Beatrice Comparative Assessment Report

Consultation Version

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ABBREVIATIONS

AD	Beatrice Alpha Drilling Platform
AP	Beatrice Alpha Production Platform
ARO	Asset Retirement Obligation
B	Beatrice Bravo Platform
BAP	Biodiversity Action Plan
BAT	Best Available Technique
BEIS	Department for Business Energy and Industrial Strategy (formerly DECC)
BEP	Best Environmental Practices
C	Beatrice Charlie Platform
CA	Comparative Assessment
CoP	Cessation of Production
CSS	Conductor Support Structure
C&P	Contracting and Procurement
DECC	Department of Energy and Climate Change
dia.	Diameter
DP	Decommissioning Programme
E&E	Energy and Emissions
EIA	Environmental Impact Assessment
ENVID	Environmental Impact Identification
FBE	Fusion Bonded Epoxy (coating)
FIBC	Flexible Intermediate Bulk Container
FPV	Fall Pipe Vessel
HIRA	Hazard Identification Risk Assessment
ID	Internal Diameter
km	kilometres
m	metres
MARPOL 73/78	The International Convention for Prevention of Marine Pollution 1973 and 1978
MPA	Marine Protected Area
NTF	Not Technically Feasible
OGUK	Oil and Gas UK Ltd

OOM	Order of Magnitude
OSPAR	Oslo-Paris Convention
pSPA	Potential Special Protection Area
PWA	Pipeline Works Authorisation
RAG	Red-Amber-Green
RAM	Risk Assessment Matrix
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SEPA	Scottish Environment Protection Agency
SFF	Scottish Fishermen's Federation
SIMOPS	Simultaneous Operations
SPA	Special Protection Area
SSDV	Side Stone Dumping Vessel
UKBAP	United Kingdom Biodiversity Action Plan
UKCS	United Kingdom Continental Shelf
ZPV	Zero Point Valve

HOLDS LIST

HOLD	SECTION	DESCRIPTION

1. EXECUTIVE SUMMARY

Repsol Sinopec Resources UK Ltd is in the process of updating and revising their Decommissioning Programme (DP) for the Beatrice facilities, which were in production from 1981 until the agreed Cessation of Production (CoP) in March 2015.

There is approximately 143 km of pipelines and approximately 35 km of power cable associated with the Beatrice Field to be decommissioned. The decommissioning options for the pipelines, power cables and associated mattresses have been subjected to a process of Comparative Assessment (CA) in order to assist the Repsol Sinopec Resources UK project team to determine the preferred decommissioning strategy in compliance with the Department of Energy and Climate Change DECC (BEIS) Guidance Notes [1].

The decommissioning options considered for each pipeline and cable are:

1. Full Removal, with all removed materials returned onshore for recycle and disposal.
2. Remediate in-situ, by leaving the trenched and buried sections of line in-situ, whilst remediating the exposed sections by:
    a. Rock Cover in-situ;
    b. Trenched and Buried in-situ;
    c. Cut-and Lift with all removed materials returned onshore for recycle and disposal.
3. Leave in-situ:
    a. Do Nothing, except pre and post surveys to determine status of the lines.

All three decommissioning options and their sub options listed above, including Full Removal of all pipelines and umbilicals i.e. a full removal case, have been carried through to the conclusion of the CA process.

All pipelines and cables are trenched and buried for most of their length and are predicted to remain so with only approximately 900m of pipeline and 200m of power cable having been identified as exposed.

The conclusion of, and recommended option from the CA, and common to all pipelines and cables, is therefore:

2. Remediate in-situ, by leaving the trenched and buried sections of line in-situ.

The 2.82km nearshore section of the Dunbeath power cable (PL4331) is surface laid and installed in a protective caisson for its fully exposed length, the outcome of the CA for this nearshore exposed section of cable was that "Leave In-situ/ Do Nothing" is the preferred option.

The decision to remediate in-situ the trenched and buried lines is acknowledged in the planned post project survey and monitoring strategy.

Robust evidence was gathered in terms of determining quantities and status of the pipelines and cables by review of a series of separate survey reports and survey videos carried out over a number of years which determined the burial depth of the pipelines and cables and stability of the seabed was such that lines currently trenched and buried were predicted to remain so.

Technical studies, a HIRA and an ENVID were also carried out across the decommissioning options considered to enable fact sheets to be prepared to qualitatively compare the various options across the different pipeline, cable and mattress groups, these fact sheets were adopted to inform the CA process. Details of the technical studies, HIRA and ENVID are described in Appendices B, D and G of this report

The conclusion of the CA was that there is no significant differentiator on each of these remediation options for the exposed sections of pipeline or cable, however the slight differences during the evaluation have resulted in the options being prioritised as follows:

- Priority 1 – Trench and bury
- Priority 2 – Cut-and-Lift
- Priority 3 – Rock cover in-situ

Priority 1 - Trench and bury will be carried forward as the recommended option in the Decommissioning Programme (DP). However, and due to the only slight difference in performance of each option across the criteria evaluated, Repsol Sinopec Resources UK Ltd intend to carry out a Contracting and Procurement (C&P) engagement exercise and tendering process on all 3 options and will consult with BEIS should this exercise result in a change in preference of the remediation option.

There are approximately 208 prefabricated concrete mattresses in the field. Repsol Sinopec Resources UK, propose to remove all of these mattresses where it is safe to do so. During the campaign to remove these mattresses if on attempting to remove a mattress it was found to be degrading to an extent that the mattress could not be removed, robust evidence will be gathered and Repsol Sinopec Resources UK will consult with BEIS to determine the strategy for decommissioning. Due to this current uncertainty and as a contingency, other decommissioning options have been considered during the CA for such circumstances. Where a single, isolated mattress cannot be removed as one component the CA concludes that diver or ROV intervention will be adopted to break up the mattress into manageable components to allow transfer of components to debris baskets on the seabed, before removal. The CA concludes that where a series or group of mattresses cannot be removed as single components, rock covering the mattress group and leaving in-situ will be considered.

There are approximately 37 grout filled mattresses that were originally installed as empty canvas bags which were then pumped full of grout and allowed to set in-situ, these are expected to be difficult to remove. These mattresses are associated with the small diameter flexible pipeline PL252 and the power cables.
The conclusion and recommendation of the original CA was to leave these mattresses in-situ and to carry out pre and post project monitoring surveys to establish their integrity and to ensure they can withstand over trawling. Subsequent to the CA workshop Repsol Sinopec Resources UK have undertaken overtrawl trials and a comprehensive technology appraisal, and have identified a methodology, that is notionally capable of breaking up the grout filled mattresses. Discussions are ongoing with BEIS about the emerging methodology/approach Repsol Sinopec Resources UK propose to trial, and as such removal is now the base case decommissioning option for these mattresses.

All topsides, jackets and subsea structures are to be fully removed and returned onshore for recycling and disposal, as such these have not been subjected to CA.

Only one drill cutting pile exists in the field, located at the base of the Beatrice AD platform. The cuttings pile falls below the thresholds set out by the OSPAR Guidelines: Implementation Report on Recommendation 2006/5 on the management regime for offshore cuttings piles (2009) [4] for Stage 1 screening, as such the drill cuttings pile has not been subjected to CA.

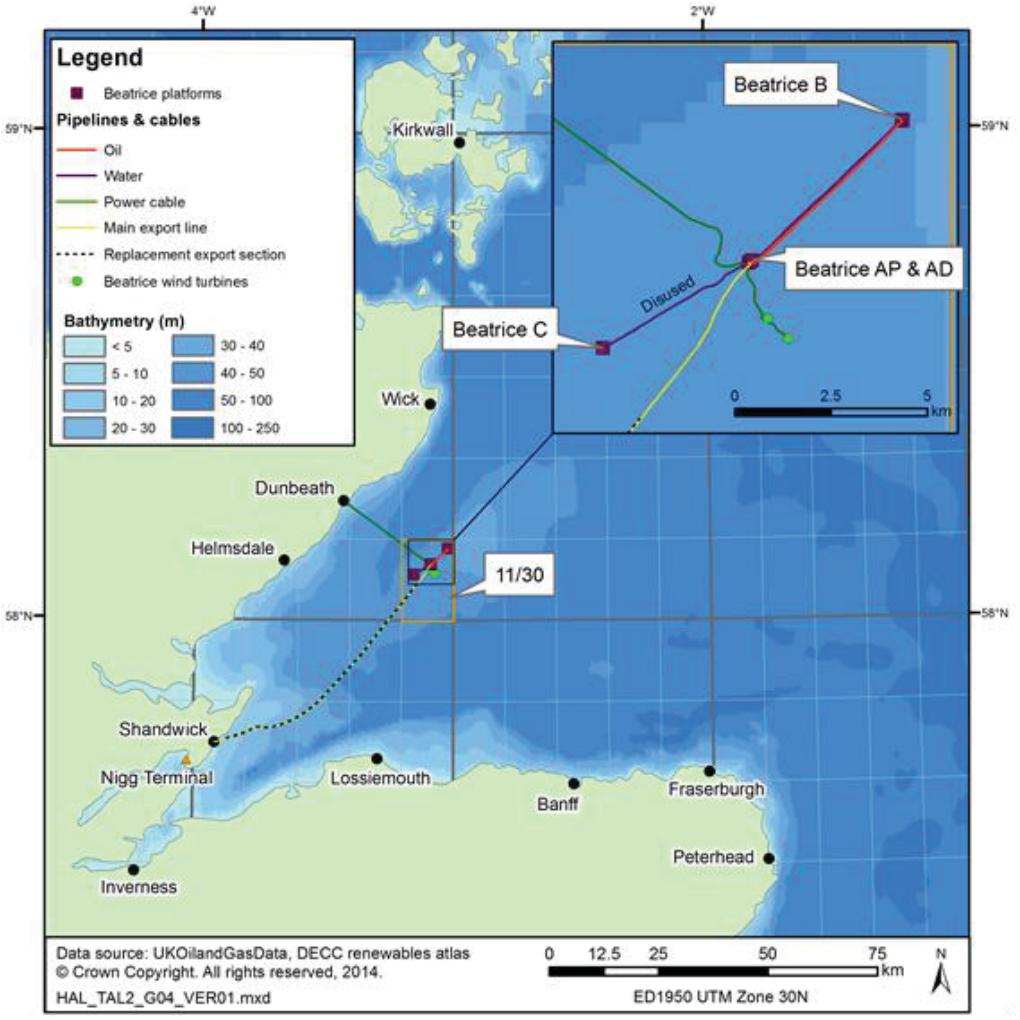
This CA report is one of three documents submitted for consultation in support of the Beatrice Decommissioning Project Decommissioning Programme (DP) [2], along with the Environmental Impact Assessment (EIA) Report [3]. Both of these documents are available online at the Department for Business Energy and Industrial Strategy (BEIS) website, on request from Repsol Sinopec Resources (UK) Limited and, during the consultation, available at Repsol Sinopec Resources UK offices.

2. PROJECT OVERVIEW

2.1 Field Description

The Beatrice Field is located in the outer Moray Firth (UKCS Block 11/30a) approximately 22km from the east Caithness cliffs, see Figure 1. The water depth in the field is around 40 metres.

Figure 1 Location of Beatrice Offshore Facilities



The Beatrice Alpha complex comprising the bridge linked Beatrice Alpha Drilling (AD) and Beatrice Alpha Production (AP). The Beatrice AD and Beatrice AP platforms are centrally located in the field, with the Beatrice Bravo and Beatrice Charlie platforms located 5.6km to the northeast and 5km to the southwest of the Alpha complex respectively.

Beatrice B is connected to Beatrice AP by flowlines and Beatrice C is no longer connected to any other facility, having ceased operation in 1998 the water injection line has subsequently been disconnected at the Alpha complex.

Crude oil was exported from Beatrice AP through a 67km submarine pipeline which makes landfall at Shandwick Bay, and a buried 9km onshore section of pipeline carried the crude to the Nigg Oil Terminal [Note 1].

Power is supplied to the facilities from the onshore electricity grid by a 26km submarine power cable from Dunbeath and from the two offshore wind turbines which are located to the south of the Beatrice Alpha complex.

Note 1 The Nigg Oil Terminal, the onshore section of pipeline from Shandwick Bay to Nigg and the onshore section of the Dunbeath Power cable are not part of the offshore decommissioning programme as these are covered under separate onshore legislation and an application to decommission these will be made separately to the appropriate authorities.

The offshore decommissioning programme covers:

- The Beatrice Alpha complex, comprising the bridge linked Beatrice AD and Beatrice AP platforms, Beatrice B and Beatrice C platforms;
- All subsea infrastructure associated with the above platforms including power cables, flowlines, templates and mattresses;
- Beatrice AD, B and C platform wells;
- The main oil export line and the power import power cable, both connected to Beatrice AP from coastal locations in the Moray Firth;
- The two offshore wind turbines and their power cables.

The Beatrice offshore field assets described above are shown in the schematic in Figure 2

The Jacky pipelines and cables local to Beatrice are also shown in Figure 2. The Jacky Field is located 10.5km from Beatrice and was tied back and produced over the Beatrice facilities until the field reached CoP in early 2014.

Jacky was developed and operated by Ithaca Energy Inc. who operated Beatrice under lease from Talisman. Responsibility for Beatrice was handed back to Talisman Sinopec Energy UK at CoP of Jacky. Ithaca Energy Inc. retain responsibility for decommissioning of the Jacky field facilities, including the pipelines local to and tied in to the Beatrice facilities.

There are 5 separate Jacky pipeline crossings associated with the Beatrice pipelines and cables where the interfaces between the Beatrice and Jacky decommissioning projects will be managed. These interfaces do not impact the CA and are therefore not expanded in this report.

