily preferred against the unical criterion which was cient to offset it being less erred against the Environmental Societal criteria. Option 2b was nost preferred option prior to nomic consideration being ted. Once economic	25.00% 20.00% 5.00% 5.00% 20.0	21.40% 20.82% 4.08% 4.91% 3.71% 2.91% 4.25% 4.38% 6.83% 3.01% 2.36% 2.57% 4.30% 3.79%					
	1 bee howe econ drive	iderations were applied, Option came slightly preferred, ever, given the guidance that nomic consideration should not the outcome, Option 2b ains the preferred option.	4.15% 3.19% 0.00% 1 - Remove 2a - Remove 2 exposed ends exposed ends exposures	4.21% 4.35% 4.10% b - Rock cover 2c - Trench and 3a - Full Removal xposed ends & bury exposed - Cut and recover exposures ends & exposures					



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].

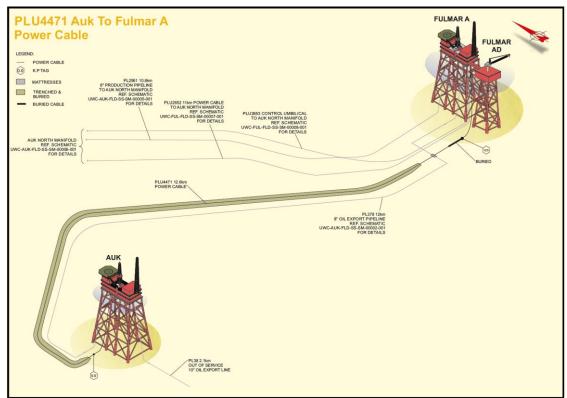


Figure 9-1: PLU4471 Auk to Fulmar A Power Cable

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].

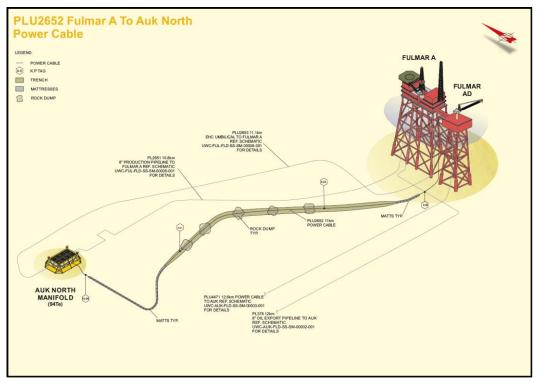


Figure 9-2: PLU2652 Fulmar A to Auk North Power Cable



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].

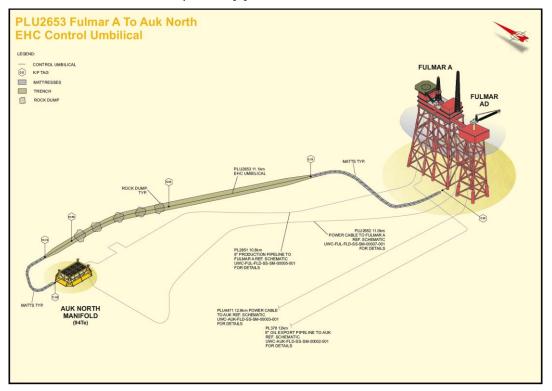


Figure 9-3: PLU2653 Fulmar A to Auk North EHC Control Umbilical



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.			
	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.			
Leave in-situ (remedial intervention)	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.			
Full removal	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

	110	Group 6 - Umbilical	s & Cable	es – Trenched and Buried (PLU4471, P	L 112652 PL 112653)					
	1 M	linimal intervention: Remove e			2b – Major intervention: Rock cover					
Screening	1 — 111	ends only.	xposed	2a – Minor intervention: Remove exposures and ends.	exposures and ends.					
Scre	2c –	Major intervention: Trench and exposures and ends.	d bury	3a – Full Removal: Cut and recover.	3b – Full Removal: Reverse Installation.					
		Note: fo	or full attri	butes tables and assessment see Appen	dix H					
	Safety	Option 1 is preferred from a therefore results in less oper From a risk to Other Users p	risk to O ations an erspective ective, Op	d less exposure. e both options are equally preferred. otion 3b is preferred as the umbilicals an	es less operations than Option 3b. ves less material returning onshore and d cables are fully removed and therefore					
Evaluation	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.									
Evalu	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.									
	Option 3b is assessed as preferable, as whilst the full area is available for commercial fishing operations under 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, althout the additional impact is expected to minimal due to transporting reeled umbilicals / cables. Overall, Option 3b is preferable.									
	Economic	With no long-term liability, Op	otion 3b is	ption 1 is preferred with respect to short t s preferred with respect to long term cost ociated weightings, Option 1 is assessed	s.					
			70.00%	1. Safety 2. Environmental 3. Tec	hnical 🧧 4. Societal 🗧 5. Economic					
		II, Option 1 is selected as	60.00%	57.63%						
	•	eferred option.	50.00%	10.25%	42.37%					
Summary	remov	ring them would not present ent benefit to warrant that	40.00%	9.60%	9.75%					
Sum	option		30.00%	15.00%	10.40%					
	liability	y; however, this is dered minimal and	20.00%	9.84%	5.00%					
		table (DoB >0.6m).	10.00%	12.94%	10.16%					
			0.00%	1 - Minimal Intervention - Remove exposed end	7.06% 3b - Full Removal - Reverse Reeling					



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

- > Technical
- > Environmental > Societal
- > Economic

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			
	1.1 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			
1. Safety	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.	place within the various Screened options. Hazard associated with the activities were identified ar any potential Major Accident Hazards (MAH) we identified. An initial risk scoring was applied to ead activity / hazard which was further considered			
	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.	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 Sinopeo Resources UK Risk Matrix to allow comparison between options.			
	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.				
	2.1 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.				
2.	2.2 Processing of Returned Materials	This sub-criterion covers the Processing of Returned Materials resulting in Use of Landfill	An ENVID was conducted as a group activity within a workshop format to determine the environmental threats applicable to the decommissioning operation options.			
Environmental	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)	With an appreciation of the threats industry experience was applied to qualitatively assess each option with respect to the sub-criteria.			
	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.
	4.1 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. Societal	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.
	5.1 Short-term CostsThis 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. Economic	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	Ν	20%
2. Environmental	N	N	N	N	Ν	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	мw	15.24%
2.2 Processing of Returned Materials	w	N	s	MW	мw	11.28%
2.3 Resource Consumption	w	w	N	MW	мw	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.



		. Technic	cal	ve - End Removal - d Rock Placement	ve - End removal - lete Rock Placement	ve - End Removal	rench Removal - Cut and		Weighting		
1. Safety		면 1. Leave - End Removal - 는 Limited Rock Placement		5.	Economic		1. Leave - End Removal - Limited Rock Placement	2. Leave - End removal - Complete Rock Placement	3. Leave - End Removal and Trench	emoval - Cut and	Weighting
1. Leave - End Removal -		Complete Rock Placement Complete Rock Placement Currench Curren				1. Leave Limited I	2. Leave Complet	3. Leave - E and Trench	4. Full Removal lift	-	
Limited Rock Placement					- End Remova Rock Placeme		Я	s	MS	VMS	50.50%
Complete Rock Placement					e - End remova e Rock Placen		w	N	s	MS	26.35%
and Trench				3. Leave - End Removal and Trench			MW	w	N	s	15.21%
4. Full Removal - Cut and lift	VMW			4. Full R lift	emoval - Cut a	nd	VMW	MW	w	N	7.94%

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

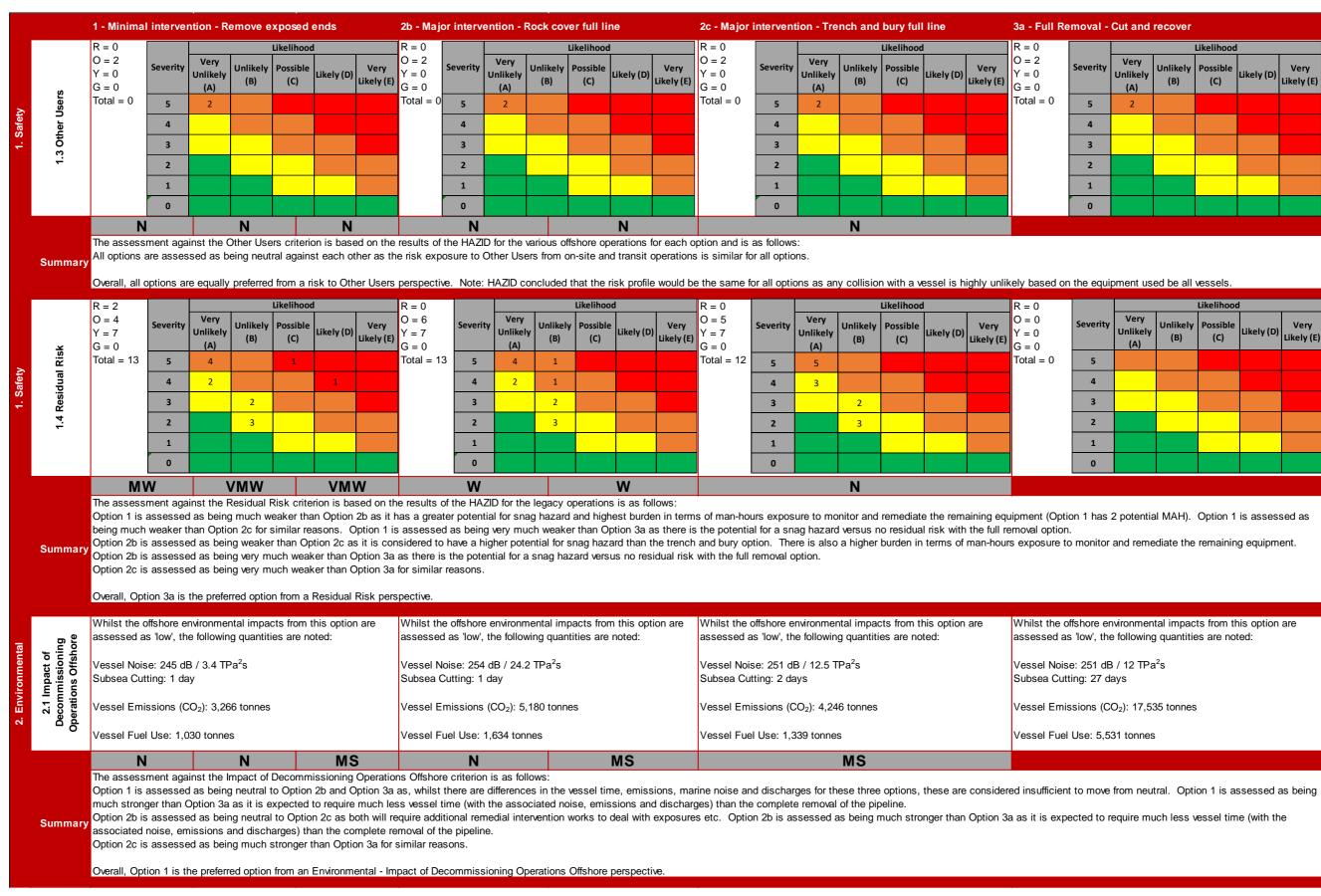
2c - Major intervention - Trench and bury full line 1 - Minimal intervention - Remove exposed ends 2b - Major intervention - Rock cover full line 3a - Full Removal - Cut and recover R = 0 Likelihood Likelihoo R = 0 Likelihood R = 0 R = 0 0 = 7Very $\Omega = 6$ Verv O = 7O = 9Verv Unlikely Very Unlikely Possible Very Unlikely Very Severity Possible Severity Severity Possible Y = 10 Unlikely ikely (D) ′ = 12 Unlikely Y = 13 Unlikely ikely (D) ikely (D) = 7 Offshore Likely (E) (C) (B) (C) (B) Likely (E) (B) (C) Likely (E) (A) (A) (A) G = 2 ∋ = 2 G = 4G = 3 Total = 19Total = 20 Total = 24 Total = 19 5 5 2 5 2 2 4 5 4 4 4 2 Personnel 4 3 1 3 3 4 3 1 3 6 8 2 7 2 2 1 Ξ 1 1 1 0 0 0 S MS S MS Ν MS 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. Summary operations. 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 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. R = 0 R = 0R = 1 R = 0O = 2 Very 0 = 1Very O = 3 Very O = 13 Unlikely Verv Unlikely Possible Verv Unlikely Severity Possible Severity Severity Possible Very Unlikely Unlikely Unlikelv Y = 11 Likely (D) Y = 11 ikely (D) ikelv (D) ' = 11= 2 Onshore Likely (E) (B) (C) Likely (E) (B) (C) Likely (E) (B) (C) G = 2 (A) G = 2 (A) G = 2 (A) G = 0 Total = 15 5 Total = 14 5 Total = 16 Total = 16 5 4 4 4 4 1 4 4 1 Personnel 2 2 3 3 3 3 3 2 3 2 2 2 2 2 2 2 2 2 2 1 1 1 0 0 0 Ν Ν MS Ν MS MS 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). Summary 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.

Appendix B.1 **Group 1 Attributes Table**



		Likelihood										
everity	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												

	Likelihood										
everity	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											





3a - Full Removal - Cut and recover

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

_			Likelihood		
everity	Very Unlikely (A)	Unlikely (B)		Likely (D)	Very Likely (E)
5					
4					
3					
2					
1					
0					

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

Vessel Noise: 251 dB / 12 TPa²s

Vessel Emissions (CO₂): 17,535 tonnes

				2b - Major intervention - Roo	ck cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover			
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:		material returned under this option are assessed as 'low', the		Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted:	Whilst the onshore environmental impacts from processing mate returned under this option are assessed as 'low', the following quantities are noted:				
2.2 Proce Retu Mate	Concrete Coated Steel Pipe:- 123 tonnes Concrete Mattresses:- 277 tonnes Grout Bags:- 3 tonnes			Concrete Mattresses:- 277 tonnes		Concrete Coated Steel Pipe:- 123 tonnes Concrete Mattresses:- 277 tonnes Grout Bags:- 3 tonnes	Concrete Coated Steel Pipe:- 8,203 tonnes Concrete Mattresses:- 277 tonnes Grout Bags:- 3 tonnes			
	N	N	S	N	S	S				
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 proce 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.										
urce otion	Whilst the environmen (not fuel) under this of quantities are noted:	•		Whilst the environmental impact (not fuel) under this option is a quantities are noted:	ct from the resources consumed ssessed as 'low', the following	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted:	Whilst the environmental impact from the resources consumed fuel) under this option is assessed as 'low', the following quanti are noted:			
2.3 Resource Consumption	Rock for rock cover: 2	200 tonnes (cut ends o	only)	Rock for rock cover: 203,100 to	onnes	Rock for rock cover: 400 tonnes (cut ends only)	Rock for rock cover: Not required for this full removal option			
2.3 Coi	Emissions for replace	ment material (CO ₂):	10,976 tonnes	Emissions for replacement material (CO ₂): 10,976 tonnes		Emissions for replacement material (CO2): 10,976 tonnes	Emissions for replacement material (CO ₂): None			
	Emissions from recov	ered material (CO ₂): 1	78 tonnes	Emissions from recovered material (CO ₂): 178 tonnes		Emissions from recovered material (CO ₂): 178 tonnes	Emissions from recovered material (CO ₂): 5,518 tonnes			
			W sumption criterion is a		VMW	W	ount for Option 2b. Option 1 is assessed as being neutral to Op			
Summary	The assessment agai Option 1 is assessed 2c as the rock cover a Option 2b is assesse amount of rock cover Option 2c is assesse	as being much strong and replacement mate d as being much weal material and a large a d as being weaker tha	isumption criterion is a ger than Option 2b as, rials are largely similar ker than Option 2c as, mount of replacement	s follows: whilst the amount of replacemen c. Option 1 is assessed as being whilst the amount of replacemer material for the remaining pipelin rge amount of replacement mate	t material is the same, Option 1 g weaker than Option 3a as there tt material is the same, Option 2t e.	W only requires a small amount of rock cover material versus a large am is a much higher requirement for replacement material for the remain prequires a large amount of rock cover material. Option 2b is assess	ing pipeline under Option 1.			
Summary	The assessment agai Option 1 is assessed 2c as the rock cover a Option 2b is assesse amount of rock cover Option 2c is assesse Overall, Option 3a is t	as being much strong and replacement mate d as being much weal material and a large a d as being weaker that the preferred option fro	sumption criterion is a: ger than Option 2b as, ' rrials are largely similar ker than Option 2c as, mount of replacement in Option 3a due the la	s follows: whilst the amount of replacemen . Option 1 is assessed as being whilst the amount of replacemer material for the remaining pipelin rge amount of replacement mate	t material is the same, Option 1 g weaker than Option 3a as there it material is the same, Option 2t e. rial for the remaining pipeline.	only requires a small amount of rock cover material versus a large am is a much higher requirement for replacement material for the remain o requires a large amount of rock cover material. Option 2b is assess	ing pipeline under Option 1. ed as being very much weaker than Option 3a as it requires a la			
	The assessment agai Option 1 is assessed 2c as the rock cover a Option 2b is assesse amount of rock cover Option 2c is assesse	as being much strong and replacement mate d as being much weal material and a large a d as being weaker that the preferred option fron thal impact in terms of or this option, there is	Isumption criterion is a: ger than Option 2b as, ' rrials are largely similar ker than Option 2c as, mount of replacement in Option 3a due the la om a Resource Consum f Seabed Disturbance impact from	s follows: whilst the amount of replacemen . Option 1 is assessed as being whilst the amount of replacemer material for the remaining pipelin rge amount of replacement mate	t material is the same, Option 1 g weaker than Option 3a as there it material is the same, Option 2t e. rial for the remaining pipeline. ct in terms of Seabed Disturbanc tion, there is an increased	only requires a small amount of rock cover material versus a large am is a much higher requirement for replacement material for the remain	Whilst the environmental impact in terms of Seabed Disturband assessed as 'low' for this option, there is impact from removing entire line. The area of impact is as follows:			
2.4 Disturbance	The assessment agai Option 1 is assessed 2c as the rock cover a Option 2b is assesse amount of rock cover Option 2c is assesse Overall, Option 3a is t Whilst the environment is assessed as 'low' fur introducing the rock of	as being much strong and replacement mate d as being much weal material and a large a d as being weaker that the preferred option fron that impact in terms of or this option, there is cover at the exposed e	Isumption criterion is a: ger than Option 2b as, ' rrials are largely similar ker than Option 2c as, mount of replacement in Option 3a due the la om a Resource Consum f Seabed Disturbance impact from	s follows: whilst the amount of replacement . Option 1 is assessed as being whilst the amount of replacemert material for the remaining pipelin rge amount of replacement mater aption perspective. Whilst the environmental impact is assessed as 'low' for this op environmental impact from rock	t material is the same, Option 1 g weaker than Option 3a as there it material is the same, Option 2t le. rial for the remaining pipeline. ct in terms of Seabed Disturbanc tion, there is an increased c covering the entire line. The	 only requires a small amount of rock cover material versus a large amount is a much higher requirement for replacement material for the remain or requires a large amount of rock cover material. Option 2b is assess 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: 	Whilst the environmental impact in terms of Seabed Disturbanc assessed as 'low' for this option, there is impact from removing entire line. The area of impact is as follows:			
Disturbance	The assessment agai Option 1 is assessed 2c as the rock cover a Option 2b is assesse amount of rock cover Option 2c is assesse Overall, Option 3a is t Whilst the environment is assessed as 'low' fi introducing the rock co impact is as follows: Seabed Disturbance:	as being much strong and replacement mate d as being much weal material and a large a d as being weaker that the preferred option fron that impact in terms of or this option, there is over at the exposed e 100 m ²	Isumption criterion is a ger than Option 2b as, i rrials are largely similar ker than Option 2c as, mount of replacement in Option 3a due the la om a Resource Consum f Seabed Disturbance impact from inds. The area of	s follows: whilst the amount of replacemen r. Option 1 is assessed as being whilst the amount of replacemen material for the remaining pipelin rge amount of replacement mate amount of replacement mate ption perspective. Whilst the environmental impact is assessed as 'low' for this op environmental impact from rock area of impact is as follows: Seabed Disturbance: 77,530 m	t material is the same, Option 1 g weaker than Option 3a as there it material is the same, Option 2t re. rrial for the remaining pipeline. ct in terms of Seabed Disturbanc tion, there is an increased c covering the entire line. The	 only requires a small amount of rock cover material versus a large amount of rock cover material for the remain to requires a large amount of rock cover material. Option 2b is assess 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 m² 	Whilst the environmental impact in terms of Seabed Disturband assessed as 'low' for this option, there is impact from removing entire line. The area of impact is as follows:			
Disturbance	The assessment agai Option 1 is assessed 2c as the rock cover a Option 2b is assesse amount of rock cover Option 2c is assesse Overall, Option 3a is t Whilst the environment is assessed as 'low' for introducing the rock of impact is as follows: Seabed Disturbance: MS	as being much strong and replacement mate d as being much weal material and a large a d as being weaker that the preferred option fro ntal impact in terms of or this option, there is rover at the exposed e 100 m ²	sumption criterion is a ger than Option 2b as, i rials are largely similar ker than Option 2c as, mount of replacement i in Option 3a due the la om a Resource Consum f Seabed Disturbance impact from inds. The area of	s follows: whilst the amount of replacement . Option 1 is assessed as being whilst the amount of replacemert material for the remaining pipelin rge amount of replacement mater aption perspective. Whilst the environmental impart is assessed as 'low' for this op environmental impact from rock area of impact is as follows: Seabed Disturbance: 77,530 m	t material is the same, Option 1 g weaker than Option 3a as there it material is the same, Option 2t le. rial for the remaining pipeline. ct in terms of Seabed Disturbanc tion, there is an increased c covering the entire line. The	 only requires a small amount of rock cover material versus a large amount is a much higher requirement for replacement material for the remain or requires a large amount of rock cover material. Option 2b is assess 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: 	Whilst the environmental impact in terms of Seabed Disturbant assessed as 'low' for this option, there is impact from removing entire line. The area of impact is as follows:			
Disturbance	The assessment agai Option 1 is assessed 2c as the rock cover a Option 2b is assesse amount of rock cover Option 2c is assesse Overall, Option 3a is t Whilst the environmer is assessed as 'low' fi introducing the rock c impact is as follows: Seabed Disturbance: M S The assessment agai Option 1 is assessed	as being much strong and replacement mate d as being much weal material and a large a d as being weaker that the preferred option fro ntal impact in terms of or this option, there is rover at the exposed e 100 m ² MS nst the Seabed Distur- as being much strong	sumption criterion is a ger than Option 2b as, i rials are largely similar ker than Option 2c as, mount of replacement in Option 3a due the la om a Resource Consum f Seabed Disturbance impact from inds. The area of bance (short-term impa- ger than Option 2b as ti	s follows: whilst the amount of replacemen c. Option 1 is assessed as being whilst the amount of replacemer material for the remaining pipelin rge amount of replacement mate aption perspective. Whilst the environmental impart is assessed as 'low' for this op environmental impact from rock area of impact is as follows: Seabed Disturbance: 77,530 m N act) criterion is as follows: here is much less short-term sea	t material is the same, Option 1 g weaker than Option 3a as there it material is the same, Option 2t e. rial for the remaining pipeline. ct in terms of Seabed Disturbanc tion, there is an increased c covering the entire line. The 1 ² W abed disturbance than rock cover	 only requires a small amount of rock cover material versus a large amount of rock cover material for the remain to requires a large amount of rock cover material. Option 2b is assess 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 m² 	Whilst the environmental impact in terms of Seabed Disturbances as solved as being very much weaker than Option 3a as it requires a lateral whilst the environmental impact in terms of Seabed Disturbances as sessed as 'low' for this option, there is impact from removing entire line. The area of impact is as follows: Seabed Disturbance: 15,250 m ²			
2.4 Disturbance	The assessment agai Option 1 is assessed 2c as the rock cover a Option 2b is assesse amount of rock cover Option 2c is assesse Overall, Option 3a is t Whilst the environment is assessed as 'low' fintroducing the rock of impact is as follows: Seabed Disturbance: MS The assessment agai Option 1 is assessed disturbance than trencover. Option 2b is assesse Option 3a as, whilst t	as being much strong and replacement mate d as being much weal material and a large a d as being weaker that the preferred option from that impact in terms of or this option, there is cover at the exposed e 100 m ² MS nst the Seabed Distur- as being much strong ching and burying the d as being neutral to 0 he area associated with	sumption criterion is a: ger than Option 2b as, i rials are largely similar ker than Option 2c as, mount of replacement i in Option 3a due the la om a Resource Consum f Seabed Disturbance impact from inds. The area of bance (short-term impa- ger than Option 2b as ti entire line. Option 1 is Option 2c as, whilst the th rock cover is greated	s follows: whilst the amount of replacement c. Option 1 is assessed as being whilst the amount of replacemert material for the remaining pipeling rge amount of replacement mater aption perspective. Whilst the environmental impact is assessed as 'low' for this op environmental impact from rock area of impact is as follows: Seabed Disturbance: 77,530 m N act) criterion is as follows: here is much less short-term sea a assessed as being stronger that a area associated with rock cover than cut and lift, the level of imp	t material is the same, Option 1 g weaker than Option 3a as there it material is the same, Option 2t e. rial for the remaining pipeline. to in terms of Seabed Disturbanc tion, there is an increased c covering the entire line. The 12 W abed disturbance than rock cover an Option 3a as, whilst the area of r is greater than trench and bury, pact of performing cut and lift of a	 only requires a small amount of rock cover material versus a large amount is a much higher requirement for replacement material for the remain to requires a large amount of rock cover material. Option 2b is assess 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 m² 	Whilst the environmental impact in terms of Seabed Disturbances a law whilest the environmental impact in terms of Seabed Disturbances are solved by the assessed as 'low' for this option, there is impact from removing entire line. The area of impact is as follows: Seabed Disturbance: 15,250 m ² Seabed Disturbance: 15,250 m ² control of the assessed as being weaker that the assesses the assessed as being weaker that the assesses the asses			