Figure 2 Schematic Beatrice Field Layout

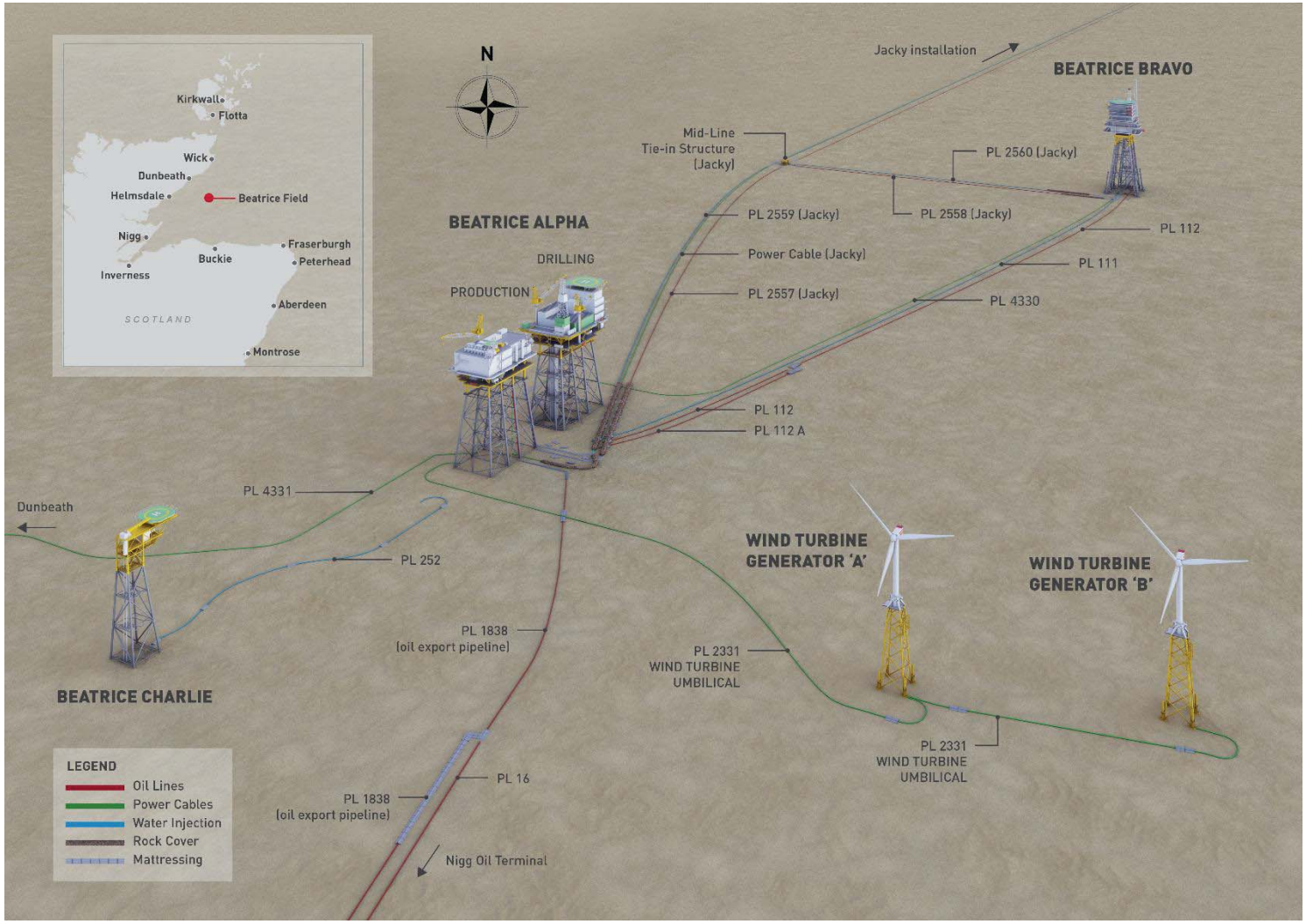


Table 1 Summary of pipelines and power cables status

Pipeline Number	Diameter	Total length (km)	Duty	Prev. Use	Coating	On bottom Status	Note 1		No. Crossings	No. Mattresses Note 2	Comment
							Combined Length of Exposed Sections (km)	No. of individual exposures			
PL1838	16"	67.01	Oil Export	N/A	Concrete & FBE (varies)	Buried	0.342	8	0	111	Excl. from PWA.
PL16	16"	58.98	Disused (flushed)	Oil Export	Concrete	Buried	0.312	11	0	0	
PL111	8.625"	5.28	Disused (flushed)	WI	Concrete	Buried	0.073	2	0	0	
PL112	6.625"	5.21	Disused (flushed)	Oil	Concrete	Buried	0.026	2	0	0	
PL112A	6.625"	1.55	Disused (flushed)	Oil	PP	Buried	0.013	3	0	30	
PL252	8" NB	4.80	Disused (flushed)	WI	PE	Buried	0.077	6	0	63	Flexible pipeline, ID 187.5mm
PL4331	108 mm	26.00	Power cable	N/A	PP	Buried	1.899	1	0	9	Dunbeath power cable
PL4330	74.1 mm	6.30	Power cable	N/A	PP	Buried	0.007	2	0	8	BA-BB power cable
PL2331	119 mm	2.90	Power cable	N/A	PE	Buried	0.134	9	1 Note 3	0	Wind turbine power cables

Notes for Table 1:

1. The exposure length and numbers of exposures reported is taken from 2016 survey and has been compared to previous surveys carried out between 1998 and 2007:
    a. The documented data across the surveys indicates that the exposures on the pipelines have not changed significantly over the years;
    b. The exposures are mainly found at the ends of the pipelines and trench transitions;
    c. There are midline exposures on only three pipelines (PL1838, PL16 and PL252) and on one power cable (PL2331).
2. Only Mattresses associated with pipelines and cables have been reported, there are a further 13 mattresses located near Beatrice Alpha and 11 mattresses located near to Beatrice Bravo that will require to be decommissioned.
3. PL2331 crosses over PL1838. The crossing is therefore part of Beatrice decommissioning;
4. Decommissioning of the Jacky infrastructure local to Beatrice is not included in the Beatrice CA and therefore not reported in this table.

2.2 Environment and Social Overview

The Environmental Impact Assessment (EIA) [3] provides a detailed description of the environmental and social baseline in the area of the Beatrice Field, whilst this section provides a brief summary.

The Beatrice Field is located c. 22 km from the Scottish coast in the outer Moray Firth in an area comprising the UK Biodiversity Action Plan (BAP) habitat 'Subtidal sands and gravels'. (Note: Section 5 of the EIA Report defines the different species and habitat designations (international and national) of relevance to the Moray Firth). There are generally three EUNIS biotope complexes associated with the region: circalittoral fine sands, circalittoral mixed sediment and circalittoral muddy sands. Some areas of burrowing muds and sea pens have been observed, however the absence of megafauna and large burrows suggest that these areas are not representative of the OSPAR habitat 'Sea pens and burrowing megafauna communities'. The export pipelines (PL16 and PL1838) to Nigg intersect the Moray Firth Special Area of Conservation (SAC). Part of the seabed in this area comprises the Annex I habitat (i.e. habitats protected under the Habitats Directive) 'sandbanks which are slightly covered by sea water all the times'.

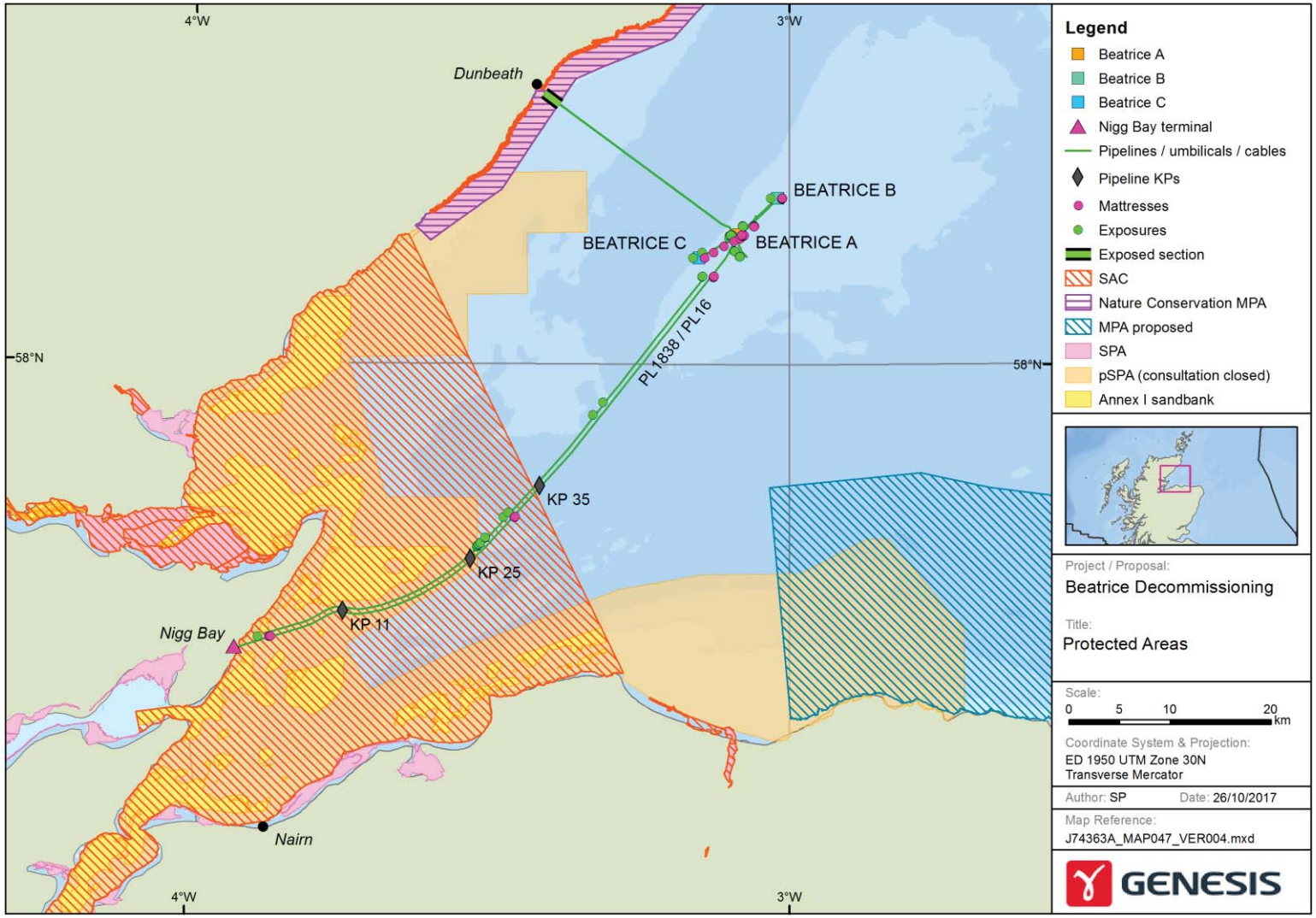
Figure 3 provides a diagram showing these SAC in relation to the export pipeline and PL4331 - Dunbeath power cable

Annex II species (i.e. species protected under the Habitats Directive) associated with the area include Atlantic salmon (*Salmo salar*); sea lamprey (*Petromyzon marinus*); Allis shad (*Alosa alosa*); Twaite shad (*Alosa fallax*); Grey seal (*Halichorerus grypus*); harbour seal (*Phoca vitulina*); bottlenose dolphin (*Tursiops truncatus*); harbour porpoise (*Phocoena phocoena*); and European otter (*Lutra lutra*).

In addition, a number of species recognised as Priority Marine Features (PMF) under the Scottish Marine Protected Area (MPA) Project also occur at the Beatrice Field. These include: Atlantic salmon (*Salmo salar*); sea lamprey (*Petromyzon marinus*); sea trout (*Salmo trutta*); anglerfish (*Lophiiformes spp.*); herring (*Clupeidae spp.*); mackerel (*Scomber scombrus*); ling (*Molva molva*); blue whiting (*Micromesistius poutassou*); cod (*Gadus morhua*); horse mackerel (*Trachurus trachurus*); saithe (*Pollachius virens*); sandeels (*Ammodytes spp.*); whiting (*Merlangius merlangus*); basking shark (*Cetorhinus maximus*); spurdog (*Squalus acanthias*) and ocean quahog (*Arctica islandica*).

A number of fishing gear types are used in the area including scallop dredges, demersal trawls, seine nets, twin beam trawling, bottom trawling, long lining and potting whilst the Beatrice Field is located east of a number of consented windfarm areas and within a windfarm area under consultation.

Figure 3 Field Location Showing Special Area of Conservation



2.3 Inclusions, Exclusions and Boundaries for CA

2.3.1 Inclusions

Pipelines and Cables

There are approximately 143 km of pipelines and approximately 35 km of power cable associated with the Beatrice Field to be decommissioned. Details of each pipeline and cable are summarised in Table 1, all lines reported in this table have been subjected to CA. A more detailed description of the configuration and status of each pipeline and power cable is provided in Appendix C.

For CA purposes the physical boundaries for the pipelines or power cables are considered to be:

- At bottom of riser (pipelines) or J Tube (Power cables) at each installation;
- Onshore at landfall for both the export pipeline and power cable.

Mattresses

In line with regulatory guidelines the base case for the decommissioning of the mattresses at the Beatrice Field is to remove those that can be removed safely and returned to shore for recycling and disposal.

There are approximately 208 prefabricated concrete mattresses in the field. Repsol Sinopec Resource UK, propose to remove all of these mattresses, in circumstances where it is found that some mattresses cannot be removed, due to their condition, a CA of the remaining decommissioning options has been carried out.
There are 37 grout filled mattresses, associated with the pipelines and cables, that were originally installed as empty canvas bags which were then pumped full of grout and allowed to set in-situ, each bag is approximately 10m long by 3.3m wide by 0.5 m high, the shape of each mattress may not be uniform due to its installation method and its final shape will have been influenced by the pipelines or power cables configuration it is protecting, i.e. it will have settled to form the shape of these facilities and the surrounding area. Due to their design and condition it is anticipated that these mattresses may be problematic to remove and therefore initially a CA of the decommissioning options was carried out. Subsequent to the workshop Repsol Sinopec Resources UK have undertaken overtrawl trials and a comprehensive technology appraisal, and have identified a methodology, that is notionally capable of breaking up the grout filled mattresses. Discussions are ongoing with BEIS about the emerging methodology/approach Repsol Sinopec Resources UK propose to trial, and as such removal is now the base case decommissioning option for these mattresses.

2.3.2 Exclusions

Pipelines and Cables

Responsibility for decommissioning the Jacky subsea infrastructure and pipelines rests with Ithaca Energy Inc. and has not been included within this CA.

Topsides, Structures and Associated Stabilisation Features

The platforms topsides, jacket structures and stabilisation features associated with Beatrice AD, Beatrice AP, Beatrice B / B Conductor Support Structure (CSS) combined platform, Beatrice C and the two wind turbine structures will all be fully removed and returned to shore for recycling and therefore these facilities have not been considered for CA.

Drill Cuttings

There is a drill cuttings pile located at the base of the Beatrice AD platform with a reported approximate maximum depth of 1.4m, volume of 678m^3 and covering an area of 1698m2. The cuttings pile falls below the thresholds set by OSPAR 2005/6 [4] based on the samples taken in November 2016, and therefore has not been considered for CA.

Subsequent to feedback at a Stakeholder Engagement Workshop held in September 2017 (details in Chapter 2 of the EIA), Repsol Sinopec Resources UK commissioned a Best Available Technique (BAT) assessment to determine the

optimal approach for decommissioning of the Beatrice AD cuttings pile [17]. In accordance with OSPAR Recommendation 2006/5 the options considered in the BAT assessment were:

1. Leave undisturbed in-situ;
2. Remove by suction dredging and dispose of by reinjection;
3. Remove by suction dredging, treat and discharge offshore;
4. Remove by suction dredging, transport for treatment onshore, coastal discharge of aqueous waste, reuse or disposal of treated solids; and
5. Spreading of cuttings pile by high pressure water jet.

The assessment undertook a high level comparative evaluation of several key environmental aspects (resuspension of the cuttings material, emissions to air (associated with vessel use), chemical use (likely to be required for reinjection), underwater noise, waste generation and accidental events) for each option. In addition, safety, technical feasibility, regulatory clarity and cost were considered. Given that a portion of the cuttings pile will require to be relocated to allow removal of the Beatrice AD jacket (minimum of 30% which is associated with internal cutting), Option 1 is not considered viable. The conclusion of the comparative evaluation was that the differences between Options 2 – 5 were small and, taken as a whole, the aggregated environmental impact was similar for all options. As such there no one single option was identified as BAT and any of these four options for managing the cuttings pile would be considered BAT. It should be noted that though reinjection of the cuttings is considered BAT, it is not considered technically feasible at Beatrice without the drilling of a new well.

Repsol Sinopec Resources UK are in ongoing discussions with BEIS and Marine Scotland Science regarding the optimal approach to managing the Beatrice AD cuttings pile. These discussions will continue following submission of the draft DPs with the aim of identifying the optimal approach to decommissioning the cuttings pile.

No noticeable drill cuttings piles are reported at Beatrice B or Beatrice C.

3. DECOMMISSIONING OPTIONS

3.1 Regulatory Context

The decommissioning of offshore oil and gas installations and pipelines on the United Kingdom Continental Shelf (UKCS) is controlled through the Petroleum Act 1998 [5], as amended by the Energy Act 2008 [6].

The UK's international obligations on decommissioning are governed principally by the 1992 Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR Convention). Agreement on the regime to be applied to the decommissioning of offshore installations in the Convention area was reached at a meeting of the OSPAR Commission in July 1998 (OSPAR Decision 98/3) [7]. DECC (BEIS) Guidance Notes [1] align with OSPAR Decision 98/3.

Pipelines do not fall within the remit of OSPAR Decision 98/3 but BEIS requires that operators apply the OSPAR framework when assessing pipeline decommissioning options.

Because of the widely different circumstances of each case, BEIS does not predict with any certainty what decommissioning strategy may be approved in respect of any class of pipeline. Each pipeline must therefore be considered on its merits and in the light of a CA of the feasible options, taking into account the safety, environmental, technical, societal and cost impacts of the options. Cost may only be a determining factor when other criteria emerge as equal.

In accordance with the OSPAR Decision 98/3, the Beatrice jackets, topsides and all subsea structures will be completely removed and returned to shore for recycling and disposal. These are not subject to derogation and, as such, the decommissioning methods being considered do not need to be comparatively assessed.

3.2 Pipelines and Power Cables

Refer to Table 1 and Section 2.1 for a description of the pipelines, cables and mattresses considered for the following decommissioning options.

All options available were reviewed and documented at the Methodology Workshop, and include:

1. Full Removal:
    a. By Reverse Reeling Techniques;
    b. By Reverse S-Lay Techniques;
    c. By Cut-and-Lift in separate sections.

Under these options all removed materials would be returned onshore for recycle and disposal.

2. Remediate in-situ (Sections of line already trenched and buried remain left in place) with:
    a. Exposed Sections Rock Covered in-situ;
    b. Exposed Sections Trenched and Buried in-situ;
    c. Exposed Sections Cut-and Lifted with all removed materials returned onshore for recycle and disposal.
3. Leave in-situ:
    a. Do Nothing, except pre and post surveys to determine status of the lines.

The methods, equipment and activities associated with each of these options are summarised in Appendix B.

Some of the decommissioning options listed above were pre-screened out for certain groupings in earlier studies and were therefore not considered further in the evaluation workshop. Appendix D clarifies why certain decommissioning options were pre-screened out ahead of the CA Evaluation Workshop. Certain Full Removal options were screened out

as not technical feasible during the pre-screening exercise. However at least one Full Removal option i.e. a full removal case, for every pipeline and umbilical group has been carried through to the conclusion of the CA process.

3.3 Mattresses

3.3.1 Prefabricated flexible concrete mattresses

The following options were considered but pre-screened out before the CA Evaluation Workshop:

1. Leave in-situ and:
    a. Do nothing and leave in-situ
2. Full removal and remove by:
    b. Use of Grab excavator to remove and recover from seabed and transfer to skips on a surface vessel

Appendix D clarifies and justifies this decision.

Options considered in the CA Evaluation Workshop were:

1. Leave in-situ and:
    b. Apply rock covering to the mattresses;
2. Full removal and recover by:
    a. Break up the mattress into manageable components in sufficient size to allow transfer of components to debris basket on the seabed, before removal.

Note 2: These results only assessed flexible concrete coated mattresses that cannot be removed safely, Repsol Sinopec Resources UK propose to remove all mattresses that can be removed safely.

3.3.2 Grout filled mattresses

The following options were considered but pre-screened out before the CA Evaluation Workshop:

1. Leave in-situ and:
    c. Relocate and bury.
2. Full removal and recover by:
    b. Use of Grab excavator to remove and recover from seabed and transfer to skips on a surface vessel

Appendix D clarifies and justifies this decision.

Options considered in the CA Evaluation Workshop were:

1. Leave in-situ and:
    a. Do nothing, except pre and post surveys to determine status of the mattresses;
    b. Apply rock covering to the mattresses;
2. Full removal and recover by:
    a. Transfer to debris basket subsea before removal to the vessel;

Option 2a) would require the mattresses to be broken up on the seabed to enable the transfer of parts of the mattress to be achieved.

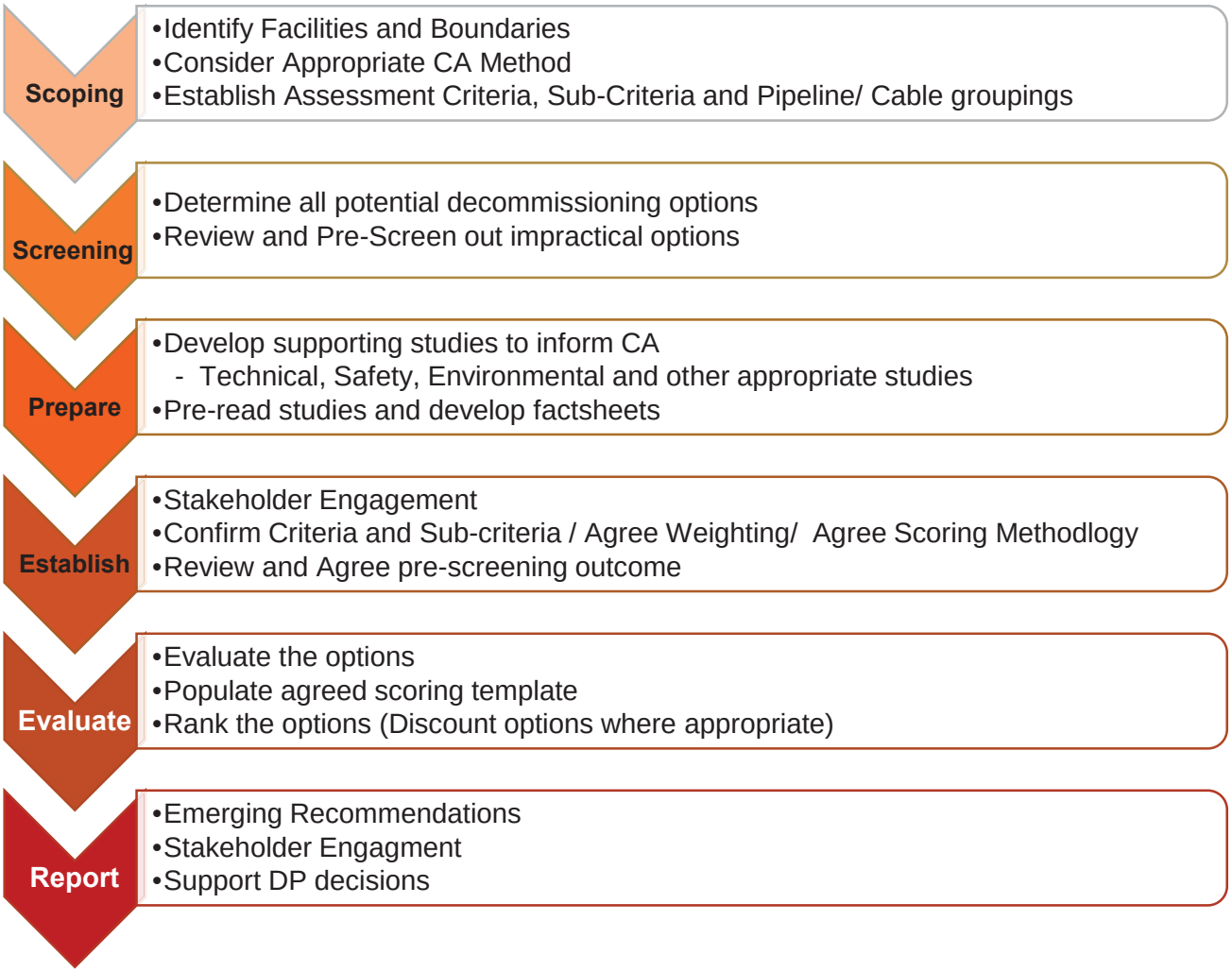
Under these options all removed materials would be returned onshore for recycle and disposal.

The methods, equipment and activities available to achieve each of these options is summarised in Appendix B.

4. OVERVIEW OF THE CA PROCESS

The Beatrice Decommissioning CA has followed fairly closely the CA process as recommended by the OGUK Guidelines [9]. Figure 4 describes the process that was followed

Figure 4 CA Process



This process is elaborated further in the flowchart in Figure 5.

4.1 Scoping

To ensure robust evidence was available to support and inform the CA evaluation of all decommissioning options, significant preparation by data gathering, reviewing drawings, inspection reports, survey report and operating history has been completed to accurately determine the quantity, specification, physical layout and status of the facilities to be decommissioned.

Two documents were produced that are relevant to, support and inform the CA, they are:

- Subsea Materials Inventory Study [13]
- Pipelines and Umbilicals Status Report [14]

Technical studies, a HIRA and an ENVID were also carried out across the decommissioning options considered to enable fact sheets to be prepared to qualitatively compare the various options across the different pipeline, cable and mattress groups, these fact sheets were adopted to inform the CA process.

A CA Methodology Workshop was convened on 10th May 2017 to introduce the concept of CA, to describe the process and to agree the parameters to be adopted at the follow-up CA Evaluation Workshops.

The Methodology Workshop reviewed and established the following in terms of how the Beatrice CA would be carried out:

- Statutory Background and Industry Practice;
- The Inclusions, Exclusions and Boundaries of the CA – See Section 2.3 for more detail:
- The CA Process as recommended by the OGUK Guidelines [9] - See Appendix E for more detail;
- The pipelines, cables and mattress groupings to be adopted for CA - see Appendix A for more detail;
- The pipeline decommissioning options and methods to be considered - see Appendix B for more detail;
- The decision context and hence the Evaluation Method to be adopted:
    - Agreed a methodology that utilises qualitative information, but that also adopts a scoring method - see Appendix E for more detail;
    - The approach to scoring and the scoring guide tables to be adopted - see Appendix G for more detail.
- The criteria and sub-criteria to be applied during the CA:
    - Initial criteria and sub-criteria was agreed - See Section 4.4.2 for more detail;
- The weighting of the criteria and sub-criteria - See Section 4.4.2 for more detail.

4.2 Screening

The outline decommissioning options established at the Methodology Workshop all related to the decommissioning of subsea facilities.

These options were taken offline and were studied in detail to define the methods, equipment and vessels needed to support each option. The results of this study are reported in the Subsea Decommissioning Methods Study [15] and are summarised in Appendix B.

An Option Screening Study [8] has been carried out where all options were reviewed in detail taking account of equipment utilisation and durations of decommissioning activities.

A Similar Assessment Criteria as described in Appendix E of this CA report were applied during the option screening study but without applying weightings. The O&G UK Guidelines Evaluation "Type A" approach was adopted, where each of the pipeline, power cable and mattress decommissioning options were qualitatively assessed using the Red-Amber-Green (RAG) evaluation method shown below.

□o□ parative□Ris□□□□□ pact□	□olour□□o□ing□
Most preferable	
Least preferable	

The results of this pre-screening study are summarised in Appendix D and reported in detail in the Options Screening Study [8] which is available upon request.

4.3 Preparation

In addition to the Technical studies described in Sections 4.1 and 4.2, safety and environmental studies were carried out in support of the CA:

4.3.1 Safety Risk Assessment

A HIRA was convened to inform the CA the methodology adopted and the results from the HIRA are summarised Appendix H. The HIRA Report [10] provides more detail and is available upon request.

The activities associated with each decommissioning option under consideration were assessed separately which enabled the specific safety related risks of each option to be identified.

To enable a comparative evaluation of the risks across each decommissioning option under consideration a Repsol Sinopec Resources UK, Risk Assessment Matrix (RAM) was adopted and used to score each decommissioning option against an agreed set of guide words.

The scores were then summated to derive the relative safety performance of each decommissioning option against:

- Project Risk to Offshore Personnel;
- Project Risk to Onshore Personnel;
- Project Risk to Other Users of the Sea;
- Residual Risk to Other Users of the Sea.

A summary table was prepared following the HIRA to inform the CA Evaluation Workshop. The summary tables are also included in Appendix H for reference.

4.3.2 Environmental Impact Identification

An ENVID was convened to inform the CA the methodology adopted and the results from the ENVID are summarised Appendix I. An ENVID Report [11] provides more detail and is available upon request.

The ENVID was expanded to include the assessment of Societal Impacts of each decommissioning option.

The energy and emissions estimates which informed the ENVID for each decommissioning option were derived from the Beatrice Energy and Emissions Assessment Report [12] which is available upon request.

Summary fact sheets were prepared following the ENVID to inform the CA Evaluation Workshop, these factsheets as presented in the CA are provided for reference in Appendix I.

4.4 Establish

4.4.1 Stakeholder Engagement

Before completing the evaluation phase of the CA, Repsol Sinopec Resources UK, carried out one to one stakeholder meetings to understand stakeholder expectations and to achieve a common understanding of the scope and options available related to Beatrice Decommissioning.

A formal Stakeholder Engagement Meeting was held in September 2017 and ahead of preparation of this report to share project progress and outcomes from studies and CA and to provide assurance to stakeholders that the approach adopted complies with regulation and guidelines.

4.4.2 Agreed Criteria, Sub-Criteria and Weightings

Main Criteria

The 5 main criteria recommended in the DECC (BEIS) Guidelines [1] were adopted i.e.:

- Safety;
- Environmental;
- Technical;
- Societal;
- Economic.

Sub-Criteria

The sub-criteria to be adopted were developed and agreed at the Methodology Workshop and are as indicated in Table 2. The sub-criteria adopted align with the example sub-criteria offered in the OGUK Guidelines [9]. The main differences being:

- Safety - "Potential for a high consequence event" has been removed as a separate sub-criterion as it was assessed under "Project Risk to Personnel – offshore";
- Societal – "Commercial Impact on Fisheries" has been extended to cover "Commercial Impact on Fisheries and Tourism" which was felt to have more relevance given the proximity of the facilities to the coast.

Weightings

It was agreed at the Methodology Workshop to not only to apply weightings across the 5 main criteria but also to drill down and apply weightings to each sub-criterion within each main criterion.

This approach allows a calculation to determine an individual weighting for each sub-criteria across the whole assessment.

Main Criteria and Sub-Criteria together with their associated weightings is also shown in Table 2

The weightings for main criteria and sub-criteria were developed using a technique known as pairwise comparison to calculate the weightings to be used. An explanation of this technique and an example of the pairwise calculations and tables developed to arrive at the weightings are included in Appendix F.