		1 - Minimal interven	tion - Remove expo	osed ends	2b - Major intervention - Roc	k cover full line	2c - Major intervention - Trench and bury full line	3a - Full Rem			
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 (long-term impact) is assessed an impact from rock covering th permanently alter the habitat ty benthic community. The area of Rock cover: 77,530 m ²	as 'low' for this option, there is he entire line which will pe and will therefore impact the	There are no long-term impacts or loss of habitats expected from the trench and bury of the pipeline.	There are negli from the full re			
		MS	MW	MW	VMW	VMW	Ν				
	Summary	Option 1 is assessed greater than the trench Option 2b is assessed Option 2c is assessed	as being much strong h and bury option. O d as being very much d as being neutral to (ption 1 is assessed as weaker than Option 2c Option 3a as there will I	he rock cover will permanently all being much weaker than Option as the rock cover will permanent	3a as the pipeline will remain on the alter the habitat over a large a	ssed as being much weaker than Option 2c as the pipeline will remain the seabed and therefore the long-term habitat change will be greated rea. Option 2b is assessed as being very much weaker than Option in and bury or full removal options.	r than the full rer			
3. Technical	3.1 Technical Risk	Feasibility:- High Concept Maturity:- H Availability of Techn widely available Track Record:- Hig Risk of Failure:- Low Consequence of Fail	nology:- High - All v h - Operations consid w		Feasibility:- High Concept Maturity:- High Availability of Technology:- equipment widely available Track Record:- High - Opera Risk of Failure:- Low Consequence of Failure:- Lin schedule	ations considered routine	 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:- numerous occa Concept Matu Availability o equipment wou technology is I recover pipe se Track Record the track recor Risk of Failur distances. May simultaneous o Consequence and schedule i 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 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 stronger than Option 2 cas 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 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, Option 1 and Option 2b are equally preferred from a Technical Risk perspective.									
4. Societal	4.1 Impact on Commercial Fisheries	Leaving majority of pip to fishing operations d			Whist area impacted from rock greater, it is expected that fishi 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 in plac			
		W	MW	MW	MW	MW	Ν				
	Summary	Option 1 is assessed and full removal option Option 2b is assessed Option 2c is assessed	as weaker than Optic ns effectively return th d as being much weal d as being neutral to 0	e full area to the fishing ker than Option 2c and Option 3a as they both	eline in place is considered wors i industry for fishing operations. Option 3a for similar reasons.	e from a fishing operations persp	ective than the full rock cover option. Option 1 is assessed as being	g much weaker t			



val - Cut and recover

ligible long-term impacts or loss of habitats expected emoval of pipeline by cut and lift.

and therefore the long-term habitat change will be moval option. asons.

High - Cutting pipelines has been conducted on casions.

turity:- High

of Technology:- Medium - Generally, vessel and build be widely available. However, suitable diverless limited. A specialist lifting tool may be required to sections.

d:- Low - Routine operation on a unit basis, however ord for the size and length of pipeline does not exist.
Ire:- High - Considered challenging over extended ay require diver support. Extended subsea works and operations.

e of Failure:- Failure would result in significant cost impact. Requirement for alternative decommissioning

the equipment required for trenching a concrete eing much stronger than Option 3a. The low track

challenging than full removal, in addition the high risk

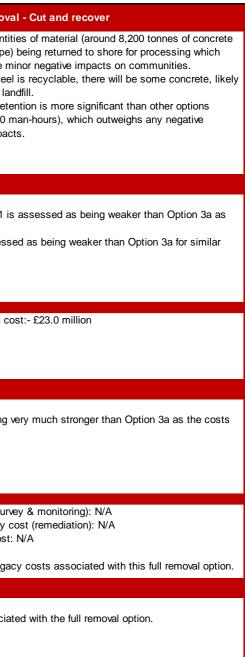
equence of failure are the key differences.

e pipeline returns the area lost from having the ce to the fishing industry for fishing operations.

han Option 2c and Option 3a as the trench and bury

		1 - Minimal interven	tion - Remove expos	ed ends	2b - Major intervention - Rock	cover full line	2c - Major intervention - Trench and bury full line	3a - Full Remo				
4. Societal	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 ma coated steel pipe) being returned in limited negative impacts on co The returned steel is recyclable, of concrete, likely to be placed i Job creation / retention minimal 48,000) man-hours to deliver this	d to shore for processing results ommunities. there will be a minimal amount n landfill. due to relatively low (around	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 quan coated steel pip results in some The returned ste to be placed in I Job creation / re (around 145,000 community impa				
		N	N	W	N	W	W					
	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 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 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 neutral to Option 3a, again for 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, 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				ion	Initial operation cost:- £5.6 million	Initial operation				
		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 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		& monitoring): £1.5 milli (remediation): £700,00 2 million		Legacy cost (survey & monitorin Potential legacy cost (remediation Total legacy cost: £880,000	<i>c,</i>	Legacy cost (survey & monitoring): £380,000 Potential legacy cost (remediation): £500,000 Total legacy cost: £880,000	Legacy cost (su Potential legacy Total legacy cos				
	5.2							There are no leg				
	Summary	Option 1 is assessed Option 2b is assessed	d as being neutral to O d as being much weake	r than Option 2b and C ption 2c as the costs a er than Option 3a for s	option 2c as the costs are around are the same. Option 2b is asse imilar reasons.	o 1	MW sed as being very much weaker than Option 3a as there are no long-t n Option 3a as there are no long-term costs associated with the full r					





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%

	Appendix B.2	Group 1 Pairwise Comparison Matrices -	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	Weighting	
1 - Minimal intervention - Remove exposed ends	N	N	N	MS	30%	1 - Re
2b - Major intervention - Rock cover full line	N	N	N	MS	30%	2b Ro
2c - Major intervention - Trench and bury full line	N	N	N	MS	30%	2c Tre
3a - Full Removal - Cut and recover	MW	MW	MW	N	10%	3a rec

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	vмw	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%

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



Weighting
25%
25%
25%
25%

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
1 - Minimal intervention - Remove exposed ends	N	MS	N	w
2b - Major intervention - Rock cover full line	MW	N	MW	VMW
2c - Major intervention - Trench and bury full line	N	MS	N	w
3a - Full Removal - Cut and recover	S	VMS	S	N

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	vмw	vмw	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
1 - Minimal intervention - Remove exposed ends	N	N	s	MS
2b - Major intervention - Rock cover full line	N	N	S	MS
2c - Major intervention - Trench and bury full line	w	w	N	MS
3a - Full Removal - Cut and recover	MW	MW	MW	N



Weighting
25%
7%
25%
44%

Weighting
33%
33%
24%
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%

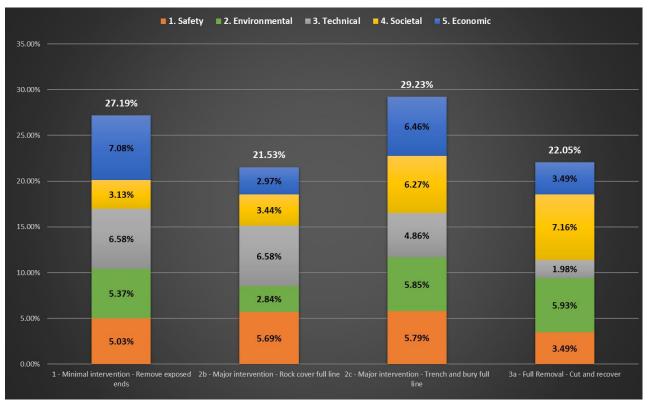
4.2 Socio- economic impact on communities and amenities	1 - Minimal intervention - Remove exposed ends	2b - Major intervention - Rock cover full line	2c - Major intervention - Trench and bury full line	3a - Full Removal - Cut and recover	Weighting
1 - Minimal intervention - Remove exposed ends	N	N	N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







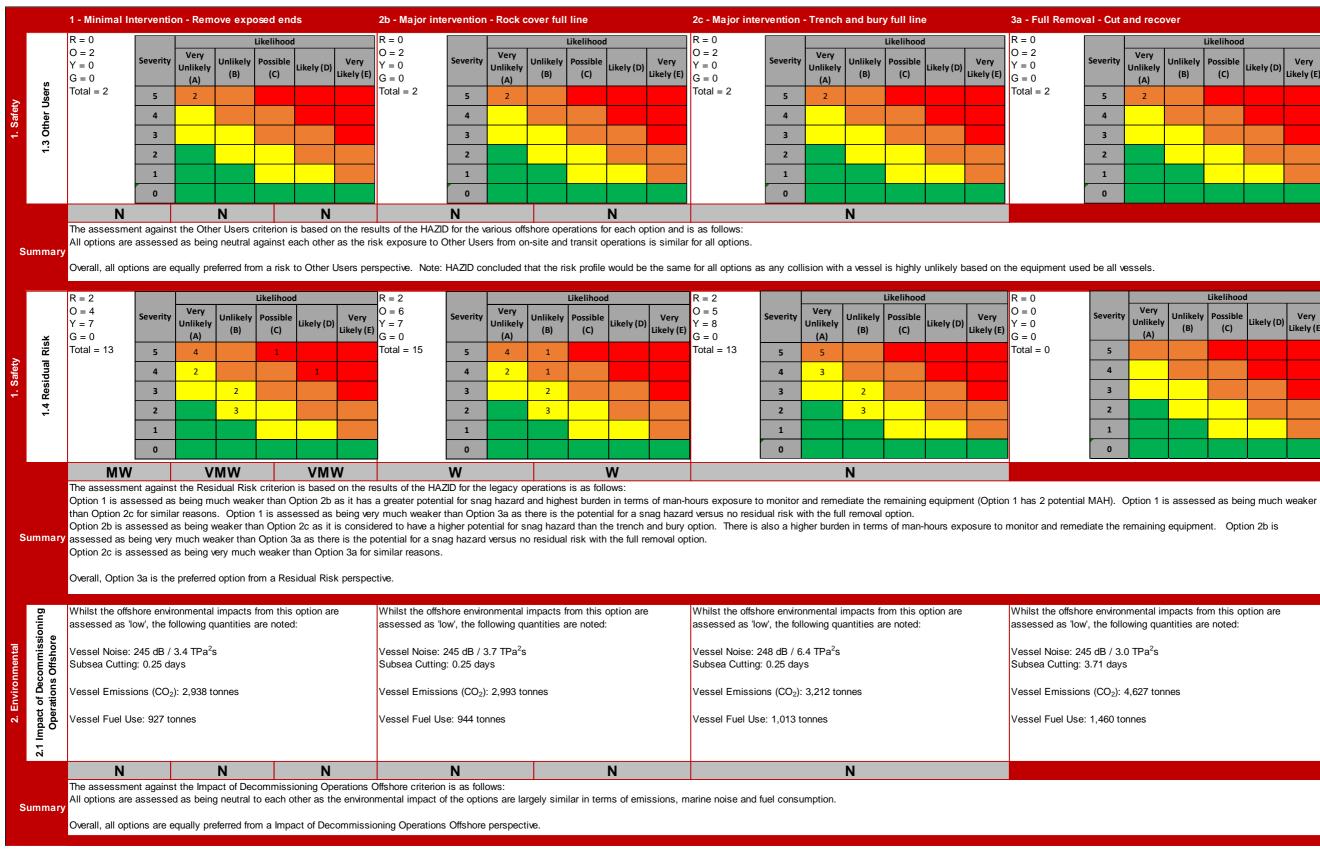
Appendix B.5 Group 1 Results Chart

GROUP 2 – DETAILED EVALUATION RESULTS APPENDIX C

	1 - Minimal I	nterventi	on - Rem	iove exp	osed end	ls		2b - Major inte	rvention	- Rock co	over full	line			2c - Major inte	ervention	- Trench	and bur	y full line	e		3a - Full Remo	val - Cut a	and reco	ver			
	R = 0				Likelihood			R = 0				Likelihood	1	1	R = 0				Likelihood	ł		R = 0				Likelihood		
ty Offshore	O = 7 Y = 10 G = 4	Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)	O = 6 Y = 10 G = 4	Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)	O = 6 Y = 12 G = 2	Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)	O = 7 Y = 8 G = 1	Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
Offsl	Total = 21	5	2					Total = 20	5	2					Total = 19	5	1					Total = 16	5	1				
Safety nnel O		4		5					4		4					4	2	4					4		3	1		
1. Safe Personnel		3	1	3					3	1	3					3		3					3		2	1		
1 Pe		2	3	6					2	3	6					2	1	7		1			2	1	4	1	1	
÷		1		1					1		1					1		1					1			1		
		0							0							0							0					
	N			S		MS	i		S			N	IS				I	MS										
Summar	assessed as Option 2b is a Option 2c is a	being muc ssessed a ssessed a	th stronge as being the as being the	er than Op stronger t much stro	ption 3a as than Optio onger than	s it has le in 2c as it i Option 3	ess risk ex has less a as it ha	ilar risk exposure kposure, with the risk exposure as s less risk expos to Offshore Perso	cut and I it has lessure as th	it having r ss back o ere are no	many lifts leck work c cutting,	and onb ing. Opt lifting or	oarding c tion 2b is onboardi	of pipe. assesse ng operat	d as being much tions.	h stronger	than Opti	ion 3a as i	t has les			0					•	
	R = 0				Likelihoo	d		R = 0				Likelihood	4		R = 0				Likelihood	ł		R = 0				Likelihood		
ore	O = 2 Y = 11 G = 2	Severit	y Very Unlikel (A)	y Unlikel (B)	y Possible (C)	Likely (D)	Very Likely (E)	O = 3 Y = 11 G = 2	Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)	O = 3 Y = 11 G = 2	Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)	O = 10 Y = 7 G = 0	Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
1. Safety ersonnel Onshore	Total = 15	5						Total = 16	5						Total = 16	5						Total = 17	5		1			
Safety nnel C		4	4						4	4	1					4	4	1					4	2	1	1		
1. S rson		3	2	3					3	2	3					3	2	3					3		2	3		
2 Pe		2	1		2	2			2	1		2	2			2	1		2	2			2		1	1	3	
÷		1		1					1		1					1		1					1			1		
		0							0							0							0					
	Ν			Ν		MS			Ν				IS				I	MS										
Summar	Option 1 is as quantities of o y Option 2b is a Option 2c is a	sessed as ut pipe (C ssessed a ssessed a	s being na option 3a as being r as being r	eutral to (also has neutral to much stro	Option 2b a potentia Option 2c onger than	and Optic I MAH). c as they n Option 3	on 2c as ti have a sir a, againsi	the results of the hey have a simila nilar risk exposu t for similar reaso Onshore Personi	ar risk exp rre. Optio ons.	oosure. C n 2b is as	Option 1 is	s assess	ed as bei	ing much	stronger than O	ption 3a a							ith handling	g, transpo	orting and	processi	ng large	
	Overall, Optio	is I, 20 a		uia pe ed	ually preie	ened nom	a lisk to	Onshole Person	nei peispe	ective.																		