Table 2 Agreed Criteria, Sub-criteria and Weightings

Criteria	Criteria Weighting	Sub-Criteria	Sub-Criteria Weighting
Safety	40%	Project risk to personnel – Offshore	6%
		Project risk to other users of the sea	11%
		Project risk to personnel - Onshore	6%
		Residual risk to other users of the sea	17%
Environment	26%	Marine impact of operations	11%
		Energy, emissions, and resource consumption	6%
		Impact on marine end points (legacy impact)	9%
Technical	14%	Risk of major project failure	9%
		Technology demands / track record	5%
Societal	11%	Commercial impact on fisheries and tourism	6%
		Socio-economic impact on communities and amenities	5%
Economic	9%	Comparative Cost	5%
		Cost risk and uncertainty	4%
TOTAL	100%		100%

4.4.3 Review and Agree pre-screening outcome

The Subsea Decommissioning Methods Study [15] and Option Screening Study [8] as described in Section 4.2 were published for review and comment to the wider project team ahead of the CA Evaluation Workshops.

The updates from the review cycle of these two studies was presented as the introduction to both the Trial CA Evaluation Workshop and the Formal CA Evaluation Workshop discussed under Section 4.5.

4.5 Evaluate

4.5.1 Trial Evaluation Workshop

To ensure the CA evaluation phase was carried out correctly and in accordance with the terms set out and agreed at the Methodology Workshop, the project team set-up a Trial Evaluation Workshop on 14th June 2017, where one sample group of pipelines (Pipelines Group A) was evaluated using the tools, fact sheets and supporting documentation. This allowed the level of information available to inform the CA, robustness of the process, the agreed scoring methods and reporting tools to be tested.

Only minor issues were identified as needing to be resolved from the Trial Evaluation Workshop and these were incorporated before the main CA Evaluation Workshop.

4.5.2 Main CA Evaluation Workshop

The main CA Evaluation Workshop was convened over two days on 19th and 20th July 2017.

Detailed scoring was applied to each of the criteria and sub-criteria for each pipeline, cable and mattress group in turn, the results are summarised in Sections 5.0 and 6.0 of this report.

The detailed score cards are not included in this report, however can be made available upon request.

4.6 Report

This document reports the emerging recommendations of the CA Workshops and these are summarised in Sections 1.0, 5.0 and 6.0.

The outcome of the CA process has been presented at a Stakeholder Engagement Meeting which was held on the 21st September 2017.

The outcome and recommendations of the CA are reflected in the draft Decommissioning Programmes to be issued for public consultation.

Figure 5 CA Flowchart

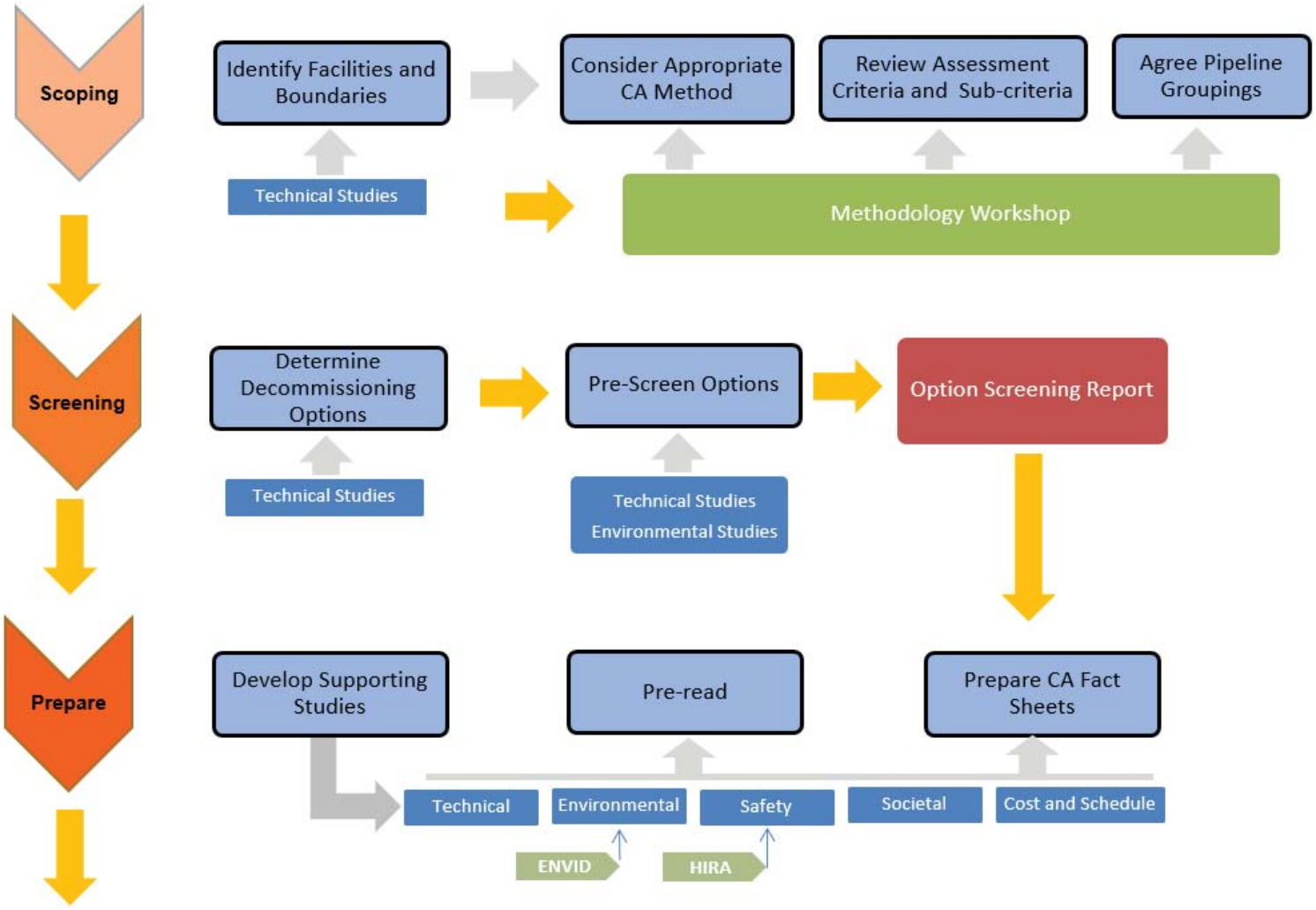
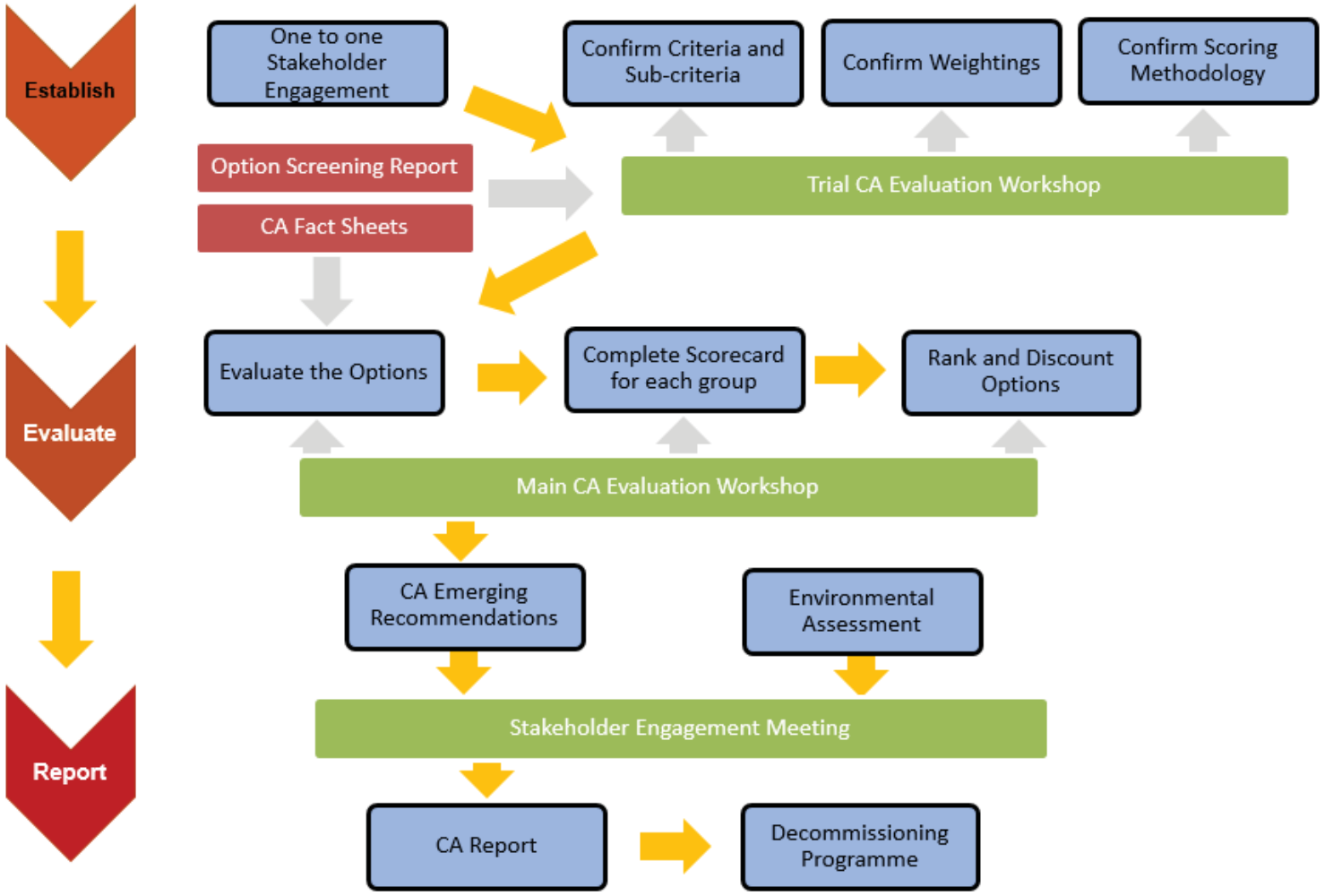


Figure 5 Continued:



5. CA OUTCOME SUMMARY

The results from the Evaluation Workshop are discussed in Section 6.0 for each pipeline, power cable and mattress group. The following sub-sections provide a summary of the conclusions and recommendations.

5.1 Pipelines

All pipelines are trenched and buried for most of their length, although a full removal option was evaluated to the end of the CA process, generally the conclusion and recommendation is to leave the trenched and buried sections decommissioned in-situ and to remediate the exposed sections at each pipeline end and at any reported exposures along the pipeline length.

Three options were considered to remediate the exposed sections of the pipelines, a) Rock cover in-situ, b) Trench and bury in-situ and c) Cut-and-lift and return onshore for recycle.

The conclusion of the CA was that there is no significant differentiator on each of these remediation options for the exposed sections of pipeline, however the slight differences during the evaluation have resulted in the options being prioritised as follows:

- Priority 1 – Trench and bury
- Priority 2 – Cut-and-Lift
- Priority 3 – Rock cover in-situ

Priority 1 - Trench and bury will be carried forward as the recommended option in the Decommissioning Programme (DP). However, and due to the only slight difference in performance of each option across the criteria evaluated, Repsol Sinopec Resources UK Ltd intend to carry out a Contracting and Procurement (C&P) engagement exercise and tendering process on all 3 options and will consult with BEIS should this exercise result in a change in preference of the remediation option.

5.2 Power Cables

All cables are trenched and buried for most of their length, generally the conclusion and recommendation is to leave the trenched and buried sections decommissioned in-situ and to remediate the exposed sections at each cable end and at the reported exposures along the length of the 2.9km Beatrice Wind Turbine Power Cable (PL2331).

Three options were considered to remediate the exposed sections of the power cables, a) Rock cover in-situ, b) Trench and bury in-situ and c) Cut-and-lift and return onshore for recycle.

The conclusion of the CA was that there is no significant differentiator on each of these remediation options for the exposed sections of cable, however the slight differences during the evaluation have resulted in the options being prioritised as follows:

- Priority 1 – Trench and bury
- Priority 2 – Cut-and-Lift
- Priority 3 – Rock cover in-situ

Priority 1 - Trench and bury will be carried forward as the recommended option in the Decommissioning Programme (DP). However, and due to the only slight difference in performance of each option across the criteria evaluated, Repsol Sinopec Resources UK Ltd intend to carry out a Contracting and Procurement (C&P) engagement exercise and tendering process on all 3 options and will consult with BEIS should this exercise result in a change in preference of the remediation option.

The 2.82km nearshore section of the Dunbeath power cable (PL4331) is surface laid and installed in a protective caisson for its fully exposed length, the outcome of the CA for this nearshore exposed section of cable was that "Leave in-situ/ Do Nothing" is the preferred option as it scored significantly better than all other options.

5.3 Mattresses

5.3.1 Prefabricated flexible concrete mattresses

Repsol Sinopec Resources UK, propose to fully remove all exposed prefabricated concrete mattresses. During the campaign to remove these mattresses, robust evidence will be gathered on their condition and where it is proven difficult to remove, Repsol Sinopec Resources UK will consult with BEIS to determine the strategy for decommissioning. Due to this uncertainty and as a contingency, a CA of the remaining decommissioning options has been carried out.

Where the condition of a mattress or mattresses does not allow safe removal in one piece the decommissioning options have been evaluated.

The location and specific condition of such mattresses will remain unknown until removal is attempted. It is therefore difficult to determine if rock cover or removal, by breaking into smaller pieces and removeing manually using debris baskets is the best option and indeed, it may change for mattresses in alternative locations and circumstances

However, the CA has concluded two potential solutions for such mattresses:

- Where a single, isolated mattress cannot be removed as one component, diver or ROV intervention will be adopted to break up the mattress into manageable components and to allow transfer of components to debris baskets on the seabed, before removal;
- Where a series or group of mattresses cannot be removed as single components, rock covering of the mattress group and leaving in-situ will be considered.

5.3.2 Grout filled mattresses

The design of these mattresses and their current condition means that they are understood to be able to be over-trawled.
The conclusion and recommendation of the original CA was to leave these mattresses in-situ and to carry out pre and post project monitoring surveys to establish their integrity and to ensure they can withstand over trawling. Subsequent to the workshop Repsol Sinopec Resources UK have undertaken overtrawl trials and a comprehensive technology appraisal, and have identified a methodology, that is notionally capable of breaking up the grout filled mattresses. Discussions are ongoing with BEIS about the emerging methodology/approach Repsol Sinopec Resources UK propose to trial, and as such removal is now the base case decommissioning option for these mattresses.

6. COMPARATIVE ASSESSMENT EVALUATION

6.1 Results, Conclusions and Recommendations

This section provides a summary of the ranking reached as a result of the scoring, for each decommissioning option under consideration and for each pipeline, power cable and mattress group. Options ranked 1 being the best option and options ranked 5 or 6 being the worst option. During the Evaluation Workshop, the allocated scores were recorded on a pre-prepared MS Excel workbook.

Each sub-section below provides conclusions and recommendations as to the preferred decommissioning options for each group and also provides a summary of the influencing factors which caused this ranking. A more detailed explanation of the scores leading to the ranking can be made available upon request.

6.1.1 Pipelines Group A

Pipelines Group A consists of the offshore rigid pipelines that are concrete coated and trenched and buried to at least 0.6 m below seabed for most of their length.

There are 3 pipelines in this group:

- PL16: 16" diameter; Oil (now disused) by 33.98km long;
- PL111: 8" diameter; WI (now disused) by 5.28km long;
- PL112: 6" diameter; Oil (now disused) by 5.21km long.

Appendix C provides diagrams of each pipeline.