Appendix C.1 Group 2 Attributes Table







al - Cut and recover											
	Likelihood										
Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)						
5	2										
4											
3											
2											
1											
0											

		Likelihood		
Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
	Unlikely	Very Unlikely (B)	Very Unlikely (B) (C)	Unlikely (B) (C) Likely (D)

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

Vessel Emissions (CO₂): 4,627 tonnes

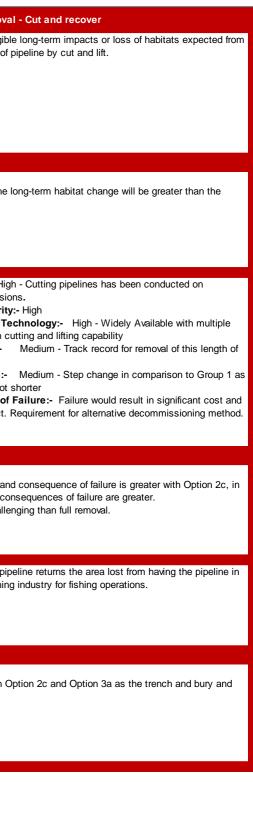
		1 - Minimal Interventi	on - Remove exposed	d ends	2b - Major intervention - Rock co	over full line	2c - Major intervention - Trench and bury full line	3a - Full Remova				
Environmental	Processing of urned Materials	Whilst the onshore envi returned under this option quantities are noted:	ronmental impacts from	n processing material	Whilst the onshore environmental in returned under this option are asses quantities are noted:	npacts from processing material	Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following quantities are noted:	Whilst the onshore				
2. Enviro	~ ~	Concrete Coated Steel Concrete Mattresses: 2 Grout Bags: 12.5 tonne	0 tonnes		Concrete Coated Steel Pipe: 10 ton Concrete Mattresses: 20 tonnes Grout Bags: 12.5 tonnes	ines	Concrete Coated Steel Pipe: 10 tonnes Concrete Mattresses: 20 tonnes Grout Bags: 12.5 tonnes	Concrete Coated S Concrete Mattress Grout Bags: 12.5 t				
		N	Ν	S	N	S	S					
Sı	ımmary	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 stronger than Option 3a as there is less 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 2b is assessed as being stronger than Option 3a as there is less 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 2b 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	Resource nsumption	Whilst the environmenta fuel) under this option is are noted:			Whilst the environmental impact fro fuel) under this option is assessed a noted:		Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted:	Whilst the environr under this option is noted:				
iviro	Res Run	Rock for Rock cover: 20	00 tonnes (cut ends onl	y)	Rock for Rock cover: 14,600 tonnes	3	Rock for Rock cover: N/A	Rock for Rock cov				
2. Er	2.3 Cor	Emissions for replacem	ent material (CO ₂): 653	tonnes	Emissions for replacement material	(CO_{2}) : 653 toppes	Emissions for replacement material (CO ₂): 653 tonnes	Emissions for repla				
			(_/									
		MS The assessment agains	N	W	MW	VMW		F · · /				
Sı		The assessment agains Option 1 is assessed a cover and replacement Option 2b is assessed cover material and a lar	N at the Resource Consur s being much stronger materials are largely sin as being much weaker ge amount of replacem as being weaker than C	W nption criterion is as fol than Option 2b as, while milar. Option 1 is asset than Option 2c as, while ent material for the remain Option 3a due the large a	MW lows: st the amount of replacement materia ssed as being weaker than Option 3a st the amount of replacement materia aining pipeline. amount of replacement material for th	VMW al is the same, Option 1 only require a as there is a much higher requires al is the same, Option 2b requires a		2b. Option 1 is as:				
	ımmary	The assessment agains Option 1 is assessed a cover and replacement Option 2b is assessed cover material and a lar Option 2c is assessed	N at the Resource Consur is being much stronger materials are largely sin as being much weaker ge amount of replacem as being weaker than C e preferred option from a al impact in terms of Se is option, there is impact	W nption criterion is as fol than Option 2b as, while milar. Option 1 is asset than Option 2c as, while ent material for the remain Option 3a due the large at a Resource Consumption eabed Disturbance is ct from introducing the	MW lows: st the amount of replacement materia ssed as being weaker than Option 3a st the amount of replacement materia aining pipeline. amount of replacement material for th on perspective. Whilst the environmental impact in	VMW al is the same, Option 1 only require a as there is a much higher requiren al is the same, Option 2b requires a ne remaining pipeline. terms of Seabed Disturbance is ere is impact from rock covering the	W es a small amount of rock cover material versus a large amount for Option nent for replacement material for the remaining pipeline under Option 1.	2b. Option 1 is ass y much weaker that Whilst the environr assessed as 'low'				
2. Environmental ອັ	sturbance	The assessment agains Option 1 is assessed a cover and replacement Option 2b is assessed cover material and a lar Option 2c is assessed Overall, Option 3a is the Whilst the environmenta assessed as 'low' for th	N at the Resource Consur s being much stronger materials are largely sin as being much weaker ge amount of replacem as being weaker than C e preferred option from a al impact in terms of Se is option, there is impar- ed ends. The area of in	W nption criterion is as fol than Option 2b as, while milar. Option 1 is asset than Option 2c as, while ent material for the remain Option 3a due the large at a Resource Consumption eabed Disturbance is ct from introducing the	MW lows: st the amount of replacement materia ssed as being weaker than Option 3a st the amount of replacement materia aining pipeline. amount of replacement material for th on perspective. Whilst the environmental impact in assessed as 'low' for this option, the	VMW al is the same, Option 1 only require a as there is a much higher requiren al is the same, Option 2b requires a ne remaining pipeline. terms of Seabed Disturbance is ere is impact from rock covering the	W es a small amount of rock cover material versus a large amount for Option nent for replacement material for the remaining pipeline under Option 1. I large amount of rock cover material. Option 2b is assessed as being very 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	2b. Option 1 is as:				
Environmental	Disturbance	The assessment agains Option 1 is assessed a cover and replacement Option 2b is assessed cover material and a lar Option 2c is assessed Overall, Option 3a is the Whilst the environmenta assessed as 'low' for th rock cover at the expos Seabed Disturbance: 10 MS	N at the Resource Consur s being much stronger materials are largely sin as being much weaker ge amount of replacem as being weaker than C e preferred option from a al impact in terms of Se is option, there is impar- ed ends. The area of in 20 m ²	W nption criterion is as fol than Option 2b as, while milar. Option 1 is asses than Option 2c as, while ent material for the remain option 3a due the large at a Resource Consumption eabed Disturbance is ct from introducing the mpact is as follows: S	MW lows: st the amount of replacement materia ssed as being weaker than Option 3a st the amount of replacement material aining pipeline. amount of replacement material for the on perspective. Whilst the environmental impact in assessed as 'low' for this option, the entire line. The area of impact is as Seabed Disturbance: 10,425 m ²	VMW al is the same, Option 1 only require a as there is a much higher requiren al is the same, Option 2b requires a ne remaining pipeline. terms of Seabed Disturbance is ere is impact from rock covering the	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:	2b. Option 1 is ass y much weaker that Whilst the environr assessed as 'low' entire line. The arc				
2. Environmental	Disturbance	The assessment agains Option 1 is assessed a cover and replacement Option 2b is assessed cover material and a lar Option 2c is assessed Overall, Option 3a is the Whilst the environmenta assessed as 'low' for th rock cover at the expos Seabed Disturbance: 10 MS The assessment agains Option 1 is assessed a and burying the entire li Option 2b is assessed the area associated wit	N at the Resource Consur s being much stronger materials are largely sin as being much weaker ge amount of replacem as being weaker than C e preferred option from a al impact in terms of Se is option, there is impar- ed ends. The area of in 00 m ² MS at the Seabed Disturbar s being much stronger ne. Option 1 is assess as being neutral to Opti h rock cover is greater as being weaker than C	W nption criterion is as fol than Option 2b as, while milar. Option 1 is assess than Option 2c as, while ent material for the remain Option 3a due the large as a Resource Consumption cabed Disturbance is ct from introducing the mpact is as follows: S nce (short-term impact) than Option 2b as there used as being stronger the tion 2c as, whilst the area than cut and lift, the lew Option 3a as whilst the area	In the amount of replacement material assed as being weaker than Option 3 as the amount of replacement material asset the amount of replacement material for the amount of replacement material for the maximum of the maximu	VMW al is the same, Option 1 only requirer a as there is a much higher requirer al is the same, Option 2b requires a a e remaining pipeline. terms of Seabed Disturbance is ere is impact from rock covering the s follows: W turbance than rock covering the ent machine than trench and bury, the short-for of a surface laid line is expected to	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 W	2b. Option 1 is as: y much weaker that Whilst the environ assessed as 'low' entire line. The ar Seabed Disturbant there is also much trench and bury. out. Option 2b is a				



val - Cut and recover
pre environmental impacts from processing material nis option are assessed as 'low', the following quantities
d Steel Pipe: 534 tonnes sses: 20 tonnes 5 tonnes
material returned to shore for processing. to shore for processing.
onmental impact from the resources consumed (not fuel) is assessed as 'low', the following quantities are
over: N/A
placement material (CO ₂): 0 tonnes
assessed as being neutral to Option 2c as the rock
nan Option 3a as it requires a large amount of rock
onmental impact in terms of Seabed Disturbance is v' for this option, there is impact from removing the area of impact is as follows:
ance: 2,125 m ²
h less short-term seabed disturbance than trenching
assessed as being weaker than Option 3a as, whilst

		1 - Minimal Interventi	on - Remove exposed	d ends	2b - Major intervention - Rock co	ver full line	2c - Major intervention - Trench and bury full line	3a - Full Remov		
2. Environmental	5 Loss of Habitat	Whilst the environmenta impact) is assessed as introducing rock cover a alter the habitat type ar There is also a permane situ. The area of impac Rock cover: 100 m ² Pipeline: 2 km	'low' for this option, the at the pipeline ends which ad will therefore impact f ent impact from leaving	ere is an impact from ch will permanently the benthic community.	Whilst the environmental impact in t impact) is assessed as 'low' for this rock covering the entire line which w type and will therefore impact the be impact is as follows: Rock cover: 10,425 m ²	option, there is an impact from ill permanently alter the habitat	There are no long-term impacts or loss of habitats expected from the trench and bury of the pipeline.	There are negligil the full removal o		
		MS	MW	MW	VMW	VMW	N			
Su	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 full removal option. Option 2b is assessed as being neutral to Option 3a as the rock cover will permanently alter the habitat over a large area. Option 2b is assessed as being neutral to 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.									
3. Technical	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 widely available Track Record:- High - Operations Risk of Failure:- Low Consequence of Failure:- Limited	s considered routine	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	Feasibility:- Hi numerous occasi Concept Maturi Availability of T contractors with Track Record:- line is limited Risk of Failure:- the length is a lo Consequence o schedule impact.		
		Ν	S	S	S	S	N			
etal	mmary	the event that a section Option 2b is assessed	s being neutral to Optio was un-trenchable it ca as being stronger than as being neutral to Opti ption 2b are equally pre- line in place means tha	on 2b, they are the same an be rock covered or re Option 2c as Rock plac ion 3a. The only real dif eferred from a Technical tt current area lost to	moved. Option 1 is also assessed a ement is considerably less challengin ference between these options is in t	as being stronger than Option 3a as ing than trenching. Option 2b is als the area of track record, as there is pring entire pipeline is greater, it is	ard to execute. Option 1 is assessed as being stronger than Option 2c a there is little to no track record of removing this quantity of line and as su o assessed as being stronger than Option 3a as Rock placement is consilititle to no track record for removing this quantity of line. Trench and bury of the pipeline effectively returns the area lost from having the pipeline in place to the fishing industry for fishing operations.	ch, the risk and c		
4.	- ⁴	W	MW	MW	MW	MW	Ν			
Su	mmary	The assessment agains Option 1 is assessed a full removal options effe Option 2b is assessed Option 2c is assessed	It the Impact on Common s being weaker than Op ctively return the full are as being much weaker as being neutral to Opti	ercial Fisheries criterion btion 2b as leaving the p ea to the fishing industry than both Option 2c and ion 3a as they both effect	is as follows: ipeline in place is considered worse f for fishing operations.	from a fishing operations perspectiv ult in an increase in the loss of hab	e than the full rock covered option. Option 1 is assessed as being much the full rock covered option. Option 1 is assessed as being much the itat versus clear seabed under Option 2c and Option 3a.	weaker than both		





		ion - Remove exposed	lends	2b - Major intervention - Rock co	over 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	being returned to shore impacts on communiti The returned steel is re concrete, likely to be p	terial (10 tonnes of concr e for processing results in es. ecyclable, there will be a placed in landfill. n minimal due to relatively his this option.	n negligible negative minimal amount of	Minor quantities of material (10 tonr being returned to shore for processi impacts on communities. The returned steel is recyclable, the concrete, likely to be placed in land Job creation / retention minimal due man-hours to deliver this this option	ing results in negligible negative ere will be a minimal amount of ffill. e to relatively low (around 27,000)	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	Ν	N	N	N		
Summary	Option 1 is assessed is slightly more job cre Option 1 is assessed Option 2b is assessed Option 2c is assessed	eation / retention, there is as being stronger than O as being neutral to Opti as being neutral to Opti	Option 2b and Option 2 more negative impacts ption 3a as it will not re on 2c and Option 3a fo on 3a, again for similar	s on communities from material return esult in as much disturbance onshore r similar reasons.	ned to shore for processing which o with minimal extra work.	mpacts on communities from material returned to shore for processing. (ancel each other out.	Dption 1 is also assessed as being neutral to Option 3a as, whilst there	
. 5	Initial operation cost: £	2.9 million		Initial operation cost: £3.7 million		Initial operation cost: £2.8 million	Initial operation cost: £4.5 million	
5. Economic 5.1 Short-term Costs								
	N	N	S	N		-		
	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.							
Summary	Option 1 is assessed a Option 2b is assessed Option 2c is assessed	ast the Short-term Costs as being neutral to Optio as being neutral to Optio	criterion is as follows: n 2b and Option 2c as on 2c and Option 3a as 3a as the cost for Opti	s, whilst the cost differential is around on 3a is around 60% higher.				
	Option 1 is assessed Option 2b is assessed Option 2c is assessed Overall, Option 1 and 0	ist the Short-term Costs as being neutral to Optio as being neutral to Optio as stronger than Option	criterion is as follows: n 2b and Option 2c as on 2c and Option 3a as 3a as the cost for Opti ferred rom a Short-term	the costs are similar. Option 1 is as whilst the cost differential is around on 3a is around 60% higher.	sessed as being stronger than Opt d 20%, this is insufficient to express	ion 3a as the cost for Option 3a is around 50% higher.	Legacy cost (survey & monitoring): N/A	
Costs	Option 1 is assessed Option 2b is assessed Option 2c is assessed Overall, Option 1 and 0 Legacy cost (survey &	st the Short-term Costs as being neutral to Optio as being neutral to Optio as stronger than Option Option 2c are equally pre monitoring): £1.25 millio remediation): £500,000	criterion is as follows: n 2b and Option 2c as on 2c and Option 3a as 3a as the cost for Opti ferred rom a Short-term	the costs are similar. Option 1 is as , whilst the cost differential is around on 3a is around 60% higher.	sessed as being stronger than Opt d 20%, this is insufficient to express £320,000	ion 3a as the cost for Option 3a is around 50% higher. s a preference.	Legacy cost (survey & monitoring): N/A Potential legacy cost (remediation): N/A Total legacy cost: N/A	
	Option 1 is assessed Option 2b is assessed Option 2c is assessed Overall, Option 1 and 0 Legacy cost (survey & Potential legacy cost (st the Short-term Costs as being neutral to Optio as being neutral to Optio as stronger than Option Option 2c are equally pre monitoring): £1.25 millio remediation): £500,000	criterion is as follows: n 2b and Option 2c as on 2c and Option 3a as 3a as the cost for Opti ferred rom a Short-term	the costs are similar. Option 1 is as , whilst the cost differential is around on 3a is around 60% higher. Costs perspective. Legacy cost (survey & monitoring): Potential legacy cost (remediation):	sessed as being stronger than Opt d 20%, this is insufficient to express £320,000	ion 3a as the cost for Option 3a is around 50% higher. s a preference. Legacy cost (survey & monitoring): £320,000 Potential legacy cost (remediation): £500,000	Potential legacy cost (remediation): N/A	
2 Long-term Costs	Option 1 is assessed Option 2b is assessed Option 2c is assessed Overall, Option 1 and 0 Legacy cost (survey & Potential legacy cost (st the Short-term Costs as being neutral to Optio as being neutral to Optio as stronger than Option Option 2c are equally pre monitoring): £1.25 millio remediation): £500,000	criterion is as follows: n 2b and Option 2c as on 2c and Option 3a as 3a as the cost for Opti ferred rom a Short-term	the costs are similar. Option 1 is as , whilst the cost differential is around on 3a is around 60% higher. Costs perspective. Legacy cost (survey & monitoring): Potential legacy cost (remediation):	sessed as being stronger than Opt d 20%, this is insufficient to express £320,000	ion 3a as the cost for Option 3a is around 50% higher. s a preference. Legacy cost (survey & monitoring): £320,000 Potential legacy cost (remediation): £500,000	Potential legacy cost (remediation): N/A Total legacy cost: N/A	
5.2 Long-term Costs	Option 1 is assessed Option 2b is assessed Option 2c is assessed Overall, Option 1 and 0 Legacy cost (survey & Potential legacy cost (Total legacy cost: £1.7 MW The assessment again Option 1 is assessed Option 2b is assessed Option 2c is assessed	St the Short-term Costs as being neutral to Optio as being neutral to Option as stronger than Option Option 2c are equally pre monitoring): £1.25 millio (remediation): £500,000 75 million	criterion is as follows: n 2b and Option 2c as on 2c and Option 3a as 3a as the cost for Opti- ferred rom a Short-term n VMW criterion is as follows: than both Option 2b and on 2c as the costs are than Option 3a for the s	the costs are similar. Option 1 is as whilst the cost differential is around ion 3a is around 60% higher. Costs perspective. Legacy cost (survey & monitoring): Potential legacy cost (remediation): Total legacy cost: £820,000 N Option 2c as the costs are around d the same. Option 2b is assessed as ame reasons.	sessed as being stronger than Opti d 20%, this is insufficient to express £320,000 £5500,000 MW ouble. Option 1 is assessed as be	ion 3a as the cost for Option 3a is around 50% higher. s a preference. Legacy cost (survey & monitoring): £320,000 Potential legacy cost (remediation): £500,000 Total legacy cost: £820,000	Potential legacy cost (remediation): N/A Total legacy cost: N/A There are no legacy costs associated with this full removal option.	