- The Evaluation Workshop ranking for each option is shown in Table 3:

Table 3 Pipelines Group A – Ranking of the Decommissioning Options

	Decommissioning Options						
	1. Full Removal			2. Remediate in-situ (Trenched and buried Sections Left in-situ) with:			3. Leave in-situ
	a. By Reverse Reeling	b. By Reverse S-Lay	c. By Cut-and-Lift	a. Exposed Sections Rock-Covered	b. Exposed Sections Trenched and Buried	c. Exposed Sections Cut and Removed	Do Nothing
RANKING	N/A (NOT TECHNICALLY FEASIBLE)	5th	N/A (PRE-SCREENED OUT)	2nd	1st	3rd	4th

Recommendations for Pipeline Group A:

Discount:

- Option 1b – Full Removal by reverse S-lay
- Option 3 – leave in-situ and do nothing, should be discounted at this stage;

Retain and carry forward in the DP:

- Option 2b Remediate in-situ with exposed sections trenched and buried.
- Repsol Sinopec Resources UK Ltd intend to carry out a Contracting and Procurement (C&P) engagement exercise and tendering process on all 3 remediate options for the exposed sections and will consult with BEIS should this exercise result in a change in preference of the remediation option for the exposed sections.

Key Influencing Factors in Ranking of Group A:

Safety Criteria

The scores allocated to Option 1b resulted in a worse ranking than all other remediate in-situ options due to the risk exposure time and extent of handling on deck of materials was regarded as significantly greater for Option 1b. The fact that vessels would be on-station much longer for Option 1b was also considered a factor in the need for crew change and heli-ops. Risk to onshore personnel was also an influence for the poor ranking, as more materials were returned onshore to be handled than the remediate in-situ options

Option 3 was the worst option for the safety sub-criteria residual risk to other users of the sea, specifically fishermen during trawling activities, where the risk of leaving exposed sections of the line on the seabed that could eventually deteriorate and cause a potential future snagging hazard. This contribution resulted the Main Criteria "Safety" performance for Option 3 being ranked worse than the other decommissioning options.

The scores allocated to Options 2a and 2c resulted in a worse ranking than Option 2b acknowledging that there may be increased risk involved in loading rock onto the vessel at the quayside and or in the back loading and handling of returned pipeline sections on the vessel deck.

Environmental Criteria

The scores allocated to Option 1b resulted in a worse ranking than all other options as it is anticipated that there will be more seabed disturbance in exposing the already trenched and buried pipelines their full length, due to available excavation techniques that will spread seabed materials, to allow the large diameter pipelines to be fully removed.

The scores allocated to Option 2b resulted in a worse ranking than all other remediate in-situ options for Legacy or long term impact to the marine environment as it was acknowledged introducing new materials to the seabed was the worst option of this sub-criteria.

Technical Criteria

The scores allocated to Option 1b resulted in a worse ranking than all other options as, although this technique has been used to install concrete coated pipelines and partial removal of new lines, the technique has not been widely used for older lines where the condition of the line and the coating is uncertain.

Societal Criteria

No significant positive or negative impact is anticipated. The scores allocated to Option 1b resulted in a slightly better ranking than the other options as it was acknowledged that more materials were being returned onshore for recycling would create more work for existing businesses, however the benefit is marginal.

Economic Criteria

The scores allocated were on comparative cost of each option and in relation to the overall Asset Retirement Obligation (ARO) budget being carried by the project for overall subsea scope, and on the risk of cost escalation due to uncertainty. Option 1b will cost over three times more than the other options which has resulted in its poor ranking.

The potential impact of additional post project monitoring surveys and potential remedial works for the leave in-situ options has also been taken into account during the evaluation.

6.1.2 Pipelines Group B

Pipelines Group B consists of the offshore rigid pipelines, but not concrete coated and trenched and buried to at least 0.6 m below seabed, including:

- PL1838: 16" Oil Export by 42.01km long;
- PL112: 6" Oil (now disused) by1.55km long.

Appendix C provides diagrams of each pipeline.

A summary of the Evaluation Workshop Ranking is shown in Table 4:

Table 4 Pipelines Group B - Ranking of the Decommissioning Options

	Decommissioning Options						
	1. Full Removal			2. Remediate in-situ (Trenched and buried Sections Left in-situ) with:			3. Leave in-situ
	a. By Reverse Reeling	b. By Reverse S-Lay	c. By Cut-and-Lift	a. Exposed Sections Rock-Covered	b. Exposed Sections Trenched and Buried	c. Exposed Sections Cut and Removed	Do Nothing
RANKING	5th	6th	N/A PRE-SCREENED OUT	2nd	1st	3rd	4th

The scores are identical to pipelines Group A for safety, environmental, technical and societal criteria as most of the influencing factors are similar to Group A

Recommendations for Pipeline Group B:

Discount:

- Option 1: Full Removal Options:
  - 1a –by reverse reeling;
  - 1b –by reverse S-lay.
- Option 3 – leave in-situ and do nothing.

Retain and carry forward in the DP:

- Option 2b Remediate in-situ with exposed sections trenched and buried.
- Repsol Sinopec Resources UK Ltd intend to carry out a Contracting and Procurement (C&P) engagement exercise and tendering process on all 3 remediate options for the exposed sections and will consult with BEIS should this exercise result in a change in preference of the remediation option for the exposed sections.

Key Influencing Factors in Ranking Group B:

The factors that influenced the scores in Group A are equally relevant to Group B.

Economic criteria have been scored similar but slightly lower across all decommissioning options to reflect the fact that the pipelines in Group B will cost less than Group A to decommission. The potential impact of additional post project monitoring surveys and potential remedial works for the leave in-situ options has also been taken into account during the evaluation.

The scores allocated to Option 1b was allocated a slightly lower (and better) score for Technical criteria than was allocated in Pipelines Group A, which acknowledges the technique should be less problematic on pipelines without concrete coating. It did not however change the overall ranking.

Option 1a has been included for this pipelines group as this is technically feasible with pipelines that are not concrete coated. The scores allocated in the Safety criteria are better than Option 1b which reflects the reduced exposure time and less manual handling on the vessel as the pipelines are transferred on reels.

The scores allocated across the Safety criteria to Option 1a are generally worse and therefore is ranked lower than all other remediate in-situ options due to the fact that the vessel durations offshore and the extent of manual handling of materials onshore pose greater risk to the project team than any of the remediate in-situ methods.

6.1.3 Pipelines Group C

Pipelines Group C consists of the:

Offshore flexible pipelines, trenched and buried to at least 0.6 m below seabed, including:

- PL252: 8" Water Injection (now dis-used and isolated) by 4.8km long, with only 80m of exposed line currently;
- This line is covered by grout filled mattresses for approximately 250m of its length, if these mattresses were to be removed it would expose a further 250m of the pipeline on the seabed.

Appendix C provides a diagrams of the pipeline.

A summary of the Evaluation Workshop Ranking is shown in Table 5:

Table 5 Pipelines Group C - Ranking of the Decommissioning Options

	Decommissioning Options						
	1. Full Removal			2. Remediate in-situ (Trenched and buried Sections Left in-situ) with:			3. Leave in-situ
	a. By Reverse Reeling	b. By Reverse S-Lay	c. By Cut-and-Lift PRE-SCREENED OUT	a. Exposed Sections Rock-Covered	b. Exposed Sections Trenched and Buried	c. Exposed Sections Cut and Removed	Do Nothing
RANKING	5th	4th	N/A	3rd	1st	2nd	6th

Recommendations for Pipeline Group C:

Discount:

- Option 1: Full Removal Option:
  - 1a –by reverse reeling;
- Option 3 – leave in-situ and do nothing.

Retain and carry forward in the DP:

- Option 2b Remediate in-situ with exposed sections trenched and buried.
- Repsol Sinopec Resources UK Ltd intend to carry out a Contracting and Procurement (C&P) engagement exercise and tendering process on all 3 remediate options for the exposed sections and will consult with BEIS should this exercise result in a change in preference of the remediation option for the exposed sections.

Key Influencing Factors in Ranking Group C:

Safety Criteria

Options 2a, 2b, 2c and 3 ranked the same as the pipelines in group A as the influencing factors were identical.

Options 1a and 1b were allocated score slightly lower (and better) than for pipelines Group B, acknowledging that the pipeline is a small diameter flexible line of relatively short length compared to Group B, hence the exposure duration and the handling risk both on the vessel and onshore should be lower than the pipelines under Group B.

Environmental Criteria

Options 2a, 2b, 2c and 3 scored similar to pipelines Group A as the influencing factors were similar.

The scores allocated to Options 1a and 1b were better than for pipelines Group B, acknowledging that the pipeline is a small diameter flexible line and the technique to remove it from below the seabed involves pulling it through the seabed without prior excavation as is required for the larger diameter pipelines in Groups A and B, therefore resulting in less seabed disturbance compared to pipelines Group B.

Economic Criteria

The potential impact of additional post project monitoring surveys and potential remedial works for the leave in-situ options has also been taken into account during the evaluation.

6.1.4 Pipelines Group D

Pipelines Group D consists of the:

Nearshore rigid pipelines, trenched and buried to at least 0.6 m below seabed, including:

- PL16: 16" Oil (now disused) by 25km;
- PL1838: 16" Oil Export by 25km long;
- The nearshore pipelines were deliberately grouped separately as they are routed through an area of special environmental interest. It was anticipated this may result in a different environmental impact to that evaluated for the offshore section of the lines and ultimately may affect the ranking and the recommended decommissioning option.

The boundary between the nearshore section and offshore sections of these pipelines (KP25.0) was chosen as it extends beyond the designated sandbanks.

Appendix C provides diagrams of each pipeline.

A summary of the Evaluation Workshop Ranking is shown in Table 6:

Table 6 Pipelines Group D - Ranking of the Decommissioning Options

	Decommissioning Options						
	1. Full Removal			2. Remediate in-situ (Trenched and buried Sections Left in-situ) with:			3. Leave in-situ
	a. By Reverse Reeling NOT TECHNICALLY FEASIBLE	b. By Reverse S-Lay	c. By Cut-and-Lift PRE-SCREENED OUT	a. Exposed Sections Rock-Covered	b. Exposed Sections Trenched and Buried	c. Exposed Sections Cut and Removed	Do Nothing
RANKING	N/A	5th	N/A	3rd	1st	2nd	4th

Recommendations for Pipeline Group D:

Discount:

- Option 1b – Full Removal by reverse S-lay
- Option 3 – leave in-situ and do nothing, should be discounted at this stage;

Retain and carry forward in the DP:

- Option 2b Remediate in-situ with exposed sections trenched and buried.

- Repsol Sinopec Resources UK Ltd intend to carry out a Contracting and Procurement (C&P) engagement exercise and tendering process on all 3 remediate options for the exposed sections and will consult with BEIS should this exercise result in a change in preference of the remediation option for the exposed sections.

Key Influencing Factors in Ranking Group D:

Safety Criteria

The factors that influenced the scores in Group A are equally relevant to Group D therefore ranking remains the same.

Environmental Criteria

Marine Impacts During Operations: seabed disturbance was regarded as the main differentiator across the decommissioning options and although recorded as moderate to low impact, similar to pipelines Group A, the allocated scores were increased across Options 1b, 2a, 2b and 2c: (compared to Pipelines Group A) acknowledging the location of the activity nearshore and local to sandbanks and in relatively shallow water. The ranking did not change compared to Group A.

Legacy marine impact: Impact change from No Effect (under pipelines Group A) too Low for Options 1b, 2b and 2c (for Pipelines Group D) acknowledged that these options were likely to leave seabed scars in the areas nearshore and close to the sandbanks. Option 2a was increased to moderate impact, acknowledging the fact this introduces new materials into an area of special environmental interest.

The allocated scores, whilst increasing the overall scores for this pipeline group, do not change the overall ranking of the options compared to Group A.

Technical Criteria

The factors that influenced the scores in Group A are equally relevant to Group D therefore scores remain the same, except for track record of Option 1b where the allocated score was worse than Group A, acknowledging the lack of expertise in reverse S-Lay in relatively shallow water. A shallow water barge would need to be deployed instead on the usual type of vessel.

Societal Criteria

The factors that influenced the scores in Group A are equally relevant to Group D therefore scores remain the same, except for negative impact for Option 1b where the allocated score was worse than Group A, acknowledging the works could cause disruption nearshore and on the beach.

Economic Criteria

This criterion has been scored similar but slightly lower to reflect the fact that the pipelines in Group D will cost less than Group A to decommission. The potential impact of additional post project monitoring surveys and potential remedial works for the leave in-situ options has also been taken into account during the evaluation.

Overall

Whilst the scores for Group D varied slightly and generally improved from Group A. The overall ranking across Group D is identical to Group A.

6.1.5 Power Cable Group E

Power cable Group E consists of the:

Offshore flexible power cables, trenched and buried to at least 0.6 m below seabed, including:

- PL4331 - Dunbeath to Beatrice A Power Cable (Offshore Section) - 108mm dia. by 26.0km
- PL4330 - Beatrice AP to Beatrice B power cable - 74mm dia. by 6.3km;
- PL2331 - Beatrice Wind Turbine power cable – 119mm dia. by 2.9km.

Appendix C provides diagrams of each cable.

A summary of the Evaluation Workshop Ranking is shown in Table 7:

Table 7 Power Cable Group E - Ranking of the Decommissioning Options

	Decommissioning Options						
	1. Full Removal			2. Remediate in-situ (Trenched and buried Sections Left in-situ) with:			3. Leave in-situ
	a. By Reverse Reeling PRE-SCREENED OUT	b. By Reverse S-Lay	c. By Cut-and-Lift PRE-SCREENED OUT	a. Exposed Sections Rock-Covered	b. Exposed Sections Trenched and Buried	c. Exposed Sections Cut and Removed	Do Nothing
RANKING	N/A	4th	N/A	3rd	1st	2nd	5th

Recommendations for Power Cable Group E:

Discount:

- Option 1: Full Removal Options:
  - 1a –by reverse reeling;
  - 1b –by reverse S-lay.
- Option 3 – leave in-situ and do nothing.

Retain and carry forward in the DP:

- Option 2b Remediate In-situ with exposed sections trenched and buried.
- Repsol Sinopec Resources UK Ltd intend to carry out a Contracting and Procurement (C&P) engagement exercise and tendering process on all 3 remediate options for the exposed sections and will consult with BEIS should this exercise result in a change in preference of the remediation option for the exposed sections.

Key Influencing Factors in Ranking Group E:

The activities and methods associated with the different decommissioning options for the cables that make up Group E are very similar to those proposed for the 8" (203mm dia.) x 4.8 km long flexible WI pipeline assessed under Group C. It was expected therefore that the evaluation results should be similar.

Safety and Technical Criteria

The factors that influenced the scores in Group C are equally relevant to Group E therefore allocated scores and ranking remain the same.

Environmental Criteria

The factors that influenced the scores in Group C are equally relevant to Group E therefore allocated scores remain the same, except that Options 1a and 1b – Full Removal have been allocated scores slightly worse than Group C acknowledging there will be more seabed disturbance due to the longer power cable length and there will be more energy and emissions due to the slightly longer vessel campaign time.

Societal Criteria

The factors that influenced the scores in Group C are equally relevant to Group E therefore allocated scores remain the same except that Options 1a and 1b – Full Removal have been allocated scores slightly worse than Group C acknowledging that there may be more disruption and potential loss of revenue to fishermen during the operational phase, compared to pipelines Group C as the campaign duration is slightly longer.