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	мw	MW	N	10%

Appendix C.2 Group 2 Pairwise Comparison Matrices – Safety

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	vмw	vмw	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%

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	И	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%



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
1 - Minimal Intervention - Remove exposed ends	N	MS	N	w
2b - Major intervention - Rock cover full line	MW	N	MW	vмw
2c - Major intervention - Trench and bury full line	N	MS	N	w
3a - Full Removal - Cut and recover	S	VMS	S	N

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	vмw	vмw	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
1 - Minimal Intervention - Remove exposed ends	N	N	s	s
2b - Major intervention - Rock cover full line	N	N	S	S
2c - Major intervention - Trench and bury full line	w	w	N	N
3a - Full Removal - Cut and recover	w	w	N	N



Weighting
25%
7%
25%
44%

Weighting
30%
30%
20%
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	мw	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	vмw	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%





30.00%		 1. Safety 	2. Environmental	3. Technical	4. Societal	5. Economic			
30.00%					27.05%	27.05%		26.22%	
25.00%	24.04%		22.70%		5.06%		5.85%		
20.00%	4.43%		4.66%				5.65%		
20.0076	3.35%				6.49%		6.49%		
15.00%	c 000/		3.66%		4.00%				
10.00%	6.00%		6.00%		4.0070		4.00%		
10.00%	5.22%		2.69%		5.70%		6.200/		
5.00%					_		6.39%		
	5.03%		5.69%	5.79%		3.49%			
0.00% 1 - Minim	al Intervention exposed ends		- Major intervention cover full line	n - Rock 2c - N	lajor interventi and bury full		ull Removal - Cu recover	ut and	

Appendix C.5 Group 2 Results Chart



APPENDIX D GROUP 3 – DETAILED EVALUATION RESULTS

1 - Minimal Intervention - Remove exposed ends 3a - Full Removal - Cut and recover 3b - Full Removal - Reverse installation Likelihood Likelihood Likelihood R = 0 $\mathbf{R} = \mathbf{0}$ R = 0O = 7 Very O = 9 Very O = 11 Very Severity Unlikely Very Severity Unlikely Very Possible Possible Severity Unlikely Possible Verv Y = 10 Unlikely Likely (D) Y = 9 Unlikely ikely (D) Y = 13 Unlikely Likely (D) 1.1 Personnel Offshore (B) (C) Likely (E) (B) (C) Likely (E) Likely (E) (B) (C) G = 4 G = 1 (A) (A) G = 1 (A) Total = 21 Total = 25 5 Total = 19 5 5 2 2 4 4 5 3 3 4 3 4 3 1 3 3 3 1 3 5 1 2 6 2 4 1 1 4 3 2 1 1 1 1 1 1 1 0 0 0 W MS MS 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. Summary 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. Likelihood Likelihood Likelihood R = 0R = 0R = 00 = 2Very O = 8 Very O = 8Very Severity Unlikely Possible Very Severity Unlikely Possible Very Unlikely Severity Possible Very Unlikely Unlikely Likely (D) Likely (D Y = 11 Y = 7Y = 7Unlikely Likely (D) (B) (C) Likely (E) (B) (C) Likely (E) 1.2 Personnel Onshore (B) (C) Likely (E) G = 2 (A) G = 0(A) G = 0(A) Total = 15 Total = 15 Total = 15 5 5 1 5 1 4 4 4 2 1 4 2 1 3 2 3 3 2 3 3 2 3 2 2 2 2 1 1 3 2 1 1 3 1 1 1 1 1 0 0 0 MS MS Ν 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. Summary 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. Likelihood Likelihood Likelihood $\mathsf{R} = 0$ R = 0R = 0O = 2 Very O = 2 Very O = 2 Very Unlikely Unlikely Unlikely Severity Possible Very Severity Possible Very Severity Possible Very Y = 0Unlikely Likely (D) Y = 0 Unlikel ikely (D) Y = 0 Unlikely Likely (D) (B) Likely (E) (B) (C) Likely (E) (B) Likely (E) (C) (C) (A) (A) (A) G = 0G = 0G = 01.3 Other Users Total = 2Total = 2Total = 2 5 5 5 2 2 2 4 4 4 3 3 3 2 2 2 1 1 1 0 0 0 Ν Ν Ν 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. Summary 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. R = 0Likelihood Likelihood R = 0 Likelihood R = 0Very O = 6 O = 0Very Very O = 0Severity Unlikelv Possible Very Severity Unlikely Possible Very Severity Unlikely Possible Very Unlikely ikely (D). Unlikely ikely (D). Unlikely ikely (D). Y = 7Y = 0Y = 0(B) (C) Likely (E) (B) (C) Likely (E) (B) (C) Likely (E) (A) (A) (A) G = 0G = 0G = 01.4 Residual Risk Total = 13 Total = 0 Total = 0 5 5 5 4 2 1 4 4 3 2 3 3 3 2 2 2 1 1 1 0 0 0

Appendix D.1 Group 3 Attributes Table

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.							
ummary Option 3a is assessed as being neutral to Option 3b as both are full removal options and therefore have no residual risk.							
t							



		1 - Minimal Intervention - Remo	eve expected ands	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation					
	<u> </u>	Whilst the offshore environmental assessed as 'low', the following qu		Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted:	Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted:					
ntal	miss shor	Vessel Noise: 245 dB / 3.6 TPa ² s	3	Vessel Noise: 247 dB / 5.1 TPa ² s	Vessel Noise: 248 dB / 7.3 TPa ² s					
Environmental	≣ ≝ O	Subsea Cutting: 1 day		Subsea Cutting: 7.33 days	Subsea Cutting: 1.08 days					
<i>i</i> iror	Decons	Vessel Emissions (CO ₂): 3,000 to	onnes	MFE: 1.71 days	MFE: 2.04 days					
2. Env	act of perati	Vessel Fuel Use: 946 tonnes		Vessel Emissions (CO ₂): 6,485 tonnes	Vessel Emissions (CO ₂): 5,909 tonnes					
	o O			Vessel Fuel Use: 2,046 tonnes	Vessel Fuel Use: 1,803 tonnes					
	2.1									
		N	N	N						
			act of Decommissioning Operations	Offshore criterion is as follows: here are differences in the quantities of atmospheric emissions and fuel	use these are insufficient to move from the neutral position. As					
				erms of emissions, marine noise and fuel consumption.						
				ssioning Operations Offshore perspective.						
		Overall, all options are equally pre	merred from an impact of Decommis	ssioning Operations Olishore perspective.						
				Whilst the onshore environmental impacts from processing material	Whilst the onshore environmental impacts from processing material					
intal	ng o erial:	returned under this option are ass quantities are noted:	essed as 'low', the following	returned under this option are assessed as 'low', the following quantities are noted:	returned under this option are assessed as 'low', the following quantities are noted:					
Environmental	ssi Mat			1						
virol	roce ed l	Concrete Coated Steel Pipe: 12 to Rigid Steel Pipe: 7.5 tonnes	onnes	Concrete Coated Steel Pipe: 641 tonnes Rigid Steel Pipe: 32 tonnes	Concrete Coated Steel Pipe: 641 tonnes Rigid Steel Pipe: 32 tonnes					
	2 P.	Umbilicals: 1.6 tonnes		Umbilicals: 35 tonnes	Umbilicals: 35 tonnes					
2.	Re 2	Concrete Mattresses: 256 tonnes		Concrete Mattresses: 256 tonnes	Concrete Mattresses: 256 tonnes					
		S	S	Ν						
			cessing of Returned Materials criter	ion is as follows:						
				tion 3b as there is less material being returned onshore for processing						
	Summary	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.								
		Whilst the environmental impact f	rom the resources consumed (not	Whilst the environmental impact from the resources consumed (not	Whilst the environmental impact from the resources consumed (not					
tal		fuel) under this option is assessed		fuel) under this option is assessed as 'low', the following quantities	fuel) under this option is assessed as 'low', the following quantities					
mer	ptio	are noted:		are noted:	are noted:					
Environmental	2.3 Resource Consumption	Rock for Rock cover: 800 tonnes	(cut ends only)	Rock for Rock cover: N/A	Rock for Rock cover: N/A					
	2.3 J Con	Emissions for replacement material (CO.): 856 tennos		Emissions for replacement material (CO ₂): 0 tonnes	Emissions for replacement material (CO_2): 0 tonnes					
2		Emissions for replacement material (CO ₂): 856 tonnes Emissions from recovered material (CO ₂): 105 tonnes		Emissions from recovered material (CO_2): 510 tonnes	Emissions from recovered material (CO ₂): 510 tonnes					
		W	W	N						
	1		ource Consumption criterion is as f							
		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 R	Resource Consumption perspective.						
ntal	e			Whilst the environmental impact in terms of Seabed Disturbance is	Whilst the environmental impact in terms of Seabed Disturbance is					
mer	rban	assessed as 'low' for this option, t the rock cover over the cut ends o		assessed as 'low' for this option, there is impact from removing the entire line. The area of impact is as follows:	assessed as 'low' for this option, there is impact from removing the entire line. The area of impact is as follows:					
Environmental	istur	is as follows:								
Env	2.4 Disturbance	Seabed Disturbance: 400 m ²		Seabed Disturbance: 8,210 m ²	Seabed Disturbance: 8,210 m ²					
2.	N									
		MS	S bed Disturbance (short-term impact	t) criterion is as follows:						
				re is a small area of seabed disturbance versus a much larger area wit	h Option 3a. Option 1 is assessed as being stronger than Option 3b					
		as there is also a small area of se		arger area with Option 3b, however, it is noted that the impact on the s						
		than the cut and recover option. Option 3a is assessed as being w	veaker than Option 3b as. whilst th	e area of impact is the same, the level of impact from the reverse insta	lation option will be lower than the cut and recover option.					
			•							
		Overall, Option 1 is the preferred of	option from a Disturbance perspect	ive.						
		Whilst the environmental impact in			There are no long-term impacts or loss of habitats expected from the					
		term impact) is assessed as 'low' from introducing rock cover at the		cut and recover full removal of the pipelines / umbilicals.	reverse installation full removal of the pipelines / umbilicals.					
ntal	bita	will permanently alter the habitat f								
nme	f Ha		a permanent impact from leaving							
Environmental	o ss	the pipelines (2.4km) and umbilication impact is as follows:	ais (1.7 km) in-situ. The area of							
	2.5 Loss of Habitat									
2.		Rock cover: 400 m ² Pipelines: 2.4 km								
		Umbilicals: 1.7 km								
		N	N	N						

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 Summary lines, which is the same for all options.

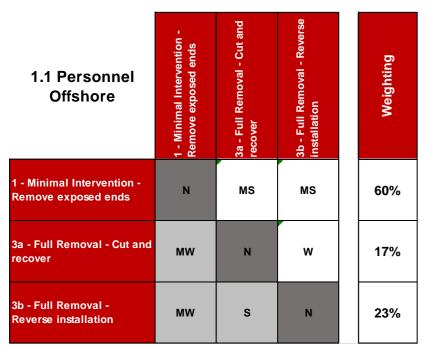
Overall, all options are equally preferred from a Loss of Habitat perspective.

Page 73 of 144



_									
		1 - Minimal Intervention - Rem	nove 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:- H widely available Track Record:- High - Opera Risk of Failure:- Low Consequence of Failure:- Limi	tions considered routine	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	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 Tec Option 1 is assessed as being m versus minimal routine operations Option 3a is assessed as being s	hnical Risk criterion is as follows: nuch stronger than both Option 3a a s for Option 1. stronger than Option 3b as there ar option from a Technical Risk persp	nd Option 3b as there is limited track record of cut and recover of pipel e more challenges associated with the cut and recover option.	ines / umbilicals or reverse installation of pipelines at this scale Removal of the pipelines / umbilicals does not return the area lost to				
4. Societal		current area lost to fishing operat	tions due to their presence is act is minimal due to short lengths	fishing operations as the current rock cover will remain.	fishing operations as the current rock cover will remain.				
		N	N	N					
		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.							
		Deletively miner questities of mot	torial returned	Delatively minor quantities of material returned	Deletively miner supplifies of material ratemady				
4. Societal	ocio-economic impact or nmunities and amenities	Relatively minor quantities of mat Concrete coated steel pipe: 12 to Rigid steel pipe: 7.5 tonnes Umbilicals: 1.6 tonnes Concrete Mattresses: 256 tonnes This results in limited negative im The returned steel is recyclable, i potentially be reused. Job creation / retention minimal of 27,000) man-hours to deliver this	onnes s npacts on communities. the concrete mattresses could due to relatively low (around	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 Soc All options are assessed as bein returned, this is offset by higher j	io-economic criterion is as follows: g neutral to each other as the quar ob creation / retention and thus lar	tities of material returned are insufficient to cause any significant negat	ive impact on communities. Where there are greater quantities				
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				
	Summary	Option 1 is assessed as being m Option 3a is assessed as being v	weaker than Option 3b as it is £1.7	s ± 5.4 million lower cost and much stronger than Option 3b as it is ± 3.7 million higher cost.	7 million lower cost.				
		Overall, Option 1 is the preferred	option from a Short-term Costs per	spective.					
	<u> </u>	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	Ν					
	Summary	The assessment against the Lon Option 1 is assessed as being m Option 3a is assessed as being r	g-term Costs criterion is as follows	d Option 3b as there are no long-term costs associated with the full reparent.	moval options.				

Page 74 of 144



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	мw	14%
3a - Full Removal - Cut and recover	MS	N	N	43%
3b - Full Removal - Reverse installation	MS	N	N	43%

Appendix D.2 Group 3 Pairwise Comparison Matrices – Safety





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	Я	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	И	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	vмw	vмw	5%
3a - Full Removal - Cut and recover	VMS	N	N	47%
3b - Full Removal - Reverse installation	VMS	N	N	47%





50.00%	1. Safety	2. Environmental 3. Tech	iical 🗖 4. Societal	5. Economic	Total
45.00%	44.96%				
40.00%	9.23%				
35.00% — 30.00% —	6.67%				28.98%
25.00%			26.07%		5.79%
20.00%	11.96%		4.98%		6.67%
15.00%			6.67%		0.0770
	7.67%		3.48%		4.56%
10.00% ——			5.84%		6.50%
5.00% —	9.44%		5.10%		5.46%
0.00%	1 - Minimal Intervention - Remove expos	sed ends 3a - Full Rem	oval - Cut and recover	3b -	Full Removal - Reverse installation

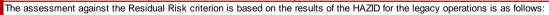
Appendix D.5 Group 3 Results Chart



APPENDIX E GROUP 4 – DETAILED EVALUATION RESULTS

1 - Minimal Intervention - Remove exposed ends 3a - Full Removal - Cut and recover 3b - Full Removal - Reverse installation R = 0 Likelihood R = 0Likelihood $\mathbf{R} = \mathbf{0}$ Likelihood O = 7 Very O = 9 O = 11 Severity Very Very Unlikely Possible Very Possible Unlikely Severity Unlikely Severity Very Possibl Likely (D) Likely (E) Very Y = 10 Unlikel Likely (D) Y = 9 Y = 13 Unlikel Likely (D) Unlikely 1.1 Personnel Offshore (B) (C) Likely (E) (B) (C) Likely (E) (B) (C) G = 4 (A) G = 1 G = 1 (A) (A) Total = 21 Total = 19 Total = 25 5 5 5 2 4 4 3 5 3 4 4 3 3 1 3 3 3 1 3 5 1 2 6 2 4 1 1 2 4 3 1 1 1 1 1 1 0 0 0 MS MS W 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 Summary 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 Likelihood R = 0Likelihood R = 1Likelihood R = 1O = 2 O = 12 Very 0 = 8 Very Very Jnlikely Severity Very Unlikely Severit Unlikely Very Possible Possible everit Possible Likely (D) Likely (E) Very Y = 11 Y = 2 Unlikely likely (D) Y = 6 Unlikely Likely (D) Unlikely 1.2 Personnel Onshore (B) (C) Likely (E) (B) Likely (E) (C) (B) (C) G = 2 G = 0(A) G = 0 (A) (A) Total = 15 Total = 15 5 Total = 15 5 5 4 4 4 1 2 4 2 1 3 5 3 2 3 3 2 3 2 1 3 1 2 2 2 2 1 3 1 1 1 1 1 1 1 0 0 0 VMS VMS W 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. Summary Overall, Option 1 is the preferred option from a risk to Onshore Personnel perspective. Likelihood Likelihood Likelihood R = 0R = 0R = 0Very O = 2 Very O = 2 Very O = 2 Severity Severity Unlikely Very Unlikely Unlikely Possible Severity Possible Very Possible Very Unlikel Unlikel Unlikely Y = 0Likely (D) Y = 0ikely (D) Y = 0ikely (D) Likely (E) (B) (C) Likely (E) (B) (C) Likely (E) (B) (C) G = 0 (A) (A) (A) G = 0G = 01.3 Other Users Total = 0 5 Total = 05 Total = 05 2 4 4 4 3 3 3 2 2 2 1 1 1 0 0 0 Ν Ν Ν 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. Summary 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. Likelihood Likelihood Likelihood R = 0 R = 0R = 0O = 5 Very O = 0 Very O = 0 Very Severity Unlikely Possible Very Jnlikely Possible Very Unlikely Possible Severity Severity Very Y = 8 Unlikel Likely (D) Y = 0 Unlikel Likely (D) Unlikely .ikely (D) Y = 0Likely (E) (B) (C) Likely (E) (B) (C) (B) Likely (E) (C) G = 0 (A) (A) G = 0 (A) G = 0 1.4 Residual Risk Total = 13 Total = 0 5 Total = 0 5 5 4 3 4 4 3 2 3 3 2 3 2 2 1 1 1

Appendix E.1 Group 4 Attributes Table



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

Ν

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.

W

W

Summary



		1 - Minimal Intervention - Remo	ave exposed ends	3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation			
	51	Whilst the offshore environmental		Whilst the offshore environmental impacts from this option are	Whilst the offshore environmental impacts from this option are			
	sioning	assessed as 'low', the following qu		assessed as 'low', the following quantities are noted:	assessed as 'low', the following quantities are noted:			
Environmental	2.1 Impact of Decommissioning Operations Offshore	Vessel Noise: 245 dB / 3.5 TPa ² s Subsea Cutting: 0.5 days		Vessel Noise: 253 dB / 18.3 TPa ² s Subsea Cutting: 40.13 days	Vessel Noise: 250 dB / 10.8 TPa ² s Subsea Cutting: 0.5 days			
inviror	of Dec ations	Vessel Emissions (CO ₂): 3,347 to	unnes	MFE: 9.61 days Vessel Emissions (CO ₂): 21,797 tonnes	MFE: 9.61 days Vessel Emissions (CO ₂): 5,387 tonnes			
2. E	mpact Oper	Vessel Fuel Use: 1,056 tonnes		Vessel Emissions (CO ₂): 21,797 tonnes	Vessel Emissions (CO ₂): 5,387 tonnes			
	2.1 lr							
		S	N	W				
	Summary	Option 1 is assessed as being str there are differences, these are de	eemed insufficient to move from neu	s significantly less fuel and generates significantly lower atmospheric e				
				ssioning Operations Offshore perspective.				
		Whilst the onshore environmental	impacts from processing material	Whilst the onshore environmental impacts from processing material	Whilst the onshore environmental impacts from processing material			
Environmental	2.2 Processing of Returned Materials	returned under this option are assi quantities are noted:		returned under this option are assessed as 'low', the following quantities are noted:	returned under this option are assessed as 'low', the following quantities are noted:			
ron	d M	Concrete Coated Steel Pipe: 16 to	onnes	Concrete Coated Steel Pipe: 16 tonnes	Concrete Coated Steel Pipe: 16 tonnes			
IN	Pro	Rigid Steel Pipe: 4.5 tonnes		Rigid Steel Pipe: 1,958 tonnes	Rigid Steel Pipe: 1,958 tonnes			
2. E	2.2 Retu	Concrete Mattresses: 230 tonnes Grout Bags: 3.3 tonnes		Concrete Mattresses: 230 tonnes Grout Bags: 3.3 tonnes	Concrete Mattresses: 230 tonnes Grout Bags: 3.3 tonnes			
	_	-		-	Glour Bags. 3.3 tonnes			
		MS	MS	ion is as follows:				
			essing of Returned Materials criter uch stronger than both Option 3a a	non is as follows: nd Option 3b as there much less material being returned onshore for p	processing / placed in landfill.			
	Summary							
nental	tion	Whilst the environmental impact fr fuel) under this option is assessed are noted:		Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted:	Whilst the environmental impact from the resources consumed (not fuel) under this option is assessed as 'low', the following quantities are noted:			
Environmenta	2.3 Resource Consumption	Rock for Rock cover: 400 tonnes ((cut ends only)	Rock for Rock cover: N/A	Rock for Rock cover: N/A			
2. EI	2 N	Emissions for replacement materi Emissions from recovered materia		Emissions for replacement material (CO ₂): 0 tonnes Emissions from recovered material (CO ₂): 1,948 tonnes	Emissions for replacement material (CO ₂): 0 tonnes Emissions from recovered material (CO ₂): 1,948 tonnes			
		MW	MW	N				
			ource Consumption criterion is as f	ollows: Ind Option 3b as there is a requirement to replace the left in-situ pipeline				
	S	rock cover.	ich weaker than both Option 3a an	to Option 30 as there is a requirement to replace the left in-situ pipeling	e material and there is also a small amount of rock required for the			
	Summary	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 v	would be equally preferred from a F	Resource Consumption perspective.				
le I		Whilst the environmental impact ir		Whilst the environmental impact in terms of Seabed Disturbance is	Whilst the environmental impact in terms of Seabed Disturbance is			
ienta	ance	assessed as 'low' for this option, t		assessed as 'low' for this option, there is impact from removing the entire line. The area of impact is as follows:	assessed as 'low' for this option, there is impact from removing the			
muo	urba	is as follows:	The pipeline. The area of impact	entire line. The area of impact is as follows:	entire line. The area of impact is as follows:			
Environmenta	2.4 Disturbance	Seabed Disturbance: 200 m ²		Seabed Disturbance: 46,120 m ²	Seabed Disturbance: 46,120 m ²			
2. E	2.4	Seabed Disturbance: 200 m ⁻						
		MS	S	W				
			bed Disturbance (short-term impact					
	Summary	buried) versus the significant seab seabed disturbance from reverse i	bed disturbance from the deburial a installation of the lines is expected		sed as being stronger than Option 3b for similar reasons, however the			
			option from a Disturbance perspect					
		Whilst the environmental impact ir	n terms of Loss of Habitat (long-	There are no long-term impacts or loss of habitats expected from the	There are no long-term impacts or loss of habitats expected from the			
al	tat	term impact) is assessed as 'low'		cut and recover full removal of the pipelines.	reverse installation full removal of the pipelines.			
nen	Hab	from introducing rock cover at the permanently alter the habitat type						
Environmental	s of	benthic community. There is no a						
invii	sso	leaving the pipelines in place as the buried. The area of impact is as for						
2. E	2.5 Loss of Habitat		-					
		Rock cover: 200 m ²						
		W	W	N				
			s of Habitat (legacy / long-term) crit		the rock cover introduced at the cut ends of the pipelines versus the full			
	0	removal options.	aver than both Option sa and Opti	on so as there will be a small amount of permanent habitat loss from t	The rook cover mitroduced at the cut ends of the pipelines versus the full			

illary Option 25 is approached as being neutral to Option 26 on there is no behitet loss approxisted with the full removal of

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.

Page 80 of 144



		- Minimal Intervention - Remo		3a - Full Removal - Cut and recover	3b - Full Removal - Reverse installation
6		1 - Minimal Intervention - Remo	ove exposed ends		
		Feasibility:- High Concept Maturity:- High		Feasibility:- Medium Concept Maturity:- High	Feasibility:- High - Deburial could be challenging (if required) but the reeling of cables pipelines from the seabed is feasible, subject to
		Availability of Technology:- High	gh - All vessels and equipment	Availability of Technology:- High - Numerous contractors offering	line integrity.
		widely available		MFE and numerous contractors offering cut and lift	Concept Maturity:- High - We know exactly what the procedural
	Ţ.	Track Record:- High - Operatio	ns considered routine	Track Record:- Low - Routine operation but track record low for	steps would be to complete this operation and the concept is mature
_	Rist	Risk of Failure:- Low Consequence of Failure:- Limit	ed impact to cost and schedule	size and length of pipeline that is already trenched & buried Risk of Failure:- High - Considered challenging over large distance.	Availability of Technology:- High - Numerous contractors offering MEE: deck carousel may be used for 8" un-weight coated pipe, reel
3. Technical	Technical Risk			May require diver support. Extended subsea works & simultaneous	vessel not necessary
echi	ind			operations.	Track Record:- Med - Routine installation operation but limited
Э. Т	Tec			Consequence of Failure:- Failure would result in significant cost and schedule impact / requirement for alternative decommissioning	track record of reverse reeling in North Sea for decommissioning over extended distance. Limited track record of MFE unburial over
~	3.1			method	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	
		The assessment against the Tech Option 1 is assessed as being mu		nd Option 3b as removing the ends of the lines is much less technicall	v challenging than performing either cut and lift or reverse installation
	Summary	of lines at this scale.			,
	Cullinary	Option 3a is assessed as being w	eaker than Option 3b as cut and li	ft is considered more technically challenging than reverse reel.	
		Overall, Option 1, is the preferred	option from a Technical Risk persp	ective.	
li					
	5 -	Whilst the majority of the pipelines currently trenched and buried. As		Whilst full removal of the pipelines returns the full area for fishing operations, the current impact is minimal as the pipelines are	Whilst full removal of the pipelines returns the full area for fishing operations, the current impact is minimal as the pipelines are
4. Societal	act o ricia	fishing operations is that current o		trenched and buried.	trenched and buried.
Soci	mpa shei	the pipelines.			
4. \$	4.1 Impact on Commercial Fisheries				
	4 -				
		Ν	Ν	Ν	
		The assessment against the Impa			n
	Summary	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 pre-	ferred from an Impact on Commerc	ial Fisheries perspective.	
		Relatively minor quantities of mate	erial returned:	Mainly minor quantities of material returned, large quantity of rigid	Mainly minor quantities of material returned, large quantity of rigid
		Concrete Coated Steel Pipe: 16 to		steel pipe:	steel pipe:
	es on	Rigid Steel Pipe: 4.5 tonnes		Concrete Coated Steel Pipe: 16 tonnes	Concrete Coated Steel Pipe: 16 tonnes
	impact on menities	Concrete Mattresses: 230 tonnes Grout Bags: 3.3 tonnes		Rigid Steel Pipe: 1,958 tonnes Concrete Mattresses: 230 tonnes	Rigid Steel Pipe: 1,958 tonnes Concrete Mattresses: 230 tonnes
_		Crout Dags. 0.0 tormes		Grout Bags: 3.3 tonnes	Grout Bags: 3.3 tonnes
ietal		This results in limited negative imp			
4. Socie	ono es a	The returned steel is recyclable, the potentially be reused, the grout ba		This results in moderate negative impacts on communities, largely relating to the transportation and handling of the rigid pipe.	This results in minor negative impacts on communities as whilst there is a large quantity of rigid pipe being retuned, this is handled on
4.		concrete from the pipeline coating		The returned steel is recyclable, the concrete mattresses could	reel(s), thus the transportation impact will be more limited.
	ocio 1 mr	Job creation / retention minimal du	- · ·	potentially be reused, the grout bags and a small amount of concrete	
	.2 S con	30,000) man-hours to deliver this t	nours to deliver this this option. from the pipeline coating likely to go to landfill. Job creation / retention is notable due to the (aro		potentially be reused, the grout bags and a small amount of concrete from the pipeline coating likely to go to landfill.
	4			hours to deliver this option.	Job creation / retention is minimal due to the low (around 55,000)
					man-hours to deliver this this option.
		W	S	S	
		The assessment against the Socie		re is a higher negative impact from the return and transportation of large	a quantities of materials with Option 2a, this is more than offset by the
			•	of this option. Option 1 is assessed as being stronger than Option 3b	
	Summary			ne negative impact from the returned material is higher (more transport	ation loads), this is more than offset by the benefits associated with
	,	job creation and retention from the	e delivery of this option.		
		Overall, Option 3a is the preferred	option from a Socio-economic imp	act on communities and amenities perspective.	
السوم					
Economic	Short- n Costs	Initial operation cost: £3.2 million		Initial operation cost: £41.5 million	Initial operation cost: £17.1 million
ouo	Sho Co				
5. Ec	5.1 S term				
2		VMS	VMS	MW	
		The assessment against the Shor			
		Option 1 is assessed as being ver		s the costs are more than 10 times higher. Option 1 is assessed as be	eing very much stronger than Option 3b as the costs are more than
	Summary	five times higher. Option 3a is assessed as being m	nuch weaker than Ontion 2h on the	costs are around 4 times higher	
		option on is assessed as being it	at the second se		
		Overall, Option 1, would be the pre	eferred option from a Short-term Co	osts perspective.	
		Legacy cost (survey & monitoring)): £420,000	Legacy cost (survey & monitoring): N/A	Legacy cost (survey & monitoring): N/A
	ter te	Potential legacy cost (remediation		Potential legacy cost (remediation): N/A	Potential legacy cost (remediation): N/A
	ng-l osts	Total legacy cost: £920,000		Total legacy cost: N/A	Total legacy cost: N/A
	5.2 Long-term Costs			There are no legacy costs associated with this full removal option.	There are no legacy costs associated with this full removal option.
	5.2				

	MW	MW	N							
Summary	Option 1 is assessed as being mu full removal options.		d Option 3b as there are legacy costs associated with monitoring the elong-term costs associated with the full removal options.	quipment left in-situ versus no long-term costs associated with the						
	Overall, Option 3a and Option 3b would be equally preferred options from a Long-term Costs perspective.									

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	z	38%
3b - Full Removal - Reverse installation	S	N	N	38%

Appendix E.2 Group 4 Pairwise Comparison Matrices – Safety



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

2.1 Impact of Decommissioning Operations Offshore	1 - Minimal Intervention - Remove exposed ends	3a - Fuil 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%	I
3a - Full Removal - Cut and recover	MW	N	N	20%	1
3b - Full Removal - Reverse installation	MW	N	N	20%	I

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	мw	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
I - 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	vмw	N	мw	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%

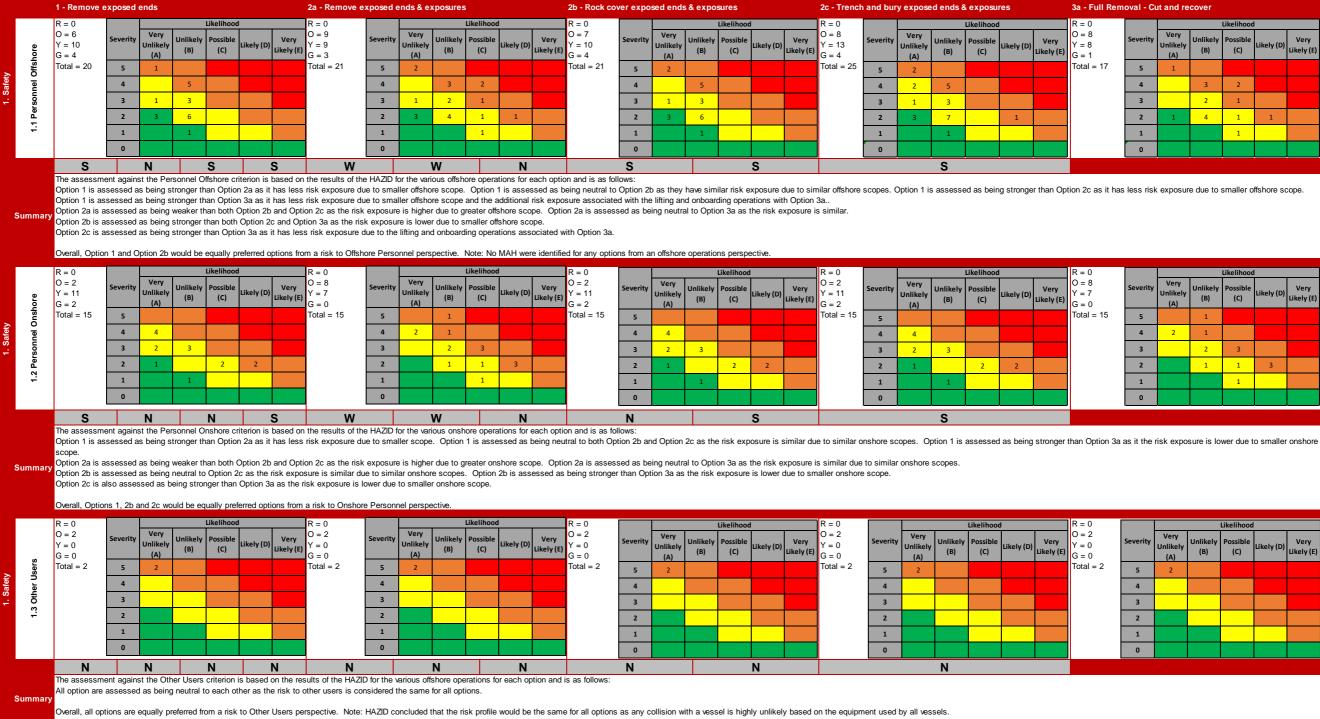






Appendix E.5 Group 4 Results Chart

APPENDIX F GROUP 5 – DETAILED EVALUATION RESULTS



Appendix F.1 **Group 5 Attributes Table**



- Full Removal - Cut and recover											
			Likelihood	1							
Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)						
5	1										
4		3	2								
3		2	1								
2	1	4	1	1							
1			1								
0											
	Severity 5 4 3 2 1	Severity Very Unlikely (A) 5 1 4 2 3 2 1 1 1 1	Very Unlikely (A) Unlikely (B) 5 1 3 4 3 3 3 2 3 2 1 4 1 4 4	Severity Unikely Unikely (B) Possible (C) 5 1 0 0 4 - 3 2 3 - 2 1 2 1 4 1 1 - 4 1	Very Unlikely (B) Ossible (C) Likely (D) 5 1 1						

0				Likelihood		
8 7 0	Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
= 15	5		1			
	4	2	1			
	3		2	3		
	2		1	1	3	
	1			1		
	0					

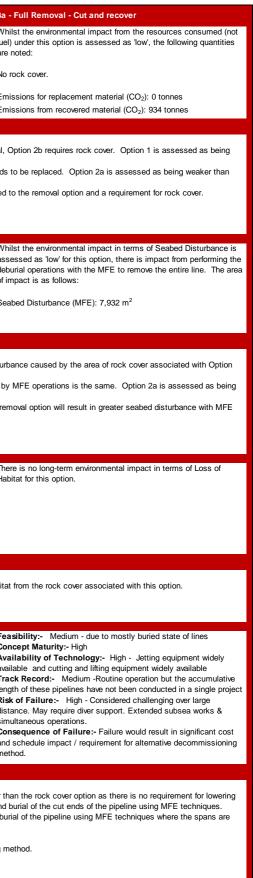
			Likelihood		
Severi	ty Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
5	2				
4					
3					
2					
1					
0					

					A . B		•											
	1 - Remov	e exposed ends			2a - Remove expose	d ends & exposures		2b - Rock cove	er exposed end	s & exposures		2c - Trench	and bury exposed ends	& exposures	3a - Full Rer	noval - Cut and r	ecover	
	R = 2		Likelihood	d	R = 0	Like	elihood	R = 1		Likeliho	od	R = 0		Likelihood	R = 0		Likelihood	
1. Safety 1.4 Residual Risk	O = 4 Y = 7 G = 0 Total = 13	Unlikely	hikely Possible (b) (c) 1 2 3 3 4 5 5 6 6 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Likely (D) Very Likely (E) 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	O = 5 Y = 8 G = 0 Total = 13 4 3 2 1 0	· Unlikely /	ssible Likely (D) Very (C) Likely (D) Likely (E) 7 10 10 10 10 10 10 10 10 10 10 10 10 10	Y = /	Severity Very Unlikely (A) 5 4 4 2 3 2 2 1 1 0	Unlikely (B) Possibility (C) 1 1 2 2 3 3 4 4	e Likely (D) Very Likely (E) 2 1 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2	O = 5 Y = 8 G = 0 Total = 13	Very Unlikely (A) Unlikely (B) 5 5 4 3 3 2 2 3 1 4 0 4	Possible (C) Likely (D) Ver Likely Image: State S	v (E) $O = 0$ Y = 0 G = 0 Total = 0	Severity Very Unlikely (A) 5 4 3 2 2 1 1 0	Unlikely (B) Possible (C) Image: Comparison of the state of the	Likely (D) Very Likely (E)
	W	N	MW	MW	S	w	MW		W		MW		W	· · ·				
Summ	Option 1 is zero. Option 2a i the residua Option 2b i the residua Option 2c i	assessed as being muc is assessed as being str il risk is higher than the f is assessed as being we il risk is zero.	th weaker than option on the second s	Option 2c due to the ion 2b due to the re ion. on 2c as the residua on 3a due to the res	e residual risk from the sidual risk from the roc al risk from rock cover i idual risk from fully tre	rock cover being higher. k cover being lower. Not	Note: Option 1 has 2 pc e: Option 2a has no pote d and buried option. Not	otential MAH, Op ntial MAH, Optic e: Option 2b has	otion 2c has none on 2b has 1. Opt s 1 potential MAH	e. Option 1 is ass tion 2a is assesso I, Option 2c has i	ed as being weaker	ch weaker that	Option 2b as the residual ris an Option 3a due to the resi c due to the residual risk fro being much weaker than Op	idual risk from the rock cov	ver being higher th gher. Option 2a is	an the full removal assessed as beir	option where the ready and the ready and the second s	sidual risk is n Option 3a as
rations	Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted:						al impacts from the quantities are not			ffshore environmental impac s 'low', the following quantiti				al impacts from this quantities are noted				
onmental pact of ing Opera		ise: 245 dB / 3.6 TPa ² s itting: 0.5 days			Vessel Noise: 247 dB Subsea Cutting: 5.96		Vessel Noise: 3 Subsea Cutting	245 dB / 3.6 TPa g: 0.5 days	² s			e: 248 dB / 6.1 TPa ² s ting: 0.5 days		Vessel Noise Subsea Cutti MFE Ops:- 1		² s		
Envire 2.1 lm ission	Vessel Em	missions (CO ₂): 2,938 tonnes Vessel Emissions (CO ₂): 3,666 tonnes					Vessel Emissio	ons (CO ₂): 2,938	tonnes			ssions (CO_2): 3,211 tonnes			sions (CO ₂): 6,717	toppos		
2. Decomm	Vessel Fue	el Use: 927 tonnes			Vessel Fuel Use: 1,1	6 tonnes		Vessel Fuel Us	e: 927 tonnes				Use: 1,013 tonnes			Jse: 2,119 tonnes	tornes	
	N	N	Ν	S	N	N	S		Ν		S		S					
Summ	Option 1 is indicate a r Option 2a i Option 2b i Option 2c i	minor preference. is assessed as being nei is assessed as being nei is assessed as being str	tral to Option 2a utral to Option 2 utral to Option 2 onger than Opti	a, Option 2b and Op 2b and Option 2c ar 2c and stronger that ion 3a for similar rea	otion 2c as, whilst ther nd stronger than Option n Option 3a for similar asons.	e are differences in the qu 3a for similar reasons.		impacts, these	are considered ir	nsufficient to diffe	entiate. Option 1 is	assessed as	being stronger than Option	a as the increased impa	ct (whilst still low)	associated with C	ption 3a is conside	red sufficient to
onmental essing of Materials	returned un	onshore environmental ir nder this option are asses are noted:		Ū		vironmental impacts from tion are assessed as 'low			this option are as	al impacts from p ssessed as 'low',	rocessing material the following		nshore environmental impac der this option are assessed re noted:	1 0		er this option are a	al impacts from pro- ssessed as 'low', the	
2. Environn 2.2 Process Returned Ma		Coated Steel Pipe: 108 to fattresses: 108 tonnes s: 5 tonnes	onnes		Concrete Coated Stee Concrete Mattresses: Grout Bags: 5 tonnes				ed Steel Pipe: 10 esses: 108 tonne tonnes				bated Steel Pipe: 108 tonnes attresses: 108 tonnes 5 tonnes	s		tted Steel Pipe: 1, tresses: 108 tonne 5 tonnes		
	N	N	N	S	N	N	S		Ν		S		S					
Summ	Option 1 is Option 2a i ary Option 2b i Option 2c i	is assessed as being new is assessed as being new is assessed as being mu	tral to Option 2 utral to Option 2 utral to Option 2 utral to Option 2 uch stronger that	a, Option 2b and Op 2b and Option 2c as 2c as these options an Option 3a for sim	otion 2c as similar qua s similar quantities of n will return the same w ilar reasons.	aterial will be returned to	eturned to shore for proc shore for processing. C cessing. Option 2b is as	ption 2a is asse sessed as being	1 is assessed as essed as being st	ronger than Optic	an Option 3a as a l n 3a as a lower volu	ime of materia	of material will be returned for al will be returned for proces ned for processing than the	sing than the full removal				



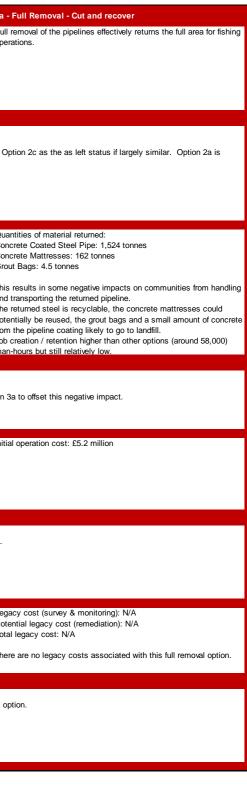
		1 - Remove exposed ends	·		2a - Remove expose	d ends & exposures		2b - Rock cover exposed end	ls & exposures	2c - Trench and bury exposed ends & exposures	3
		Whilst the environmental impact f			Whilst the environmen	tal impact from the reso	,	Whilst the environmental impac	t from the resources consumed (not	Whilst the environmental impact from the resources consumed (not	W
ental	tion	fuel) under this option is assesse are noted:	as low, the foll	owing quantities	noted:	is assessed as 'low', the	tollowing quantities are	are noted:	sed as 'low', the following quantities	fuel) under this option is assessed as 'low', the following quantities are noted:	fu ar
ironm	2.3 Resource Consumption	No rock cover.			No rock cover.			Rock cover: 21,500 tonnes		No rock cover.	N
Env	2.3 F Con:	Emissions for replacement mater	al (CO ₂): 1,844 t	onnes	Emissions for replacer	ment material (CO ₂): 1,2	92 tonnes	Emissions for replacement mat	erial (CO ₂): 1,844 tonnes	Emissions for replacement material (CO ₂): 1,844 tonnes	E
2		Emissions from recovered materia				ered material (CO ₂): 326		Emissions from recovered mate		Emissions from recovered material (CO ₂): 75 tonnes	E
		N S The assessment against the Res	N N	W on critorion is as fo	S	N	W	W	MW	W	
Su	mmary	weaker than Option 3a as there is Option 2a is assessed as being s Option 3a as there is much more Option 2b is assessed as being v Option 2c is assessed as being v	much more pipe tronger than Opti pipeline material eaker than Optic eaker than Optic	eline material needi ion 2b as, whilst bo needing replaced v on 2c as, whilst bot on 3a as there is m	ng replaced when comp oth have similar amounts when compared to the re h have the same amour uch more pipeline mate	ared to the full removal of s of replacement materia emoval option. hts of replacement mater	option. I, Option 2b needs rock ial, Option 2b needs roc	cover. Option 2a is assessed as k cover. Option 2b is assessed a	being neutral to Option 2c as neither	In Option 2b as, whilst both have similar amounts of replacement mat requires rock cover and they have a similar amounts of material that is as there is much more pipeline material needing replaced when comp	need
		Overall, Option 3a would be the p	eferred option fro	om a Resource Con	sumption perspective.						
-		Whilst the environmental impact i assessed as 'low' for this option,				tal impact in terms of Se his option, there is impa			t in terms of Seabed Disturbance is a, there is impact from rock covering	Whilst the environmental impact in terms of Seabed Disturbance is assessed as 'low' for this option, there is impact from performing the	N
Environmental		burial operations with the MFE at spans. The area of impact is as the spans.	the cut pipeline e		burial operations with t	the MFE at the cut pipeli removed. The area of im	ine ends and where the	the spans, exposures and area	s of low burial cover. There is further al operations with the MFE at the cut	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:	d of
2. Envi	2.4 Di	Seabed Disturbance (MFE): 1,55	6 m ²		Seabed Disturbance (I	MFE): 3,464 m ²		Seabed Disturbance (Rock): 17 Seabed Disturbance (MFE): 95		Seabed Disturbance (MFE): 3,464 m ²	s
		S MS	S	MS	S	N	S	W	W	S	
2. Environmental		operations over a greater area. Option 2c is assessed as being s Overall, Option 1 is the preferred of There is no long-term environmen Habitat for this option.	ption from a Dist	turbance perspectiv	ve.	pacting a wider area.	terms of Loss of Habitat	term impact) is assessed as 'lo from introducing rock cover at t burial cover which will permane therefore impact the benthic co follows:	t in terms of Loss of Habitat (long- w for this option, there is an impact ne spans, exposures and areas of low ntly alter the habitat type and will mmunity. The area of impact is as	There is no long-term environmental impact in terms of Loss of Habitat for this option.	Tì H
		N MS	N	N	MS	N	N	Rock cover: 17,057 m ²	MW	Ν	╈
		The assessment against the Loss		cy / long-term) crite	erion is as follows:						
Su	mmary	Option 1, Option 2a, Option 2c ar Overall, Option 1, Option 2a, Opti		0		0		associated with these options. O	ption 2b is assessed as being much v	weaker than all other options due to the long-term impact and loss of	nabi
3. Technical	ical Risk	Feasibility:- High Concept Maturity:- High Availability of Technology:- Hi widely available Track Record:- High - Operatic Risk of Failure:- Low Consequence of Failure:- Limi	ns considered ro	outine	widely available Track Record:- High Risk of Failure:- Low	ology:- High - All vess	d routine	widely available Track Record:- High - Opera Risk of Failure:- Low	High - All vessels and equipment tions considered routine nited 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.	FC A a Ti le R di si C ar m
		N W	N	S	W	S	S	MS	MS	S	
Su	mmary	The assessment against the Tect Option 1 is assessed as being ne and burial of the pipeline under th Option 2a is assessed as being v not removed is greater than where Option 2b is assessed as being r	nical Risk criteri utral to Option 24 s option. Option eaker than Optio the spans are re nuch stronger tha tronger than Opti	on is as follows: a and Option 2c as a 1 is assessed as on 2b due to the risi ermoved. Option 2a an Option 2c and O ion 3a as, whilst ac	the key technical risk r stronger than Option 3a k associated with achie is assessed as being s ption 3a as the rock co- chieving sufficient lowering	elates to the ability to ac as the technical risk as ving sufficient lowering a stronger than Option 3a c ver option is the least tec ng and burial of the pipel	chieve sufficient lowering sociated with the extend nd burial of the cut ends due to the technical risk chnically risky of the opt	and burial of the cut ends of the led but unproven operations and t of the pipeline using MFE techni associated with the extended bur ions.	pipeline using MFE techniques which ne potential for requiring an alternative ques. Option 2a is assessed as bein unproven operations and the potentia	applies to each of these options. Option 1 is assessed as being weat decommissioning method is greater than achieving sufficient lowering g stronger than Option 2c as the risk of achieving sufficient lowering a l for requiring an alternative decommissioning method. operations and the potential for requiring an alternative decommission	g an Ind b