Economic

This criterion has been scored similar to Group C but with minor changes for the estimated cost of each decommissioning option for power cables. The potential impact of additional post project monitoring surveys and potential remedial works for the leave in-situ options has also been taken into account during the evaluation.

Overall

Whilst the scores for Group E varied slightly and generally improved from Group C the overall ranking across Group E is identical to Group C.

6.1.6 Power Cable Group F

Cable Group F consists of the nearshore flexible power cable. Only the nearshore section of PL4331 - Dunbeath to Beatrice A Power Cable - 108mm dia. by 2.82km is applicable to this cable group. This section of cable is surface laid and housed in a steel protection caisson.

This nearshore cable was evaluated separately as it is routed through an area of special environmental interest as it reaches the shore. This was anticipated to result in a different environmental impact to that evaluated for the offshore section of the cable and ultimately may affect the scoring and the recommended decommissioning option.

Appendix C provides diagram of the Dunbeath power cable.

A summary of the Evaluation Workshop Ranking is shown in Table 8.

Table 8 Power Cable Group F - Ranking of the Decommissioning Options

	Decommissioning Options						
	1. Full Removal			2. Remediate in-situ (Trenched and buried Sections Left in-situ) with:			3. Leave in-situ
	a. By Reverse Reeling	b. By Reverse S-Lay	c. By Cut-and-Lift	a. Exposed Sections Rock-Covered	b. Exposed Sections Trenched and Buried	c. Exposed Sections Cut and Removed	Do Nothing
RANKING	5th	4th	2nd	3rd	N/A PRE SCREENED OUT	N/A SAME AS OPTION 1C	1st

Notes on Table 8: Since the nearshore section of cable is fully exposed on the seabed option 1c and option 2c are the same. Therefore, option 2c was not subjected to the CA process as the results are as per Option 1c.

Recommendations for Power Cable Group F:

Discount:

- Option 2 - All remediate in-situ options
- Option 1 - Full Removal options
    - 1a) - by reverse reeling
    - 1b) - by reverse S-Lay
    - 1c) – by Cut-and-Lift

Retain and Carry forward in the DP:

- Option 3: Leave in-situ/Do Nothing

Option 3: Leave in-situ/Do Nothing is the preferred option and is scored as significantly better than all other options.

Key Influencing Factors in Ranking Group F:
This nearshore section of power cable was originally surface laid as the soil conditions in the area did not allow trenching and burying the full length. Therefore, Option 2b - trenching and burying of this exposed section as a decommissioning option will still not be possible and was screened out and therefore was not carried forward to the CA workshop.

Safety Criteria

All Full Removal options, 1a, 1b and 1c scored equally poorly in terms of project safety performance due to the significant vessel over side work involved, working in shallow water and removal of significant materials onto the vessel deck with these options. Residual safety risk across all the options available was not identified as a significant differentiator due to the fact that the cable is located in an area of special environmental interest, trawler fishing in the area was unlikely and therefore the potential as a snagging hazard is low.

Environmental Criteria

All Full Removal options, 1a, 1b and 1c scored equally poorly in terms of project environmental performance due to the significant vessel time involved on station, working in shallow water near shore. Legacy impact of introducing foreign materials (Rock cover) to an area of special environmental interest was not deemed as a good strategy and therefore Option 2a remediate in-situ by introducing rock cover to exposed sections was score significantly worse than all other options for legacy impact. Option 3 – Leave -in-situ and do nothing was viewed as being the best option

environmentally as the cable and protective caisson had been in-place for many years and was already established in the environment.

Technical Criteria

Options 1a and 1b removal by reverse reeling and by reverse S lay scored poorly for technical performance due to the uncertainties surrounding removal of the cable whilst inside the protective caisson. There is a lack of recorded detail on how the cable is located inside the protective caisson and whether it is secured or free to be withdrawn from the caisson, this resulted in a much poorer score for these options compared to the other decommissioning options

Societal Criteria

Commercial impact on fisheries and tourism was scored equally across all removal options but not an influence in the overall score. The impact of option 2a Rock cover to exposed sections of line was viewed as the worse outcome on commercial impact and scored poorly for that reason.

Economic

This criterion has been scored similarly across all options the cost of all options is very similar when taking post project monitoring surveys and potential remedial works of the leave in-situ option into account. Economic did not have a significant influence on the ranking for this cables group.

6.1.7 Mattress Group G

This group consists of Prefabricated flexible concrete mattresses, only. There is a total of 208 mattresses installed in the field.

Repsol Sinopec Resources UK, propose to remove all exposed prefabricated concrete mattresses.

During the campaign to remove these mattresses if on attempting to remove a mattress it was found to be degraded to an extent that the mattresses could not be removed, robust evidence will be gathered and Repsol Sinopec Resources UK will consult with BEIS to determine the strategy for decommissioning

However, and as a contingency and in circumstances where it is found that some mattresses cannot be removed in one piece due to their condition, a CA of the remaining decommissioning options has been carried out and this will form the foundation of discussions with BEIS.

A summary of the Evaluation Workshop Ranking is shown in Table 9:

Table 9 Mattress Group G - Ranking of the Decommissioning Options

	Decommissioning Options				
	1. Leave in-situ and:			2. Full Removal and recover by:	
	a. Do Nothing (PRE-SCREENED OUT)	b. Rock Cover	c. Relocate and Bury (PRE-SCREENED OUT)	a. Transferred to Debris Basket Subsea before removal	b. Use of Grab Excavator to remove to vessel and transfer to skips (PRE-SCREENED OUT)
RANKING	N/A	1st	N/A	2nd	N/A

Notes on Table 9: Base case proposed is that all flexible concrete mattresses will be fully removed. The decommissioning options in Table 9 will only be considered if removal of the mattress in one piece is not achievable due to its condition.

Since the specific location and condition of such mattresses that cannot be removed is unknown it is difficult to determine if rock cover or removal is the best option and indeed, it may change for mattresses in alternative locations and circumstances

Recommendations for Mattress Group G:

- Where a single, isolated mattress cannot be removed and removed as one component
  - Diver or ROV intervention will be adopted to break up the mattress into manageable components and to allow transfer of components to debris basket on the seabed, before removal;
- Where a series or group of mattresses cannot be removed and removed as single components
  - Rock covering the mattress group and leaving in-situ will be considered.

Key Influencing Factors in Ranking Mattress Group G:

Safety Criteria
The scores allocated to Project Risk to Personnel – Offshore sub-criteria for, resulted in a poor ranking of Option 2a Removal by breaking up the concrete and transferring to debris baskets subsea before removal to the surface, due to the type of manual handling activity anticipated by divers in assisting with breaking up the mattresses and subsequently transferring the debris to baskets for removal. This option was also allocated a poor ranking for Project Risk to Personnel On-shore.

The scores allocated to Project Risk to Other Users of the Sea sub-criteria was scored similarly across the two options being evaluated as the durations of each option are similar and worksite area is relatively small.

The scores allocated to residual risk to Other Users of the Sea sub-criteria resulted in a poor ranking for Option 1b) Rock Cover, as it was acknowledged that although the rock cover profile would allow over trawl this could deteriorate over time and pose a risk to fishermen.

Environmental Criteria

Option 1b Rock Cover was ranked lower than 2a Removal by breaking up the concrete and transferring to debris baskets for both Marine Impact of Operations and Impact on Marine end points (legacy impact) criteria and it was seen as slightly worse option causing more seabed disruption and introducing new materials to the seabed. It should be noted however that the differentiators were not regarded as significant which was reflected in the relatively low and close scores allocated across both options.

Technical and Economic Criteria

The scores allocated to Option 2a Removal by breaking up the concrete and transferring to debris baskets subsea before removal to the surface, resulted in this being ranked second to Option 1b Rock Cover, due to the uncertainty and degree of difficulty in breaking up the concrete subsea. It is considered that there is not a track record of the methods and activities required for Option 2a and the potential for project schedule and cost over-run is therefore high.

Societal Criteria

Scores allocated across the two options are relatively low as there is no significant differentiator.

6.1.8 Mattress Group H

There are a total of 37 of the grout filled mattresses installed in the field:

- 20 on the dis-used Beatrice Charlie WI line - PL252 (Pipeline Group C)
- 9 on PL4331 - Dunbeath to Beatrice Alpha power cable (Cable Group E)
- 9 on PL4330 - Beatrice Alpha to Beatrice Bravo power cable (Cable Group E)

The decision and recommendation on how Group H mattresses are decommissioned will affect how the above pipeline and power cable groups may be decommissioned.

A summary of the original CA Evaluation Workshop Ranking is shown in Table 10:

Table 10 Mattress Group H - Ranking of the Decommissioning Options

	Decommissioning Options				
	1. Leave in-situ and:			2. Full removal and recover by:	
	a. Do Nothing	b. Rock Cover	c. Relocate and Bury	a. Transferred to Debris Basket Subsea before removal	b. Use of Grab Excavator to remove to vessel and transfer to skips
RANKING	1st	2nd	N/A PRE-SCREENED OUT	3rd	N/A PRE-SCREENED OUT

Notes on Table 10: Option 1a was the preferred option to be carried forward at the CA workshop, this decision is now superseded as follows:

Subsequent to the workshop Repsol Sinopec Resources UK have undertaken overtrawl trials and a comprehensive technology appraisal, and have identified a methodology, that is notionally capable of breaking up the grout filled mattresses. Discussions are ongoing with BEIS about the emerging methodology/approach Repsol Sinopec Resources UK propose to trial, and as such removal is now the base case decommissioning option for these mattresses.

7. REFERENCES

References	
1	DECC (BEIS) Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998, Version 6, March 2011.
2	Beatrice Decommissioning Programmes – 1st Pre-draft issued 30 June 2017 Document. No. RP-DTABEA001-DC-0039
3	Beatrice Decommissioning Environmental Impact Assessment (EIA) Document No. RP-DTABEA001-HS-0051
4	OSPAR Commission: Implementation report on Recommendation 2006/5 on a management regime for offshore cutting piles (2009)
5	The Petroleum Act 1998
6	The Energy Act 1998
7	OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations.
8	Beatrice Decommissioning Subsea Facilities Option Screening Study Document No. RP-DTABEA001-SS-0045
9	Oil and Gas UK Guidelines for Comparative Assessment in Decommissioning Programmes, October 2015.
10	Beatrice Decommissioning HIRA Report. Document No. HAZ-DTABEA001-HS-0042
11	Beatrice Decommissioning: ENVID Report Document No. RP-DTABEA001-HS-0047
12	Beatrice Decommissioning: Energy and Emissions Assessment Document No. RP-DTABEA001-HS-0048

13	Beatrice Decommissioning: Subsea Materials Inventory Document No. RP-DTABEA001-SS-0023
1	Beatrice Decommissioning: Pipelines and Umbilicals Status Report Document No. RP-DTABEA001-SS-0044
15	Beatrice Decommissioning: Subsea Decommissioning Methods Document No. RP-DTABEA001-SS-0055
16	Beatrice Decommissioning: Grout Mattress Decision Paper Document No. RP-DTABEA001-SS-0069
17	Beatrice Decommissioning: Cuttings Pile BAT Assessment Document No. TN-DTABEA001-HS-0067

APPENDIX A - PIPELINE, POWER CABLE AND MATTRESS GROUPS

Pipeline and Power Cable Groups

There are four separate pipeline groups and two separate power cable groups that have been agreed for CA purposes and are summarised in Table 11.

Table 11 Pipelines and Power Cables Grouping Summary

Group ID	Component type / as-laid condition	Agreed groupings	Boundary
Pipelines			
A	Offshore: • Rigid pipeline • Concrete coated • Trenched and buried	PL16: 16" Oil (now disused)	KP25.0 – KP61.64
		PL111: 8" WI (now disused)	Entire length
		PL112/ PL112X: 6" Oil (now disused)	Entire length
B	Offshore: • Rigid pipeline • Trenched and buried	PL1838: 16" Oil Export	KP25.0 – KP66.96
		PL112A: 6" Oil (now disused)	Entire length
C	Offshore: • Flexible pipeline • Trenched and buried	PL252: 8" WI (now disused)	Entire length
D	Nearshore: • Inside the area of special environmental interest • To mean low water mark	PL16: 16" Oil (now disused)	KP2.66 – KP25.0
		PL1838: 16" Oil Export	KP0.0 – KP25.0

Group ID	Component type / as-laid condition	Agreed groupings	Boundary
Power Cables			
E	Offshore: • Trenched and buried	PL4331 - Dunbeath to Beatrice A Power Cable [Note 4]	KP2.82 – KP26.0
		PL4330 - Beatrice A to Beatrice B Power Cable	Entire length
		PL2331: Wind Turbine Generator Power Cable	Entire length
F	Nearshore: • Inside the area of special environmental interest • To mean low water mark	PL4331 - Dunbeath to Beatrice A Power Cable	KP0.00 – KP2.82

[Note 4] The nearshore sections of pipeline have been considered separately due to the fact that they pass through environmental areas of special interest and therefore may be evaluated differently from an environmental perspective than the offshore pipeline and power cable groupings.

The pipelines and power cable groups are shown on Figure 6 and Figure 7 below.

Figure 6 Schematic Field Layout showing Offshore Pipeline and Power Cable Groupings

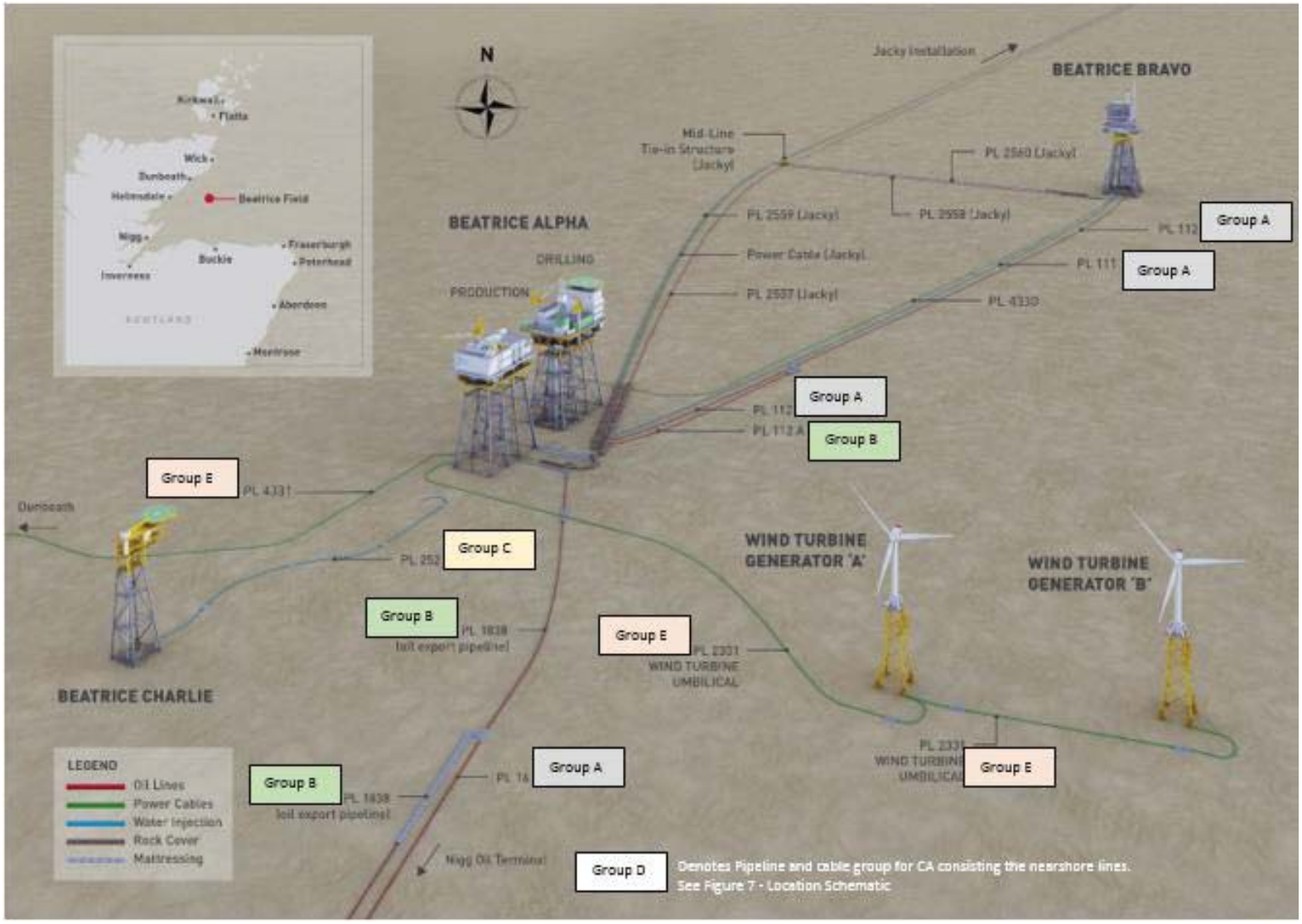
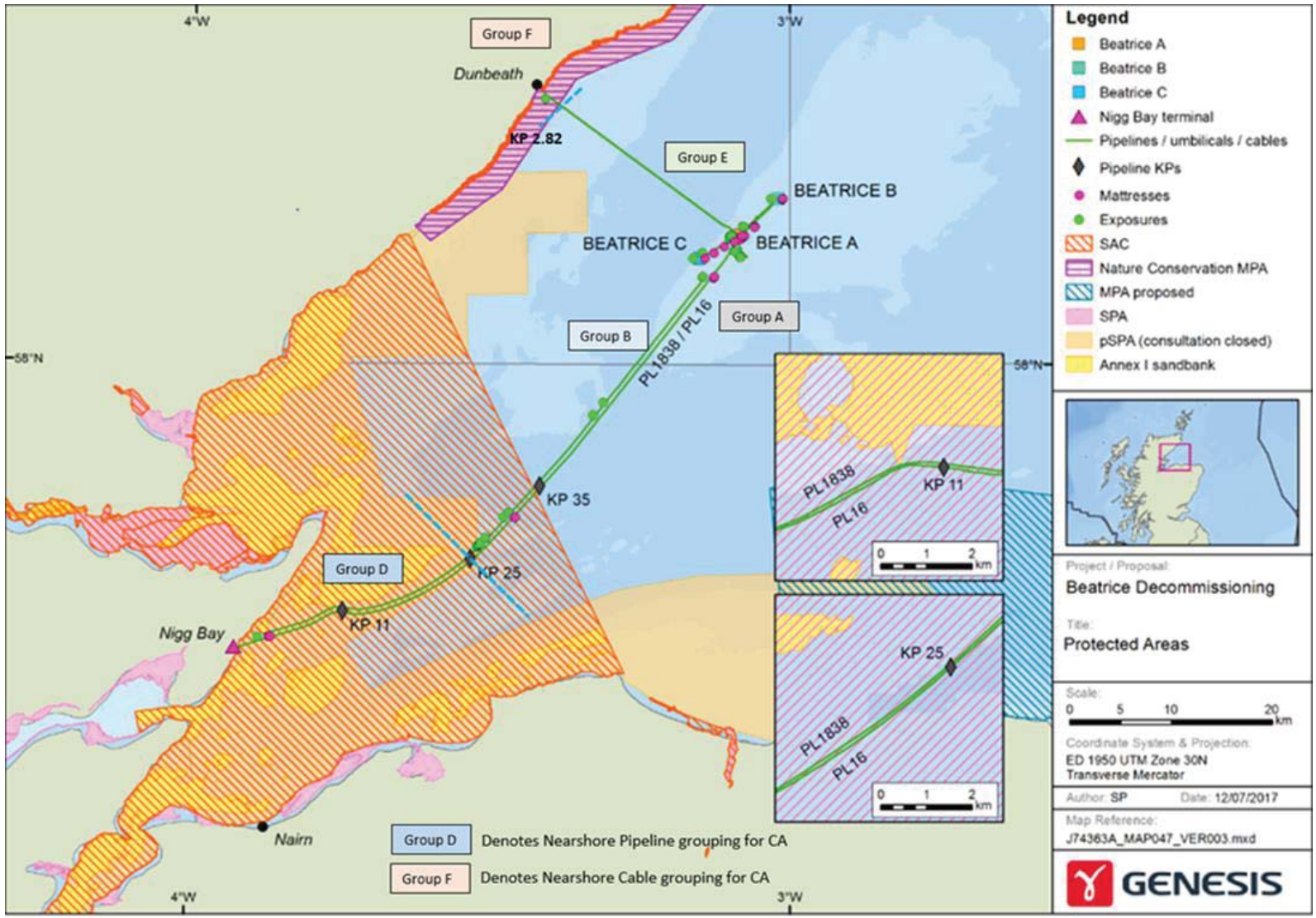


Figure 7 Field Layout showing Nearshore Pipeline and Power Cable Grouping



Mattress Groups

There are two separate mattress groups that have been agreed for CA purposes and are summarised in Table 12

Table 12 Mattress Grouping Summary

Group ID	Current condition	Mattress Types / agreed groupings	Quantity
G	Unable to be removed safely or efficiently	Flexible concrete mattresses	21 Note 3 (assumed 10% of total number of mattresses)
H	Unable to be removed safely or efficiently	Grout filled mattresses	37

Prefabricated flexible concrete mattresses (Group G) are designed to provide a high degree of flexibility, allowing them to closely follow the contours of a pipeline/umbilical power cable and seabed. They are constructed using high strength concrete profiled blocks and U.V. stabilised polypropylene rope tying the blocks together. These types of mattresses come in various sizes, Beatrice has two sizes deployed:

- 6m long by 3 m wide by 0.15m high (60 approx. deployed across the field)
- 5m long by 3 m wide by 0.15m high (150 approx. deployed across the field)

Note 3 It is Repsol Sinopec Resources UK intention to fully remove all prefabricated flexible concrete mattresses (Group G) and where this is not possible due to condition of the mattress and only after attempts at removal have failed, will they consult with BEIS to agree how the remaining problem mattresses are to be decommissioned.

For the purposes of CA, it has been assumed 10% of the total flexible concrete mattresses may fall into this scenario. Since this is an allowance the location of the problematic flexible concrete mattresses cannot be predicted.

The grout filled mattresses (Group H) were originally installed as empty canvas bags and were then pumped full of grout and allowed to set in-situ, each bag is 10m long by 3.3m wide by 0.5 m high, the shape of each mattress may not be uniform due to its installation method and will have been influenced by the pipelines or power cables configuration it is protecting, i.e. it will have settled to form the shape of these facilities and the surrounding area.
The conclusion and recommendation of the original CA was to leave these grout filled mattresses in-situ and to carry out pre and post project monitoring surveys to establish their integrity and to ensure they can withstand over trawling.

Subsequent to the workshop Repsol Sinopec Resources UK have undertaken overtrawl trials and a comprehensive technology appraisal, and have identified a methodology, that is notionally capable of breaking up the grout filled mattresses. Discussions are ongoing with BEIS about the emerging methodology/approach Repsol Sinopec Resources UK propose to trial, and as such removal is now the base case decommissioning option for these mattresses.

APPENDIX B - DECOMMISSIONING METHODS TO BE CONSIDERED

A brief summary of the methods considered and evaluated during the CA is provided in this Appendix.

Common Activities

Common activities that are applicable to Full Removal and Remediate in-Situ decommissioning options are described below.

Excavation

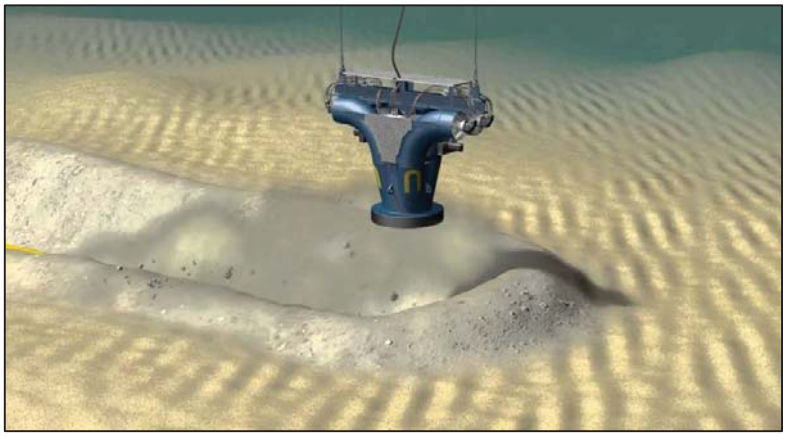
Large scale soil excavation and mattress or rock removal at the pipeline ends and crossings will be required for pipelines that are already trenched and buried and where the decommissioning options being considered involve Full Removal. Various subsea excavation equipment and techniques are available and these described below.

For small diameter flexible pipelines (Pipeline Group C) and power cables, the CA Evaluation workshop assumed that these could be removed by pulling them through the seabed without prior excavation. Although acknowledged this would be less disruptive to the seabed than pre-excavation, it was recognised that this technique may still leave berms or markings on the seabed.

Mass Flow Excavators

For large scale seabed and debris removal, such as exposure of a buried pipeline, a mass flow excavator may be used. This type of equipment uses powerful propellers to generate large volumes of seawater flow that can be directed at buried infrastructure. Seabed disturbance is significant. Precise control is not possible due to the power of the flow.

The CA Evaluation Workshop assumed Mass Flow Excavation would be deployed where Full Removal of larger diameter pipelines was considered.

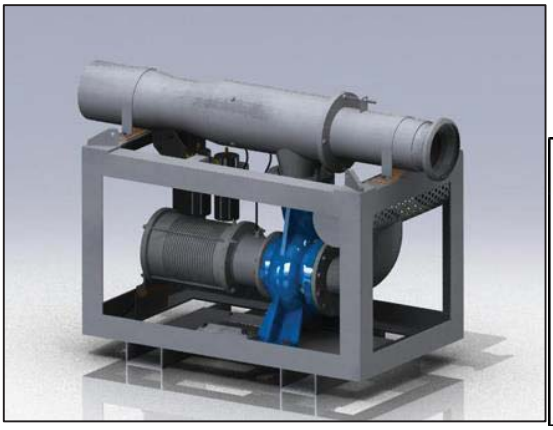


Mass flow excavator

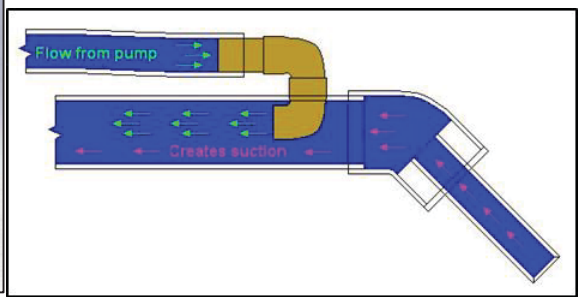
Subsea Dredges

Where more control is required over the spread of debris a subsea dredge unit may be used.

A typical dredge unit together with the principle of its operation is shown below. As the debris is sucked away rather than blown, the operation can be much less disruptive than a mass flow excavator. Debris may be deposited in a pre-determined location away from other areas of the structure being excavated. Diver and ROV-operated dredge units are available.



Subsea dredge unit



Subsea dredge unit - principle of operation

The CA Evaluation Workshop assumed dredging techniques may be deployed at pipeline and power cable exposed sections where access to transition bases may be required to enable cutting i.e. for Options 2c.

Mechanical Excavators

For firmer seabed and removal of more challenging debris, mechanical excavation equipment such as subsea grab units may be used.

The grab excavator is more suited to the removal of rock dump and larger debris which may not be removable by conventional dredging. The grab excavator can be deployed from a basic vessel.

Grab unit in operation

Cutting

Once exposed after the use of excavation equipment, pipelines and power cables can be cut using the equipment described below.

Saws

There are several subsea operable saws available that adopt various mechanical methods. The abrasive action of the sawing technique is time consuming. Typically, a diver would attach the saw to the item being cut. ROV-operable versions are also available but setup time is significantly increased.

Dual Cut Band Saw

In a dual cut band saw, two cuts are performed simultaneously in opposing directions with the saw adopting a reciprocating mechanism. This approach aims to cancel out the reaction loads in order to achieve a smooth, vibration free and reliable cut. Following completion of the cut a 30 mm wide 'coupon' is created leaving a gap between the two ends of the pipe. Pipe diameters of between 4-inch and 30-inch can be cut using this type of saw, without needing to carry multiple saw sizes.

Chop Saw

The chop saw adopts a rotating circular saw to cut through the pipe. The saw operates on a continuous rotation, spreading wear over the blade circumference. A return stroke is not necessary, making the mechanism more efficient than a reciprocating saw. Multiple saw sizes are required for different sizes of pipe.

Dual cut band saw

Chop saw

Diamond Wire Saw

The diamond wire saw can be used in-situations where precision and straightness are not critical. A steel wire, held in tension, is driven around the surface of the pipe generating the friction required to make the cut. As the wire cuts across the entire surface, there is no risk of the wire becoming trapped in a closing gap during the final stages of a cut.

Similar to the dual cut band saw, a range of pipe sizes can be cut using the same saw. The cutting wire is a low cost consumable, available in long length reels. Replacement of the wire has the potential to be frequent, depending on the nature of the cut.

Hydraulic Shears

A faster alternative to a subsea saw is hydraulic shears. A powerful grip and scissor action is achieved via the application of high pressure hydraulic fluid onto a plunger which drives the cutting blade onto the anvil. The cutting blades are made from heat treated alloy steel and require to be re-ground after a number of uses in order to maintain performance. The shears can be positioned by diver or ROV.

A typical set of hydraulic shears is shown below. Shears are currently available with a jaw opening of 41" and suitable for 22" dia. pipe.

The CA Evaluation Workshop assumed hydraulic shears would be deployed to cut all pipelines and power cables as they are all below 22" dia. cutting threshold.

Diamond wire saw

Hydraulic shears

Pipeline and Cable Removal

The three options considered for the removal of pipelines and power cables are:

- Reverse reeling;
- Reverse S-lay;
- Cut and lift.

Reverse Reeling

For pipelines with a diameter of 16 inches or less, and which are not concrete coated, a possible method of removal is by a reversal of the reeling installation process. Reeling has been used extensively across the North Sea for the installation of both rigid and flexible flowlines.