		1 - Remove ex	xposed ends			2a - Remove expose	ed ends & exposures		2b - Rock cover exposed e	ends & exposures	2c - Trench and bury exposed ends & exposures	3a
4. Societal	pact on nercial eries	currently trench operations is th pipelines. Exis assumed that fi	ority of the pipelines hed and buried. As s hat currently occupie sting exposures will n fishing operations are ue despite presence	such, the area rea d by the exposed remain but will be e currently perforr	turned for fishing d ends of the e managed - med over this line	currently trenched and is that currently occup	the pipelines will be left in d buried. The area returns bied by the exposed ends removed. It is assumed f aining pipeline.	ed for fishing operations s and exposures of the	currently trenched and buried operations is that currently of	pelines will be left in-situ, these are d. The area returned for fishing occupied by the exposed ends and t is assumed fishing operations will areas.	Removal of the exposed pipeline ends and burial of the spans and exposures effectively returns the full area for fishing operations.	Ful
s	ummary	Option 1 is ass Option 2a is as assessed as w Option 2b is as Option 2c is as	ssessed as being str veaker than Option 3 ssessed as being we ssessed as being we	aker than all other ronger than Option a as the line is fu eaker than Option eaker than Option	r options as, whils n 2b as the rock o lly removed. n 2c and Option 3a n 3a for similar rea	st the exposed pipeline covered pipeline is expe a due to the line being fu asons.	ected to be less attractive ully removed.	e from a commercial fishi			W to commercial fishing operations that the other options. spans and exposures removed. Option 2a is assessed as being neutral	l to C
4. Societal	onomic impact on es and amenities	Relatively mino Concrete Coate Concrete Mattrr Grout Bags: 4.5 This results in I The returned st potentially be re from the pipelin Job creation / re	or quantities of mater ed Steel Pipe: 28 tor resses: 162 tonnes 5 tonnes limited negative impr teel is recyclable, the	ial returned: nnes acts on communi e concrete mattre ys and a small an o to landfill. e to relatively low	ities. esses could nount of concrete	Relatively minor quant Concrete Coated Stee Concrete Mattresses: Grout Bags: 4.5 tonne This results in limited The returned steel is n potentially be reused, from the pipeline coati	162 tonnes regative impacts on com recyclable, the concrete n the grout bags and a sm ing likely to go to landfill. n minimal due to relatively	: muunities. mattresses could iall amount of concrete	potentially be reused, the gra- from the pipeline coating like	:: 28 tonnes onnes ive impacts on communities. able, the concrete mattresses could rout bags and a small amount of concrete ely to go to landfill. mal due to relatively low (around 27,000)	from the pipeline coating likely to go to landfill.	pot
s	ummary	Option 1, Optio Option 1, Optio	on 2a, Option 2b and	l Option 2c are all l Option 2c are all	I assessed as bei I assessed as bei	ing stronger than Optior		ative impact on communi	ities than from the transportati	/ dismantling / transport and similar level ion of larger quantities of returned materi	S Is of job creation / retention. ial under Option 3a. There is insufficient job creation / retention with Op	
5. Economic	5.1 Short-term Costs	Initial operation	n cost: £2.3 million			Initial operation cost: f	23.7 million		Initial operation cost: £2.8 m	illion	Initial operation cost: £2.5 million	Init
		MS	N	Ν	VMS	W	W	S	N	MS	VMS	
s	ummary	Option 1 is ass Option 2a is as Option 2b is as Option 2c is as Overall, Option Legacy cost (so	essessed as being we seessed as being ne seessed as being ne seessed as being ver 2b would be the pre urvey & monitoring): cy cost (remediation)	ch stronger than (eaker than Option utral to Option 2c ry much stronger ferred option from £330,000	Option 2a as the o 2b and Option 2c c as the costs are than Option 3a as	c as the costs are arour a similar. Option 2b is a s the costs are more th ists perspective.	nd a third higher. Option assessed as being much an double. & monitoring): £330,000 (remediation): £500,000	2a is assessed as being	2b and Option2c as the costs g stronger than Option 3a as ti as the costs are almost doub Legacy cost (survey & monit Potential legacy cost (remer Total legacy cost: £830,000	he costs are 40% higher. le. itoring): £330,000 diation): £500,000	Legacy cost (survey & monitoring): £330,000 Potential legacy cost (remediation): £500,000 Total legacy cost: £830,000	Leg Po Tot
		N	N	Ν	MW	N	N	MW	N	MW	MW	
s	ummary	The assessmer Option 1 is ass Option 2a is as Option 2b is as	nt against the Long-t sessed as being neu ssessed as being neu ssessed as being neu	term Costs criteri tral to Option 2a, utral to Option 2b utral to Option 2c	ion is as follows: Option 2b and Option 2c as and Option 2c as and much weak	ption 2c as the legacy a s the legacy and potent	and potential remediation tial remediation costs are milar reasons as above.	a costs are the same. Op the same. Option 2a is	ption 1 is assessed as being r s assessed as being much we	much weaker than Option 3a as there are	re no legacy or potential remediation costs associated with the full removal optic	





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	И	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	мw	11%
2a - Remove exposed ends & exposures	S	N	S	w	мw	16%
2b - Rock cover exposed ends & exposures	N	w	N	w	мw	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%



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%

Appendix F.3 Group 5 Pairwise Comparison Matrices – Environment / Technica	Appendix F.3	Group 5 Pairwise Cor	nparison Matrices –	Environment / Technical
--	--------------	----------------------	---------------------	--------------------------------

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	мw	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%



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%

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

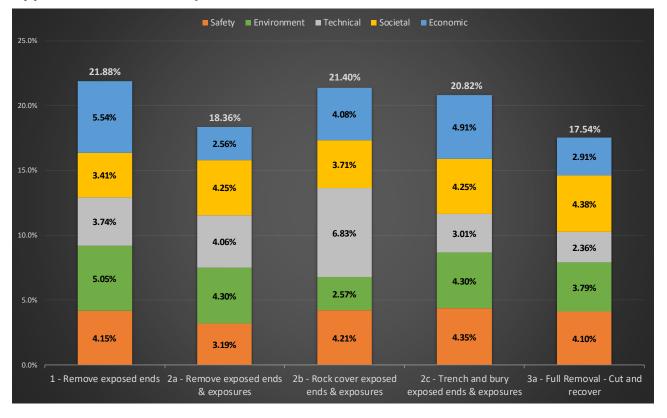
4.2 Socio- economic impact on communities and amenities	1 - Remove exposed ends	2a - Remove exposed ends & exposures	2b - Rock cover exposed ends & exposures	2c - Trench and bury exposed ends & exposures	3a - Full Removal - Cut and recover	Weighting
1 - Remove exposed ends	N	N	N	N	s	21%
2a - Remove exposed 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	vмw	w	MW	vмw	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	мw	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 I	ntervent	ion - Rer	nove ex	posed er	nds		3b - Full Re	emoval -	Reverse	Reeling			
						R = 0				Likelihood	l				
	1.1 Personnel Offshore	O = 7 Y = 10 G = 4	Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)	O = 11 Y = 13 G = 1	Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
_	Offsl	Total = 21	5	2					Total = 25	5	2				
afety	Jel (4		5					4		4	3		
1. Safety	soni		3	1	3					3		5	1		
	Per		2	3	6					2	1	4	3	1	
	÷		1		1					1			1		
			0							0					
					MS										<u> </u>
		The assessm	ent again		-	Offshore c	riterion is	based or	the results of	of the HA2	ZID for the	various o	offshore o	perations	for each
		option and is as follows: Option 1 is assessed as being much stronger than Option 3b a)h aa tha	access of wor	li in much	a hartar l	a a dina ta	loop riel:		
	Summary	Option T is as	ssessed	as being i	nuch stro	nger mar	i Option a	b as the	scope of wor	K IS MUCH	shorter i	eading to	IESS IISK	exposure.	
		Overall, Optic	on 1 is the	e preferred	d option fr	om a risk	to Offsho	ore Perso	nnel perspec	tive. Note	: No MAH	H were ide	entified for	any optio	ons.
		R = 0			1	Likelihood			R = 1				Likelihood		
	ore	O = 2 Y = 11 G = 2	Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)	O = 8 Y = 6 G = 0	Severity	Very Unlikely (A)	Unlikely (B)	Possible (C)	Likely (D)	Very Likely (E)
	hsh	Total = 15	5						Total = 15	5			1		
1. Safety			4	4						4	2	1			
1. S	sonr		3	2	3					3		2	3		
	1.2 Personnel Onshore		2	1		2	2			2		1		3	1
	1.2		1		1					1				1	
			0							0					
					MS										
	Summary	The assessm option and is Option 1 is as scope leading lines.	as follows	s: as being v	ery much	n stronger	than Opt	ion 3b as	there is less	s material	being retu	urned to s	hore so s	mall onsh	ore
		Overall, Option 1 would be the preferred option from a risk to O							e Personnel p	perspectiv	e. Note:	Option 3b	has one	potential	MAH.



Security N Nummary N Summary N Summary N <th></th> <th></th> <th>1 - Minimal I</th> <th>Intervent</th> <th>ion - Rer</th> <th>nove ex</th> <th>posed er</th> <th>nds</th> <th></th> <th>3b - Full Re</th> <th>moval - I</th> <th>Reverse</th> <th>Reelina</th> <th></th> <th></th> <th></th>			1 - Minimal I	Intervent	ion - Rer	nove ex	posed er	nds		3b - Full Re	moval - I	Reverse	Reelina			
Monto 0 - 2 0 - 0 0 - 0 0 - 0 0 - 2 0 - 0 0 - 0 0 - 2 0 - 0 0 - 2 0 - 0 0 - 0 <th< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>Likoliha</th><th></th><th></th></th<>														Likoliha		
Verticity Total = 2 s 2 1 <th1< th=""> 1 1</th1<>			O = 2 Y = 0	Severity	Unlikely	Unlikely	Possible			O = 2 Y = 0	Severity	Unlikely		Possible		Very Likely (E)
Image: set of the problem of the pr		sers		5							5					
Image: second	ıfety	ñ		4							4					
Image: set of the problem of the pr	1. Sa	Othe		3							3					
Vertail Image: Contract of the second se		1.3		2							2					
N Nome Nom Nom				1							1					
The assessment against the Other Users criterion is based on the results of the HAZID for the various offshore operations for each optic and is as follows: Nummary Summary Note: R = 0 N = 0 N = 0 N = 0 Seventy with the offshore operations is being neutral against each other as the risk exposure to Other Users from on-site and transit operations is similar for 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 are as any collision with a vessel is highly unlikely based on the equipment used be all vessels. Note: R = 0 N = 0 N = 0 N = 0 Seventy with with the offshore operations is as follow: Seventy with with the offshore operations is as follow: Operating operating the Unlikely collision with a vessel is highly unlikely based on the equipment used be all vessels. Seventy with with the offshore operation with a vessel is highly unlikely based on the equipment used be all vessels. Visual maps Seventy with unlikely collision with a vessel is highly unlikely based on the equipment used be all vessels. Seventy with unlikely for the legacy operations is as follows: Option 1 Seventy with unlikely for the logacy operations is as follows: Seventy with unlikely for the based on the results of the HAZID for the legacy operations is as follows: Option 10 Descent monitor and remediate the left in-situ unbilicals / cables versus the full removal option. Overall, Option 3b, is the preferred option from a Residual Risk				0							0					
The assessment against the Other Users criterion is based on the results of the HAZID for the various offshore operations for each optic and is as tollows: Nummary Summary Note: AI options are equally prefered from a risk to Other Users perspective. Note: HAZID concluded that the risk profile would be the same for all options are equally prefered from a risk to Other Users perspective. Note: HAZID concluded that the risk profile would be the same for all options are as any collision with a vessel is highly unlikely based on the equipment used be all vessels. Note: 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. Note: Note: HAZID for the legacy operations is as follows: Option 1 is assessment against the Residual Risk criterion is based on the results of the HAZID for the legacy operations is as follows: Option 1 is 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 neutral impacts from this option are assessed as low; the following quantities are noted: Vessel Noise: 24 do 1 do					1	N	1	1	1							
Yeig O = 5 Y = 8 S = 0 Severity Winkledy (b) Very (c) Ukely (b) Very (c)		Summary	and is as follo All options ar similar for all Overall, all op	ows: re assess options. otions are	ed as bei equally p	ng neutra referred f	l against rom a risł	each othe	er as the Users pe	risk exposure erspective. N	to Other ote: HAZI	Users fro D conclue	m on-site ded that t	and trans	sit operati	ons is
Visit Severity Very Unilitely (D) Very Unitely (D)			P – 0				Likolihoor							Likolihood	1	
Year Total = 13 s <		×	O = 5 Y = 8	Severity	Unlikely	Unlikely	Possible				Severity	Unlikely	Unlikely	Possible		Very Likely (E)
Image: Note of the system o	~	I Ris	Total = 13	5	5						5					
Image: Note of the system o	afet	idua		4	3						4					
Image: Note of the system o	+	Res		3		2					3					
Image: Construction of the section of 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. Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 246 dB / 4.4 TPa ² s Subsea Cutting: 3.63 days Vessel Emissions (CO ₂): 4,417 tonnes Vessel Fuel Use: 1,393 tonnes Vessel Fuel Use: 1,393 tonnes Vessel Fuel Use: 1,922 tonnes Mage: 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		1.4		2		3					2					
W Summary 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. Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 246 dB / 4.4 TPa ² S Vessel Noise: 251 dB / 11.5 TPa ² S Subsea Cutting: 3.63 days Vessel Emissions (CO ₂): 4.417 tonnes Vessel Emissions (CO ₂): 6.092 tonnes Vessel Fuel Use: 1,393 tonnes Vessel Fuel Use: 1,922 tonnes Vessel Fuel Use: 1,922 tonnes				1							1					
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. Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 246 dB / 4.4 TPa ² s Vessel Noise: 251 dB / 11.5 TPa ² s Subsea Cutting: 3.63 days Vessel Emissions (CO ₂): 4,417 tonnes Vessel Fuel Use: 1,393 tonnes Vessel Emissions (CO ₂): 6,092 tonnes Vessel Fuel Use: 1,393 tonnes Vessel Fuel Use: 1,922 tonnes N 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				0							0					
Summary 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. Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 246 dB / 4.4 TPa ² s Vessel Noise: 251 dB / 11.5 TPa ² s Subsea Cutting: 0.25 day MFE: 14.24 days Vessel Emissions (CO ₂): 4,417 tonnes Vessel Emissions (CO ₂): 6,092 tonnes Vessel Fuel Use: 1,393 tonnes Vessel Fuel Use: 1,922 tonnes N 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																
Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Whilst the offshore environmental impacts from this option are assessed as 'low', the following quantities are noted: Vessel Noise: 246 dB / 4.4 TPa ² s Vessel Noise: 251 dB / 11.5 TPa ² s Subsea Cutting: 3.63 days Vessel Emissions (CO ₂): 4,417 tonnes Vessel Fuel Use: 1,393 tonnes Vessel Emissions (CO ₂): 6,092 tonnes Vessel Fuel Use: 1,393 tonnes Vessel Fuel Use: 1,922 tonnes The assessment against the Impact of Decommissioning Operations Offshore criterion is as follows: 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		Summary	Option 1 is a	ssessed a	as being v	weaker th	an Optior	n 3b as th	ere is pot	ential for sna	g hazard	and addit				-hours
Image: Second			Overall, Optic	on 3b, is t	he preferr	ed option	from a R	esidual R	isk persp	ective.						
Vessel Noise: 246 dB / 4.4 TPa ² s Vessel Noise: 251 dB / 11.5 TPa ² s Subsea Cutting: 3.63 days Vessel Emissions (CO ₂): 4,417 tonnes Vessel Emissions (CO ₂): 4,417 tonnes Vessel Emissions (CO ₂): 6,092 tonnes Vessel Fuel Use: 1,393 tonnes Vessel Fuel Use: 1,392 tonnes Vessel Fuel Use: 1,393 tonnes Vessel Fuel Use: 1,922 tonnes Vessel Fuel Use: 1,922 tonnes Vessel Fuel Use: 1,922 tonnes Vessel Fuel Use: 1,922 tonnes Vessel Fuel Use: 1,922 tonnes		sioning e				•		•	are						•	are
N Vessel Fuel Use: 1,393 tonnes Vessel Fuel Use: 1,922 tonnes Image: N N N Image: N 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	nmental	commiss offshor				²s				Subsea Cutt	ing: 0.25		Pa ² s			
N Vessel Fuel Use: 1,393 tonnes Vessel Fuel Use: 1,922 tonnes Image: N N N Image: N 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	wiro	of De tions	Vessel Emis	sions (CC	0 ₂): 4,417	tonnes					•					
E Vessel Fuel Use: 1,922 tonnes File N 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		act c pera	Vessel Fuel I	Use: 1 39	3 tonnes					Vessel Emis	sions (CO	J ₂): 6,092	2 tonnes			
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		2.1 lmp. O								Vessel Fuel	Use: 1,92	22 tonnes				
Option 1 is assessed as being stronger than Option 3b as, whilst there are differences, these are deemed insufficient to move from						Ν										
		Summary	Option 1 is a	•				•	•				emed insu	ufficient to	move fro	m
Overall, Option 1 is the preferred option from a Impact of Decommissioning Operations Offshore perspective.			Overall, Optic	on 1 is the	e preferred	d option fr	om a Imp	act of De	commiss	ioning Operat	ions Offsh	nore pers	pective.			



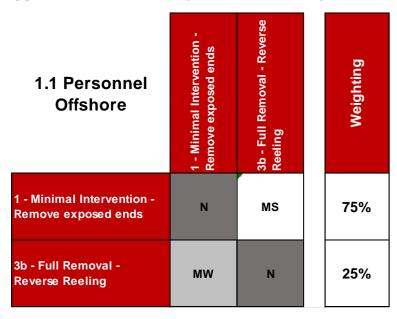
		1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling
tal	g of ials	Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following	Whilst the onshore environmental impacts from processing material returned under this option are assessed as 'low', the following
2. Environmental	2.2 Processing of Returned Materials	quantities are noted:	quantities are noted:
ron	ces d Ma	Umbilicals / Cables: 64 tonnes	Umbilicals / Cables: 1,107 tonnes
invi	Pro	Concrete Mattresses: 1,445 tonnes	Concrete Mattresses: 1,445 tonnes
2. E	2.2 četu	Grout Bags: 10 tonnes	Grout Bags: 10 tonnes
	Ľ	0	
		S The assessment against the Processing of Returned Materials criteri	on is as follows:
		Option 1 is assessed as being stronger than Option 3b as there muc	
S	ummary	landfill.	
		Overall, Option 1 is the preferred option from a Processing of Returne	d Materials perspective.
_			Whilst the environmental impact from the resources consumed (not
ntal	8 5	fuel) under this option is assessed as 'low', the following quantities are noted:	fuel) under this option is assessed as 'low', the following quantities
amr	ptic		are noted:
Environmental	2.3 Resource Consumption	Rock for Rock cover: 600 tonnes (cut ends only)	Rock for Rock cover: N/A
2. Er	° 53	Emissions for replacement material (CO ₂): 2,260 tonnes	Emissions for replacement material (CO ₂): 0 tonnes
~		Emissions from recovered material (CO ₂): 549 tonnes	Emissions from recovered material (CO ₂): 1,348 tonnes
		W	
		The assessment against the Resource Consumption criterion is as for	
	ummoni	Option 1 is assessed as being weaker than Option 3b as there is a re also a small amount of rock required for the rock cover.	equirement to replace the left in-situ pipeline material and there is
3	ummary	also a small amount of fock required for the fock cover.	
		Overall, Option 3b is the preferred option from a Resource Consumpti	on perspective.
_		Whilst the environmental impact in terms of Seabed Disturbance is	Whilst the environmental impact in terms of Seabed Disturbance is
enta	nce	assessed as 'low' for this option, there is impact from introducing the	
ů	urba	rock cover over the cut ends of the umbilicals / cables. The area of impact is as follows:	the umbilicals / cables by reverse reeling. The area of impact is as follows:
Environmental	2.4 Disturbance		
	2.4 [Seabed Disturbance: 300 m ²	Seabed Disturbance: 64,500 m ²
2.			
		S	
		The assessment against the Seabed Disturbance (short-term impact)	
~		Option 1 is assessed as being Stronger than Option 3b due to limited ends and leaving the remainder in-situ (already trenched and buried)	-
S	ummary	option.	5
		Overall, Option 1 is the preferred option from a Disturbance perspectiv	ve.
		Whilst the environmental impact in terms of Loss of Habitat (long-	There are no long-term impacts or loss of habitats expected from the
a	tat		full removal of the umbilicals / cables by reverse reeling.
ent	labi	from introducing rock cover at the umbilical / cable ends which will	
muc	of F	permanently alter the habitat type and will therefore impact the benthic community. There is no additional permanent impact from	
virc	SSC	leaving the umbilicals / cables in place as they are already trenched	
2. Environmental	2.5 Loss of Habitat	and buried. The area of impact is as follows:	
2	Ň	\mathbf{D} and \mathbf{r} and \mathbf{r}^2	
		Rock cover: 300 m ²	
		The assessment against the Loss of Habitat (legacy / long-term) crite	erion is as follows:
		Option 1 is assessed as being weaker than Option 3b as there will be	
S	ummary	introduced at the cut ends of the umbilicals / cables versus the full re	moval option.
		Overall, Option 3b is the preferred option from a Loss of Habitat persp	pective.



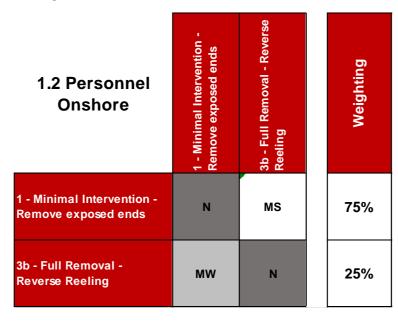
		1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling
3. Technical	3.1 Technical Risk	Feasibility:- High Concept Maturity:- High Availability of Technology:- High - All vessels and equipment widely available Track Record:- High - Operations considered routine Risk of Failure:- 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	
s	Summary	The assessment against the Technical Risk criterion is as follows: Option 1 is assessed as being much stronger than Option 3b as ther scale and the potential for integrity failure of lines during reverse reelir uncertainties	e is limited track record of reverse reeling umbilicals / cables at this ng versus minimal and routine operations for Option 1. There are also
		Overall, Option 1 is the preferred option from a Technical Risk perspe	ctive.
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.	
		W	
s	Summary	The assessment against the Impact on Commercial Fisheries criterio Option 1 is assessed as weaker than Option 3b as whilst the full area the line is removed under Option 3b.	
		Overall, Option 3b is the preferred option from an Impact on Commerce	cial Fisheries perspective.
	impact on menities	Quantities of material returned are: Umbilicals / Cables: 64 tonnes Concrete Mattresses: 1,445 tonnes Grout Bags: 10 tonnes	Quantities of material returned are: Umbilicals / Cables: 1,107 tonnes Concrete Mattresses: 1,445 tonnes Grout Bags: 10 tonnes
4. Societal	4.2 Socio-economic impact on communities	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.	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	
		The assessment against the Socio-economic criterion is as follows:	larger quantity of Umbilical / Cable returned with Option 3b, although
s	Summary	the additional impact is expected to minimal due to transporting reele	



		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	
S	ummary	The assessment against the Short-term Costs criterion is as follows: Option 1 is assessed as being stronger than Option 3b as the costs	
		Overall, Option 1 is the preferred option from a Short-term Costs pers	pective.
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
5.	. .	MW	There are no legacy costs associated with this full removal option.
s	ummary	The assessment against the Long-term Costs criterion is as follows: Option 1 is assessed as being much weaker than Option 3b as there Overall, Option 3b would be preferred from a Long-term Costs perspe	



Appendix G.2 Group 6 Pairwise Comparison Matrices – Safety



1.3 Other Users

1 - Minimal Intervention -Remove exposed ends

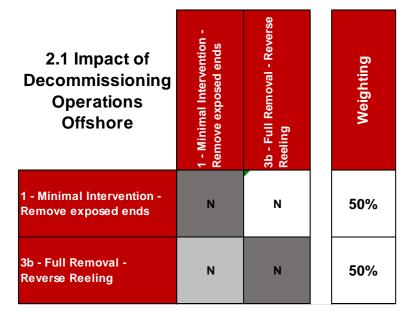
3b - Full Removal -Reverse Reeling

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%



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

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



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	

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%

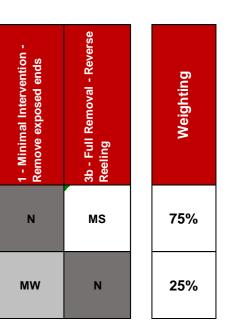
3. Technical

1 - Minimal Intervention -Remove exposed ends

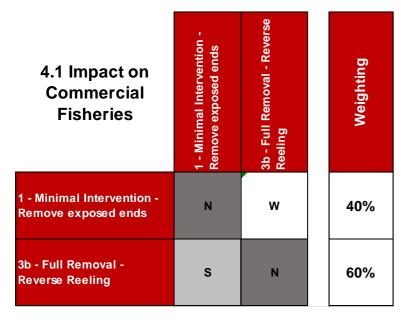
3b - Full Removal -Reverse Reeling



1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling	Weighting
N	w	40%
s	N	60%



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



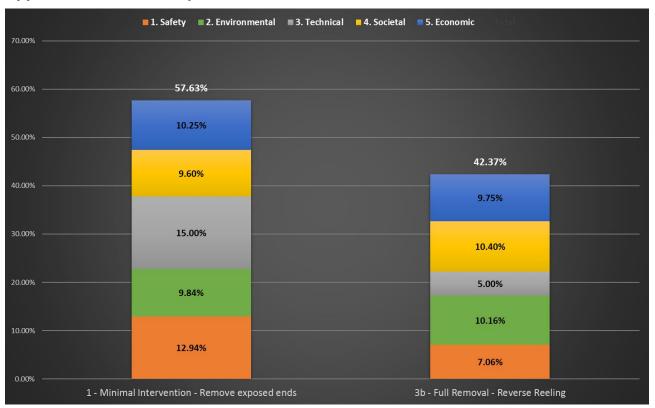
4.2 Socio- economic impact on communities and amenities	1 - Minimal Intervention - Remove exposed ends	3b - Full Removal - Reverse Reeling	Weighting
1 - Minimal Intervention - Remove exposed ends	N	S	60%
3b - Full Removal - Reverse Reeling	w	N	40%

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	мw	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 t	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			·	
	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	9	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Vessel Type	Number off	Duration	Activity
Legacy)	Survey Vessel (Legacy)	1	8	Survey Works
Noise	Parameter	dB re 1mP	TPa ² s	
(Total = Ops + Legacy)	Sound Exposure Level	245.3	3.4	
Energy Use	Fuel	CO2	NOx	SO ₂
(Total = Ops + Legacy)	1030.4 Te	3266.3 Te	60.8 Te	12.4 Te
Life Cycle Emissions	CO2			
(Total = Ops + Legacy)	14,420 Te			



ENVIRONMENTAL	NVIRONMENTAL					
	Activity	Area (m²)	Resources			
Marine Impact	Rockdumping	100	200Te of rockdump			
(Seabed)	MFE	N/A	N/A			
	Trenching	N/A	N/A			
	Component / Material	Parameter	Weight (Te)	Length (m)		
	Concrete Coated Steel Pipe	Recovered	123.0	220		
Materials		Remaining	8079.7	15,286		
	Concrete Mattresses	Recovered	276.8	N/A		
(Grout Bags	Recovered	3.0	N/A		
	Туре	Left In-Situ	Returned			
Residuals	LSA Scale	N/A	N/A			
Residuals	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned			
	Control Fluids	N/A	N/A			

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

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

ECONOMIC						
	Comparative Cost Operational			£2.72	Μ	
Economic Considerations	Comparative Cost Legacy			£0.38	Μ	
	Comparative Cost Total (inc. contingency)			£4.03	Μ	
Economic Risk	Cost Risk	Low	Factors	0 0	ree of achievability; nanagement required.	



Appendix H.2 2D – 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)			

Appendix H.2 2b – Rock cover exposures

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 t	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	ΣΡLL	3.96E-03		

ENVIRONMENTAL

ENVIRONMENTAL				
	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	9	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Vessel Type	Number off	Duration	Activity
Legacy)	Survey Vessel (Legacy)	1	8	Survey Works
Noise	Parameter	dB re 1mP	TPa ² s	
(Total = Ops + Legacy)	Sound Exposure Level	253.8	24.2	
Energy Use	Fuel	CO ₂	NOx	SO ₂
(Total = Ops + Legacy)	1634.1 Te	5180.2 Te	96.4 Te	19.6 Te
Life Cycle Emissions	CO ₂			
(Total = Ops + Legacy)	16,334 Te			
	Activity	Area (m²)	Resources	
Marine Impact	Rockdumping	77530	203100Te of rockdump	
(Seabed)	MFE	N/A	N/A	
	Trenching	N/A	N/A	



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

TECHNICAL					
	Feasibility	High	Concept Maturity	High	
	Availability of Technology	High - All vessels and equipment widely available			
Technical Considerations	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
Societal Factors	Socio Economic	Low - Minor benefit due to small amount of returned material

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



Appendix H.S 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)			

Appendix H.3 2c – Trench and bury exposures

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	3 rd 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	ΣΡLL	3.60E-03				

ENVIRONMENTAL

ENVIRONMENTAL				
	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	9	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Parameter	dB re 1mP	TPa ² s	
(Total = Ops + Legacy)	Sound Exposure Level	251.0	12.5	
Energy Use	Fuel	CO2	NOx	SO ₂
(Total = Ops + Legacy)	1339.4 Te	4245.8 Te	79 Te	16.1 Te
Life Cycle Emissions	CO ₂			
(Total = Ops + Legacy)	15,400 Te			
Marine Impact (Seabed)	Activity	Area (m²)	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	Recovered	123.0	220		
	Pipe	Remaining	8079.7	15,286		
	Concrete Mattresses	Recovered	276.8	N/A		
	Grout Bags	Recovered	3.0	N/A		
Residuals	Туре	Left In-Situ	Returned			
	LSA Scale	Flushed & Cleaned	Flushed & Cleaned			
	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned			
	Control Fluids	N/A	N/A			

TECHNICAL				•		
	Feasibility	Med	Concept Maturity	Low		
	Availability of Technology	Med - Suitable trench/backfill equipment available but limited for size of pipe.				
Technical Considerations	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.				
	Failure to achieve target DoC would likely result in requirement for additional rock placement in that location. Cost and schedule impact.					

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

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



appendix 11.4 $a = out and Ent = out pipe in to small sections and recover$				
Area	Fulmar			
Decision / Group Group 1: 24" Concrete Coated Pipeline Surface Laid Exposed (PL1315)				
Option Option 3a: Full Removal – Cut and Lift				

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

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	Operation 3rd party pipeline crossing in working vicinity Potential diver works; Comments Extensive subsea operations; Significant lifting required; For further details from the HAZID, see Ref.		
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	ΣΡLL	1.66E-02		

ENVIRONMENTAL Number off Duration Vessel Type Activity Barge / Pipehaul 4 89 Material Transport CSV 1 33 Subsea Works DSV 1 61 Subsea Works HLV 0 0 N/A Marine Impact (Vessels) 0 0 Reel Vessel N/A Rockdump Vessel 0 0 N/A Survey Vessel 1 10 Survey Works 5 Trawl Sweep Trawler 1 Trenching Vessel 0 0 N/A Vessel Type Number off Duration Activity Marine Impact (Vessel Legacy) 0 Survey Vessel (Legacy) 0 N/A dB re 1mP TPa²s Parameter Noise (Total = Ops + Legacy) Sound Exposure Level 250.8 12.0 Fuel CO_2 NOx SO₂ Energy Use (Total = Ops + Legacy) 5531.4 Te 66.4 Te 17534.5 Te 326.4 Te CO_2 Life Cycle Emissions (Total = Ops + Legacy) 23,052 Te



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

TECHNICAL	TECHNICAL						
	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					
Technical	Track Record	Low - Routine operation but track record low for size and length of pipeline.					
Considerations	Risk of Failure	sk of Failure High - Considered challenging over extended distances. May require diver support. Extended subsea works & simultaneous operations.					
Consequence of Failure would result in significant cost and schedule impact / requirement for a							
	Failure	decommissioning method.					

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

ECONOMIC							
Comparative Cost Operational			£23.00	Μ			
Economic Considerations	Comparative Cost Legacy			£0.00	М		
Concluciations	Comparative Cost Total (inc. contingency)			£29.91	Μ		
Economic Risk	Cost Risk	High	Factors		technical and safety risk associated with 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	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 t	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	ΣΡLL	2.74E-03				

ENVIRONMENTAL			·	
	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	7	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Vessel Type	Number off	Duration	Activity
Legacy)	Survey Vessel (Legacy)	1	7	Survey Works
Noise	Parameter	dB re 1mP	TPa ² s	
(Total = Ops + Legacy)	Sound Exposure Level	245.3	3.4	
Energy Use	Fuel	CO2	NOx	SO ₂
(Total = Ops + Legacy)	926.9 Te	2938.2 Te	54.7 Te	11.1 Te
Life Cycle Emissions	CO2			
(Total = Ops + Legacy)	3,609 Te			



NVIRONMENTAL	• •		· · ·	
	Activity	Area (m²)	Resources	
Marine Impact	Rockdumping	100	200Te of rockdump	
(Seabed)	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
5	Туре	Left In-Situ	Returned	
	LSA Scale	Flushed & Cleaned	Flushed & Cleaned	
Residuals	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	•	
	Commercial Fisheries Impact	Low - Limited additional area lost.
Societal Factors	Socio Economic	Low - Minor benefit due to small amount of returned material

ECONOMIC							
	Comparative Cost Operational			£2.14	Μ		
Economic Considerations	Comparative Cost Legacy			£0.32	Μ		
Constantia	Comparative Cost Total (inc. contingency)			£3.20	Μ		
Economic Risk	Cost Risk	Low	Factors		ree of achievability; nanagement required.		



Appendix I.2 20 – 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)				

Appendix I.2 2b – Rock cover exposures

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. 1				
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	ΣΡLL	2.76E-03				

ENVIRONMENTAL

ENVIRONMENTAL				
	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	7	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Vessel Type	Number off	Duration	Activity
Legacy)	Survey Vessel (Legacy)	1	7	Survey Works
Noise	Parameter	dB re 1mP	TPa ² s	
(Total = Ops + Legacy)	Sound Exposure Level	245.7	3.7	
Energy Use	Fuel	CO ₂	NOx	SO ₂
(Total = Ops + Legacy)	944.1 Te	2992.9 Te	55.7 Te	11.3 Te
Life Cycle Emissions	CO ₂			
(Total = Ops + Legacy)	3,664 Te			
	Activity	Area (m²)	Resources	
Marine Impact	Rockdumping	10,425	14600Te of rockdump	
(Seabed)	MFE	N/A	N/A	
	Trenching	N/A	N/A	



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

TECHNICAL						
	Feasibility	High	Concept Maturity	High		
Technical Considerations	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			
Consisted Footons	Commercial Fisheries Impact	High - Significant area of natural seabed permanently lost.	
Societal Factors	Socio Economic	Low - Minor benefit due to small amount of returned material.	

ECONOMIC					
	Comparative Cost Operational			£2.78	Μ
Economic Considerations	Comparative Cost Legacy			£0.32	Μ
Constantia	Comparative Cost Total (inc. contingency)			£4.03	Μ
Economic Risk	Cost Risk	Med	Factors	Legacy m	ree of achievability; anagement required; ble for maintenance of significant length of n.



Appendix 1.5 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)			

Appendix I.3 2c – Trench and bury exposures

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. 1		
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	ΣΡLL	2.84E-03		

ENVIRONMENTAL				
	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	7	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Vessel Type	Number off	Duration	Activity
Legacy)	Survey Vessel (Legacy)	1	7	Survey Works
Noise	Parameter	dB re 1mP	TPa ² s	
(Total = Ops + Legacy)	Sound Exposure Level	248.1	6.4	
Energy Use	Fuel	CO2	NOx	SO ₂
(Total = Ops + Legacy)	1013.1 Te	3211.6 Te	59.8 Te	12.2 Te
Life Cycle Emissions	CO ₂			
(Total = Ops + Legacy)	3,883 Te			
Marine Impact (Seabed)	Activity	Area (m²)	Resources	
	Rockdumping	N/A	N/A	
	MFE	N/A	N/A	
	Trenching	2125	Trenching Spread	



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

TECHNICAL							
	Feasibility	Med	Concept Maturity	Low			
	Availability of Technology	Med - Suitable trench/backfill equipment available.					
Technical Considerations	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 le							
	Consequence of Failure	Failure to achieve target DoC would likely result in additional rock placement. Cost and schedule impact.					

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

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



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

Area	Auk
Decision / Group	Group 2: 10" Concrete Coated Pipeline Surface Laid and Exposed (PI38)
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)	of theNumber of Vessels Used5Duration 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	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	1	13	Material Transport
	CSV	1	9	Subsea Works
	DSV	1	14	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Vessel Type	Number off	Duration	Activity
Legacy)	Survey Vessel (Legacy)	0	0	N/A
Noise	Parameter	dB re 1mP	TPa²s	
(Total = Ops + Legacy)	Sound Exposure Level	244.8	3.0	
	Fuel	CO ₂	NOx	SO ₂
Energy Use (Total = Ops + Legacy)	1459.6 Te	4627 Te	86.1 Te	17.5 Te
Life Cycle Emissions	CO ₂			
(Total = Ops + Legacy)	4,955 Te			



NVIRONMENTAL				
	Activity	Area (m²)	Resources	
Marine Impact	Rockdumping	N/A	N/A	
(Seabed)	MFE	N/A	N/A	
	Trenching	N/A	N/A	
	Component / Material	Parameter	Weight (Te)	Length (m)
	Concrete Coated Steel	Recovered	533.9	2,125
Materials	Pipe	Remaining	0.0	0
	Concrete Mattresses	Recovered	20.3	N/A
	Grout Bags	Recovered	12.5	N/A
	Туре	Left In-Situ	Returned	
Desidents	LSA Scale	N/A	Flushed & Cleaned	
Residuals	Hydrocarbon	N/A	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL		•		-			
	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					
Technical	Track Record	Med - Routine operation but limited track record of cut and lift over extended distance.					
Considerations High - Considered challenging over extended distances. May require diver sup Extended subsea works & simultaneous operations.							
	requirement for alternative						

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

ECONOMIC							
	Comparative Cost Operational			£5.10	Μ		
Economic Comparative Cost Legacy				£0.00	Μ		
Concluciations	Comparative	Comparative Cost Total (inc. contingency)		£6.63	Μ		
Economic Risk	Cost Risk	High	Factors		I technical and safety risk associated with 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 t	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	ΣΡLL	2.95E-03		

	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	8	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Vessel Type	Number off	Duration	Activity
Legacy)	Survey Vessel (Legacy)	1	7	Survey Works
Noise	Parameter	dB re 1mP	TPa ² s	
(Total = Ops + Legacy)	Sound Exposure Level	245.5	3.6	
Energy Use	Fuel	CO2	NOx	SO ₂
(Total = Ops + Legacy)	946.4 Te	3000 Te	55.8 Te	11.4 Te
Life Cycle Emissions	CO ₂			
(Total = Ops + Legacy)	3,962 Te			



VIRONMENTAL				
	Activity	Area (m²)	Resources	
Marine Impact	Rockdumping	400	800Te of rockdump	
(Seabed)	MFE	N/A	N/A	
	Trenching	N/A	N/A	
	Component / Material	Parameter	Weight (Te)	Length (m)
	Concrete Coated Steel	Recovered	12.2	40
	Pipe	Remaining	628.9	1,029
	Divid Otaal Dive	Recovered	7.5	40
Materials	Rigid Steel Pipe	Remaining	24.2	1,302
	Umbilicals	Recovered	1.6	80
	Unblicais	Remaining	33.1	1,614
	Concrete Mattresses	Recovered	256.5	N/A
	Grout Bags	Recovered	0.0	N/A
	Туре	Left In-Situ	Returned	
	LSA Scale	Flushed & Cleaned	Flushed & Cleaned	
Residuals	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned	
	Control Fluids	Flushed	Flushed	

TECHNICAL						
	Feasibility	High	Concept Maturity	High		
	Availability of Technology	High - All vessels and equipment widely available				
Technical Considerations	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.				
Societal Factors	Socio Economic	Low - Minor benefit due to small amount of returned material				

ECONOMIC							
	Comparative Cost Operational			£2.42	Μ		
Economic Considerations Comparative Cost Legacy				£0.33	Μ		
oonolaorationo	Comparative Cost Total (inc. contingency)			£3.58	Μ		
Economic Risk	Cost Risk Low Factors			ree of achievability anagement required			



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

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

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 opera Significant lifting require For further details from t	ed;	
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	ΣΡLL	6.22E-03			

ENVIRONMENTAL				· · ·
	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	1	20	Material Transport
	CSV	1	17	Subsea Works
	DSV	1	21	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Vessel Type	Number off	Duration	Activity
Legacy)	Survey Vessel (Legacy)	0	0	N/A
Noise	Parameter	dB re 1mP	TPa ² s	
(Total = Ops + Legacy)	Sound Exposure Level	247.0	5.1	
Energy Use	Fuel	CO ₂	NOx	SO ₂
(Total = Ops + Legacy)	2045.9 Te	6485.4 Te	120.7 Te	24.6 Te
Life Cycle Emissions	CO ₂			•
(Total = Ops + Legacy)	6,995 Te			
	Activity	Area (m²)	Resources	
Marine Impact	Rockdumping	N/A	N/A	
(Seabed)	MFE	8210	MFE Spread	
	Trenching	N/A	N/A	



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

TECHNICAL							
	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				
Technical Considerations	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					
Consideratione	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 decommissioning method.							

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

ECONOMIC							
	Comparative Cost Operational			£6.69	Μ		
Economic Considerations	Comparative Cost Legacy			£0.00	Μ		
Concluciations	Comparative Cost Total (inc. contingency)			£8.69	Μ		
Economic Risk	Economic Risk Cost Risk High Factors			I technical and safety risk associated with 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 en Cut & lift required for ren For further details from t	moval of PL208;
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	ΣΡLL	4.46E-03		

ENVIRONMENTAL	r			
	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	1	9	Material Transport
	CSV	1	10	Subsea Works
	DSV	1	12	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Vessel Type	Number off	Duration	Activity
Legacy)	Survey Vessel (Legacy)	0	0	N/A
Noise	Parameter	dB re 1mP	TPa²s	
(Total = Ops + Legacy)	Sound Exposure Level	248.6	7.3	
Energy Use	Fuel	CO ₂	NOx	SO ₂
(Total = Ops + Legacy)	1802.9 Te	5715.1 Te	106.4 Te	21.6 Te
Life Cycle Emissions	CO ₂			
(Total = Ops + Legacy)	6,225 Te			



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

TECHNICAL							
	Feasibility	Med	Concept Maturity	Med			
	Availability of Technology	Med - Generally, vessels and required.	equipment available. MFE spre	ead required. Reel vessel			
Technical Considerations	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.					

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

ECONOMIC							
	Comparative Cost Operational			£5.39	Μ		
Economic Considerations	Comparative Cost Legacy			£0.00	Μ		
Consideratione	Comparative Cost Total (inc. contingency)			£7.01	Μ		
Economic Risk	Cost Risk	Med	Factors	Opportunit study confi	e of achievability; y to remove unburial works if engineering irms structural integrity of product will allow ulling 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			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	ΣΡLL	3.01E-03		

ENVIRONMENTAL				
	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	7	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Vessel Type	Number off	Duration	Activity
Legacy)	Survey Vessel (Legacy)	1	9	Survey Works
Noise	Parameter	dB re 1mP	TPa ² s	
(Total = Ops + Legacy)	Sound Exposure Level	245.4	3.5	
Energy Use	Fuel	CO2	NOx	SO ₂
(Total = Ops + Legacy)	1055.9 Te	3347.1 Te	62.3 Te	12.7 Te
Life Cycle Emissions	CO ₂			•
(Total = Ops + Legacy)	6,942 Te			



IRONMENTAL				
	Activity	Area (m²)	Resources	
Marine Impact	Rockdumping	200	400Te of rockdump	
(Seabed)	MFE	N/A	N/A	
	Trenching	N/A	N/A	
	Component / Material	Parameter	Weight (Te)	Length (m)
Materials	Rigid Steel Pipe	Recovered	4.5	40
		Remaining	1986.1	23,020
	Concrete Costed Dine	Recovered	16.2	66
	Concrete Coated Pipe	Remaining	0	0
	Concrete Mattresses	Recovered	229.5	N/A
	Grout Bags	Recovered	3.3	N/A
	Туре	Left In-Situ	Returned	
Desiduala	LSA Scale	Flushed & Cleaned	Flushed & Cleaned	
Residuals	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

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

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

ECONOMIC						
	Comparative Cost Operational			£2.33	Μ	
Economic Considerations	Comparative Cost Legacy			£0.42	Μ	
Considerations	Comparative Cost Total (inc. contingency)			£3.58	Μ	
Economic Risk	Cost Risk	Low	Factors		ree of achievability nanagement required	



Appendix K.2	3a – Cut and Lift – Cut pipe in to small sections and recover
ADDENDIX N.Z	38 – Cut and Lift – Cut bloe 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, so		
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	ΣΡLL	2.32E-02		

ENVIRONMENTAL		· · · ·		- 11
	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	3	94	Material Transport
	CSV	1	56	Subsea Works
	DSV	1	87	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Parameter	dB re 1mP	TPa²s	
(Total = Ops + Legacy)	Sound Exposure Level	252.6	18.3	
Energy Use	Fuel	CO2	NOx	SO ₂
(Total = Ops + Legacy)	6875.9 Te	21796.5 Te	405.7 Te	82.5 Te
Life Cycle Emissions	CO ₂			
(Total = Ops + Legacy)	23,744 Te			



NVIRONMENTAL				·
	Activity	Area (m²)	Resources	
Marine Impact	Rockdumping	N/A	N/A	
(Seabed)	MFE	46120	MFE Spread	
	Trenching	N/A	N/A	
	Component / Material	Parameter	Weight (Te)	Length (m)
Materials	Disid Steel Dise	Recovered	1958.2	22,994
	Rigid Steel Pipe	Remaining	0	0
	Concernts Constant Direc	Recovered	16.2	66
	Concrete Coated Pipe	Remaining	0	0
	Concrete Mattresses	Recovered	229.5	N/A
	Grout Bags	Recovered	3.3	N/A
	Туре	Left In-Situ	Returned	
-	LSA Scale	N/A	Flushed & Cleaned	
Residuals	Hydrocarbon	N/A	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

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

ECONOMIC	-				
	Comparative Cost Operational			£31.93	Μ
Economic Considerations	Comparative Cost Legacy			£0.00	Μ
Considerations	Comparative Cost Total (inc. contingency)			£41.51	М
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	ΣΡLL	3.96E-03		

ENVIRONMENTAL
ENVIRONMENTAL

	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	0	0	N/A
	CSV	1	15	Subsea Works
	DSV	1	7	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Vessel Type	Number off	Duration	Activity
Legacy)	Survey Vessel (Legacy)	0	0	N/A
Noise	Parameter	dB re 1mP	TPa ² s	
(Total = Ops + Legacy)	Sound Exposure Level	250.3	10.8	
Energy Use	Fuel	CO ₂	NOx	SO ₂
(Total = Ops + Legacy)	1699.4 Te	5387 Te	100.3 Te	20.4 Te
Life Cycle Emissions	CO ₂			
(Total = Ops + Legacy)	7,334 Te			



IVIRONMENTAL				· ·
	Activity	Area (m²)	Resources	
Marine Impact	Rockdumping	N/A	N/A	
(Seabed)	MFE	46120	MFE Spread	
	Trenching	N/A	N/A	
	Component / Material	Parameter	Weight (Te)	Length (m)
	Digid Steel Dine	Recovered	1958.2	22,994
	Rigid Steel Pipe	Remaining	0	0
Materials	Concernto Constad Dina	Recovered	16.2	66
	Concrete Coated Pipe	Remaining	0	0
	Concrete Mattresses	Recovered	229.5	N/A
	Grout Bags	Recovered	3.3	N/A
	Туре	Left In-Situ	Returned	
Desiduala	LSA Scale	N/A	Flushed & Cleaned	
Residuals	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.				
<u></u>						

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	Μ	
	Comparative Cost Legacy			£0.00	М	
	Comparative Cost Total (inc. contingency)			£17.10	Μ	
Economic Risk	Cost Risk	Med	Factors	Med degree of achievability; Opportunity to remove unburial works if engineering study confirms structural integrity of product will allo 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	ΣΡLL	2.74E-03		

ENVIRONMENTAL			-	
	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	7	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Vessel Type	Number off	Duration	Activity
Legacy)	Survey Vessel (Legacy)	1	7	Survey Works
Noise	Parameter	dB re 1mP	TPa ² s	
(Total = Ops + Legacy)	Sound Exposure Level	245.5	3.6	
Energy Use	Fuel	CO2	NOx	SO ₂
(Total = Ops + Legacy)	926.9 Te	2938.2 Te	54.7 Te	11.1 Te
Life Cycle Emissions	CO ₂			
(Total = Ops + Legacy)	4,857 Te]	



NVIRONMENTAL				
	Activity	Area (m²)	Resources	
Marine Impact	Rockdumping	3350	6500Te of rockdump	
(Seabed)	MFE	N/A	N/A	
	Trenching	N/A	N/A	
	Component / Material	Parameter	Weight (Te)	Length (m)
	Rigid Steel Pipe	Recovered	28.4	80
Materials	Rigid Steel Pipe	Remaining	1495.9	4,007
	Concrete Mattresses	Recovered	162.0	N/A
	Grout Bags	Recovered	4.5	N/A
	Туре	Left In-Situ	Returned	
_ ·· ·	LSA Scale	Flushed & Cleaned	Flushed & Cleaned	
Residuals	Hydrocarbon	Flushed & Cleaned	Flushed & Cleaned	
	Control Fluids	N/A	N/A	

TECHNICAL						
	Feasibility	High Concept Maturity High		High		
	Availability of Technology	High - All vessels and equipment widely available				
Technical Considerations	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.
Societal Factors	Socio Economic	Low - Minor benefit due to small amount of returned material

ECONOMIC		•	•	-	
Comparative Cost Operational			£2.51	Μ	
Economic Considerations	Comparative Cost Legacy			£0.33	Μ
Comparative Cost Total (inc. contingency)		£3.69	Μ		
Economic Risk	Cost Risk	Low	Factors		ree of achievability; nanagement required.



$\frac{1}{2} = \frac{1}{2} = \frac{1}$			
Area	Fulmar		
Decision / Group Group 5: Pipelines, Partially Trenched and Buried (PL63, PL648)			
Option	Option 2a: Leave in Situ – Minor Intervention (Cut Out Exposures)		

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

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.		
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	r			
	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	17	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Parameter	dB re 1mP	TPa²s	
(Total = Ops + Legacy)	Sound Exposure Level	247.1	5.2	
Energy Use	Fuel	CO ₂	NOx	SO2
(Total = Ops + Legacy)	1156.4 Te	3665.7 Te	68.2 Te	13.9 Te
Life Cycle Emissions	CO2			
(Total = Ops + Legacy)	5,283 Te			
	Activity	Area (m²)	Resources	
Marine Impact	Rockdumping	1200	4800Te of rockdump	
(Seabed)	MFE	N/A	N/A	
	Trenching	N/A	N/A	



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

TECHNICAL					
	Feasibility	High Concept Maturity Med		Med	
	Availability of Technology	High - All vessels and equipment widely available			
Technical Considerations	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.
Societal Factors	Socio Economic	Low - Minor benefit due to small amount of returned material

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



Appendix E.o. Zb. Rook cover expectates (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)				

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

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	ΣΡLL	2.74E-03				

ENVIRONMENTAL

ENVIRONMENTAL				
	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	7	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Vessel Type	Number off	Duration	Activity
Legacy)	Survey Vessel (Legacy)	1	7	Survey Works
Noise	Parameter	dB re 1mP	TPa ² s	
(Total = Ops + Legacy)	Sound Exposure Level	245.6	3.6	
Energy Use	Fuel	CO ₂	NOx	SO ₂
(Total = Ops + Legacy)	926.9 Te	2938.2 Te	54.7 Te	11.1 Te
Life Cycle Emissions	CO ₂			
(Total = Ops + Legacy)	4,857 Te			
	Activity	Area (m²)	Resources	
Marine Impact	Rockdumping	20435	10800Te of rockdump	
(Seabed)	MFE	N/A	N/A	
	Trenching	N/A	N/A	



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

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

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

ECONOMIC							
	Comparative Cost Operational			£2.70	Μ		
Economic Considerations	Comparative Cost Legacy			£0.33	Μ		
Constantia	Comparative Cost Total (inc. contingency)			£3.94	Μ		
Economic Risk	Cost Risk	sk Med Factors		Legacy m	ree of achievability; anagement required; ble for maintenance of significant length of n.		



.

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

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

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	ΣΡLL	2.84E-03				

ENVIRONMENTAL				
	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	7	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Vessel Type	Number off	Duration	Activity
Legacy)	Survey Vessel (Legacy)	1	7	Survey Works
Noise	Parameter	dB re 1mP	TPa ² s	
(Total = Ops + Legacy)	Sound Exposure Level	247.8	6.1	
Energy Use	Fuel	CO ₂	NOx	SO ₂
(Total = Ops + Legacy)	1013.1 Te	3211.6 Te	59.8 Te	12.2 Te
Life Cycle Emissions	CO ₂			
(Total = Ops + Legacy)	5,130 Te		<u> </u>	
	Activity	Area (m²)	Resources	
Marine Impact (Seabed)	Rockdumping	200	400Te of rockdump	
	MFE	N/A	N/A	
	Trenching	1068	Trenching Spread	



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

TECHNICAL								
	Feasibility	Med Concept Maturity Low						
	Availability of Technology	Med - Suitable jet trenching equipment available but limited						
Technical Considerations	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	Commercial Fisheries Impact	Med - Significant area of natural seabed temporarily lost. However, area would recover to natural condition
Factors	Socio Economic	Low - Minor benefit due to small amount of returned material

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



appendix E.3 3a – out and Ent – out pipe in to sman sections and recover					
Area	Fulmar				
Decision / Group	Group 5: Pipelines, Partially Trenched and Buried (PL63, PL648)				
Option	Option 3a: Full Removal – Cut and Lift				

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

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		<u> </u>		
	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	2	24	Material Transport
	CSV	1	15	Subsea Works
	DSV	1	21	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Parameter	dB re 1mP	TPa ² s	
(Total = Ops + Legacy)	Sound Exposure Level	246.7	4.6	
Energy Use	Fuel	CO2	NOx	SO ₂
(Total = Ops + Legacy)	2118.9 Te	6716.8 Te	125 Te	25.4 Te
Life Cycle Emissions	CO ₂			
(Total = Ops + Legacy)	7,651 Te			
	Activity	Area (m²)	Resources	
Marine Impact (Seabed)	Rockdumping	N/A	N/A	
	MFE	8174	MFE Spread	
	Trenching	N/A	N/A	



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

TECHNICAL			•				
	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					
Technical Considerations	Track Record	Low - Routine operation but track record low for cut & lift over extended distance. Low track record of unburial over extended distance.					
Constantiations	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	Commercial Fisheries Impact	Med - Significant area of natural seabed temporarily lost. However, area would recover to natural condition.
Factors	Socio Economic	Med - Benefit due to large amount of returned material, however transportation of material may have negative impact

ECONOMIC								
	Comparative Cost Operational			£7.90	Μ			
Economic Considerations	Comparative Cost Legacy			£0.00	Μ			
Constantia	Comparative Cost Total (inc. contingency)			£10.27	М			
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	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	0	0	N/A
	CSV	0	0	N/A
	DSV	1	21	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Vessel Type	Number off	Duration	Activity
Legacy)	Survey Vessel (Legacy)	1	10	Survey Works
Noise	Parameter	dB re 1mP	TPa ² s	
(Total = Ops + Legacy)	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	CO2			
(Total = Ops + Legacy)	7,225 Te			



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

TECHNICAL						
	Feasibility	High Concept Maturity High				
	Availability of Technology	High - All vessels and equipment widely available				
Technical Considerations	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.
Societal Factors	Socio Economic	Low - Minor benefit due to small amount of returned material

ECONOMIC						
Comparative Cost Operational			£5.69	Μ		
Economic Considerations	Comparative Cost Legacy			£0.49	Μ	
Comparative Cost Total (inc. contingency)		£8.04	Μ			
Economic Risk	Cost Risk	Low	Factors	0 0	ree of achievability; anagement 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	ents 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	ΣΡLL	5.04E-03			

ENVIRONMENTAL	· · ·			
	Vessel Type	Number off	Duration	Activity
	Barge / Pipehaul	0	0	N/A
	CSV	1	19	Subsea Works
	DSV	1	11	Subsea Works
Marine Impact	HLV	0	0	N/A
(Vessels)	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	Vessel Type	Number off	Duration	Activity
Legacy)	Survey Vessel (Legacy)	0	0	N/A
Noise	Parameter	dB re 1mP	TPa²s	
(Total = Ops + Legacy)	Sound Exposure Level	250.6	11.5	
Energy Use (Total = Ops + Legacy)	Fuel	CO2	NOx	SO ₂
	1921.6 Te	6091.6 Te	113.4 Te	23.1 Te
Life Cycle Emissions	CO ₂			
(Total = Ops + Legacy)	7,439 Te]	



ENVIRONMENTAL		· · ·		
	Activity	Area (m²)	Resources	
Marine Impact	Rockdumping	N/A	N/A	
(Seabed)	MFE	64500	MFE Spread	
	Trenching	N/A	N/A	
	Component / Material	Parameter	Weight (Te)	Length (m)
	Rigid Steel Pipe	Recovered	1107.2	34,180
Materials	Rigiu Steel Pipe	Remaining	0.0	0
	Concrete Mattresses	Recovered	1444.5	N/A
	Grout Bags	Recovered	10.0	N/A
	Туре	Left In-Situ	Returned	
Desidents	LSA Scale	N/A	N/A	
Residuals	Hydrocarbon	N/A	N/A	
	Control Fluids	N/A	Flushed	

TECHNICAL				-			
	Feasibility	High	Concept Maturity	High			
	Availability of Technology	, , , , , , , , , , , , , , , , , , ,					
Technical Considerations	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
Societal Factors	Socio Economic	High – Significant valuable material returned

ECONOMIC						
Comparative Cost Operational			£7.09	М		
Economic Considerations	Comparative Cost Legacy Comparative Cost Total (inc. contingency)			£0.00	М	
				£9.22	М	
Economic Risk	Cost Risk Low Factors		Opportunit	ee of achievability; y to remove unburial works if engineering irms integrity of umbilicals / cable.		