The installation of rigid pipelines by the reeling method relies on the plastic deformation of the pipe wall during installation. During the lay phase the pipeline is guided through an aligner, to ensure the reeled pipeline will subsequently lie straight on the seabed. When the process is reversed for the removal of a pipeline, the pipe is reeled onto the specialist reel vessel and is once again plastically deformed so that it sits on the removal reel. The length of pipeline that can be removed is limited by the size and capacity of the reels (up to a maximum of 5600 Te on current reel lay vessels). Once the pipeline is on the reel, it is taken to a shore-based facility and removed by reversing the process.

Due to the nature of the reeling and unreeling process, it is unlikely that a rigid pipeline removed using this method could be reused. The multiple cycles of plastic deformation of the pipeline wall could potentially compromise its long term integrity. The steel from removed rigid pipelines can be recycled.

This method is also used in the removal of flexible flowlines, umbilicals and power cables. The structure of the wall of a flexible flowline or umbilical means it does not experience the same deformation cycles as the rigid pipeline during the reeling and unreeling process.

Reel lay vessel

Reverse reel lay

Umbilical lay

Reverse S-Lay

Larger diameter and concrete coated pipeline are typically installed using the S-lay method. Although it has never been used before in the North Sea, a potential removal method is the reversal of the S-lay installation process.

This method would involve removeing a pipeline end to the deck of a specialist S-lay vessel. The vessel would then move along the route of the pipeline, stopping at suitable points where a cut would be made to remove a section of pipe from the removed pipeline string on the deck of the vessel. These sections would then be transferred to a suitable transportation barge for onshore recycling.

This is not an operation that has been carried out in the North Sea, although there is some experience of removing short lengths of small diameter pipelines using this method in shallow water (less than 24 metres water depth) of the Gulf of Mexico. Significant technical challenges currently exist for this method:

- High tension forces would need to be applied from the vessel tensioner system to the outer surface of the concrete weight coat to bring the pipe onto the deck and hold it in place for cutting. The integrity of aged concrete weight coating would need to be carefully assessed to confirm that the necessary tension could be applied without the concrete coating disintegrating and the control of the pipeline being compromised;
- This tension would also be applied into the steel wall of the pipeline and after many years of operation, the integrity of the pipe wall along its length under the high removal loads would need to be confirmed.

The CA Evaluation Workshop assumed that a smaller type of S-Lay vessel would be deployed for removal of the flexible pipelines associated with the Beatrice project.

Types of S-lay vessel

Cut and Lift

This method can be used for any diameter or length of pipeline. This is the process whereby a pipeline is cut into sections, nominally 24m long, subsea by diver-operated cutting tools or using remotely operated cutting equipment, and the sections are then removed to a surface vessel using an on-board crane.

This option has been widely used for removing shorter sections of pipe, either for the removal of a short pipeline in its entirety, or when discrete sections are being removed under a decommissioning plan. It is usually the preferred removal option for short sections of pipe, when it is impractical or prohibitively expensive to mobilise major removal vessels or equipment.

Most significantly, the cut and lift method does create greater risks to the personnel carrying out the offshore operations, especially divers. It has therefore been preferable to limit that risk exposure by avoiding extensive offshore cut and lift programmes.

Rigid pipe sections would traditionally be removed from the seabed using rigging attached by divers or ROV. Where possible, it is preferable to use divers for removal preparation due to their increased dexterity and adaptability.

As an alternative to conventional rigging, grab systems are available. For simple lifts, a single grab can be used where the pipeline section is long or more complex, dual grabs are also available.

Cut pipeline sections

Single grab system

Rock Cover

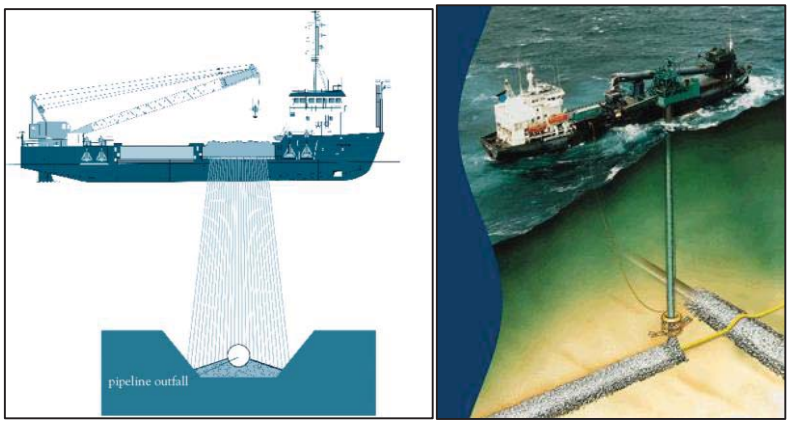
There are two principal types of subsea rock installation: side stone dumping and fall pipe rock dumping. The side stone method is typically used in shallow water for scour protection at up to 50 m water depths, as the accuracy of rock placement from the water surface is limited. The deeper the waters, the more the currents may influence and disperse the rock and the more difficult it becomes to ensure accurate placement.

On a Side Stone Dumping Vessel (SSDV) stone is loaded into compartments on a reinforced deck. Bulldozer blades are used to push the rock over the sides of the vessel and deposit the stone accurately in the water with the aid of the vessel positioning system.

For greater water depths, a Fall Pipe Vessel (FPV) would be used. Fall pipe vessels are primarily used for covering pipelines and power cables, levelling the seabed or applying scour protection. Rock material is loaded at a port or seafront quarry into the hold of the vessel.

The rock is transferred from the hull to the hopper via a conveyor belt or excavator. From the hopper the rock goes through a feeder which controls the flow of rock into the fall pipe. A Remotely Operated Vehicle (ROV) at the end of the fall pipe is used to manoeuvre the fall pipe and carries the necessary survey and positioning equipment. An additional free-flying ROV is sometimes used to monitor the operations.

The CA Evaluation Workshop assumed that FPV rock cover techniques would be deployed on the Beatrice Project.



Side Stone Dumping Vessel / Fall Pipe Vessel

Rock can also be installed via Flexible Intermediate Bulk Containers (FIBCs). Fibre bags are filled with rock and are deployed by a vessel crane. This method opens up greater vessel availability and can lead to reduced vessel costs but is limited in terms of volume of rock that can be placed quickly.

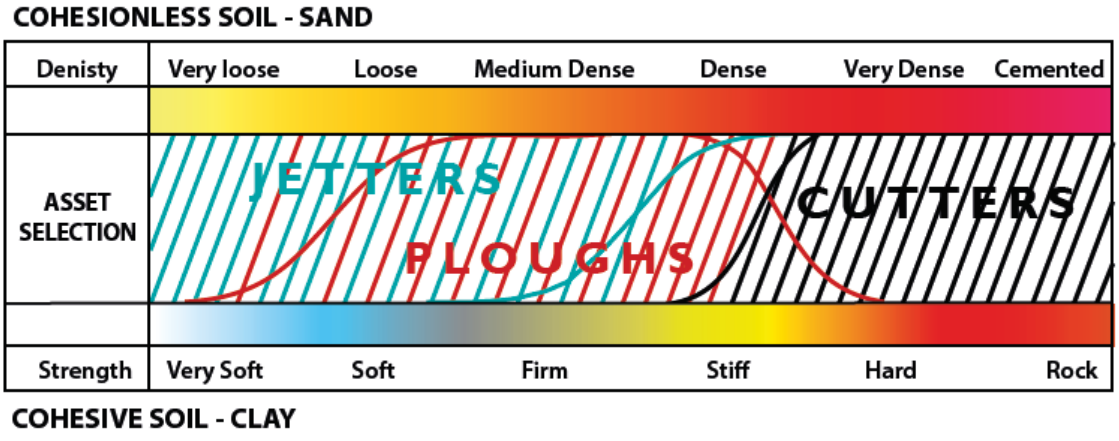
Rock-filled FIBC deployment

Trenching and Burial

Exposed pipeline sections can be buried for decommissioning using existing post-lay trenching techniques. There are three main types of tool in common use on subsea pipelines:

- Jetting machine;
- Mechanical cutting machine;
- Plough.

The applicability of each trenching method to a burial operation will depend on a number of factors, most generally the size of the pipelines and the type and strength of soil. The diagram below gives a general view of the applicability of the types of tool available. There are also hybrid tools available that combine jetting and cutting functions to cover a wider range of soil conditions.



Trenching method suitability

Jetting tools can work in sand, silt and medium clay. In loose sand, jetting produces wide shallow trenches and therefore may not provide sufficient burial for decommissioning. In denser sands and weaker cohesive soils, the trench shape is normally well defined. A typical jetting machine is shown below.

Cutting machines are similar to jetting tools but use mechanical means of creating an open trench such as chain cutters, wheels, disks, etc. The soil is cut under the pipe and the material is ejected to the side of the trench via a dredge pump system.

Subsea ploughs can be used to bury longer straight sections of pipeline (at least 100 m). The pipeline is firstly picked up by grabs and secured with rollers, and then is lowered into a 'V' cut trench formed by mechanical deformation of the seabed as the plough is pulled forward. This method is not generally suitable for platform approaches due to numerous bends and crossings.

For each method, consideration should be given to the structural integrity of the pipeline and the probability of the pipeline to remain intact during trenching operations.

Typical Jetting machine

DeepOcean "T1" mech. cutting machine

DeepOcean "AMP500" plough

Prefabricated Flexible Concrete Mattress Removal and Removal

The removal of concrete mattresses requires careful handling. The mattress ropes, being subsea for many years, can be brittle and much less robust than when first installed. The existing deployment loops are therefore not used for removal to the vessel but only for subsea lifts. This is in accordance with industry guidance.

Mattresses are lifted onto removal frames, steel cargo nets or speed loaders while still subsea, where they are then safely taken back to the surface via vessel crane. Speed loaders, as shown below, comprise of two side frames with a wire net between them.

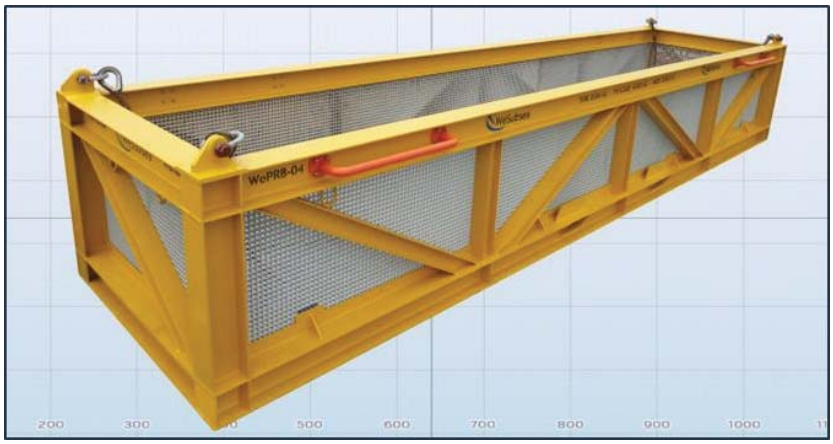
Concrete mattress lifting frames (speed loaders)

Repsol Sinopec Resources UK propose to remove all prefabricated flexible concrete mattresses and therefore it is only mattresses that due to their condition cannot be removed using one of the techniques described that would be subject to a CA evaluation.

Where the mattresses are severely degraded and at risk of disintegrating on removal, half height containers (Debris Baskets) with floor grating as shown below can be deployed on the seabed for filling by diver or ROV.

Although labour intensive and involving multiple lifts, removal of concrete mattresses is often better suited to divers as draped mattress shapes are often irregular and lifting loops can be in difficult to access locations. Durations for ROV removal of concrete mattresses can be double that of diver removal.

Where use of lifting frames is not feasible, a grab system can be adopted. The grab can lift a mattress from its side and transfer it to a removal frame. Alternatively, a grab can collect the mattress and remove it to the surface and transfer the materials to skips located on the vessel. This is similar in operation to a grab excavator. Like the grab excavator, the speed of item removal is driven by jaw capacity and weight capacity of the vessel crane. Removal using grabs is time consuming, but can be deployed from a basic vessel to keep day rate costs low.



Half height containers

Mattress lift using grab

APPENDIX C - PIPELINES AND POWER CABLES STATUS

A Pipelines and Umbilicals Status Review has examined historic and recent survey data to determine and report the current status of each line. A summary is provided on the configuration and status of each pipeline and power cable is provided in this Appendix.

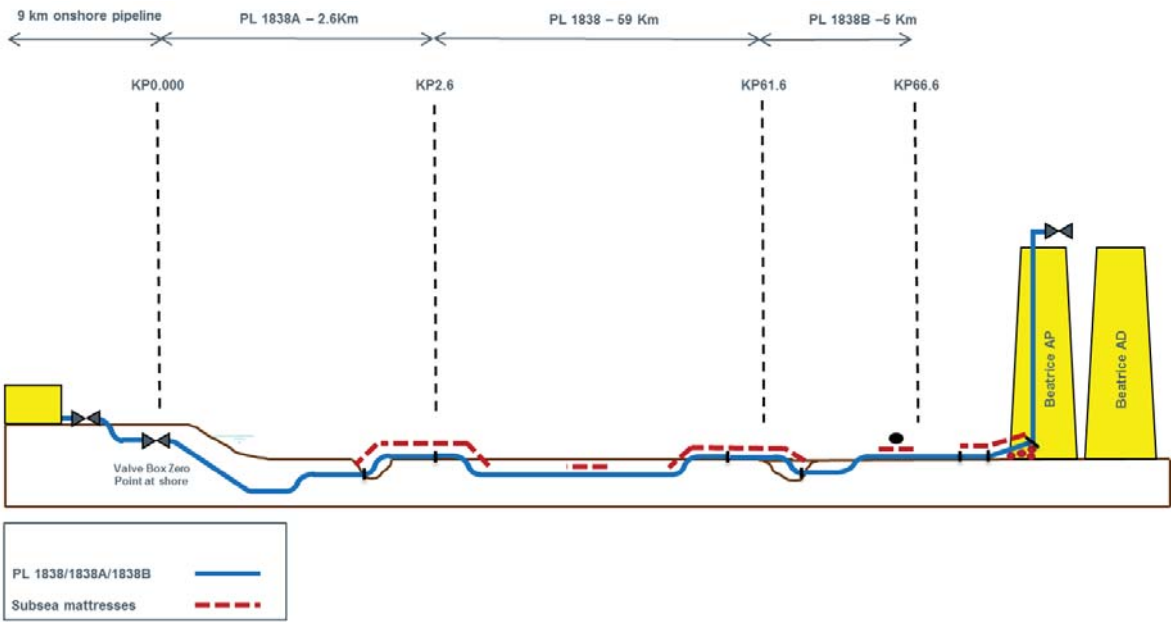
PL1838

PL1838 is the 16" (406.4mm) subsea pipeline which transports produced crude oil from both Beatrice Alpha and Beatrice Bravo to the onshore terminal at Nigg. The pipeline is approximately 67km long. The pipeline has four trench transitions, two at either end and also two where the replacement pipeline was tied into the existing sections. Each section is trenched and buried along its length. The section schematic is provided in Figure 8.

The following pipelines are covered under this section:

- PL1838A – From ZPV to downstream tie – in to PL1838 (KP 0.0 – 2.68)
- PL1838 – Replacement section (KP 2.68 – 61.5)
- PL1838B – The PL1838 upstream tie in point to Beatrice AP (KP 61.5 – 66.5)

Figure 8 PL1838 Pipeline Illustration

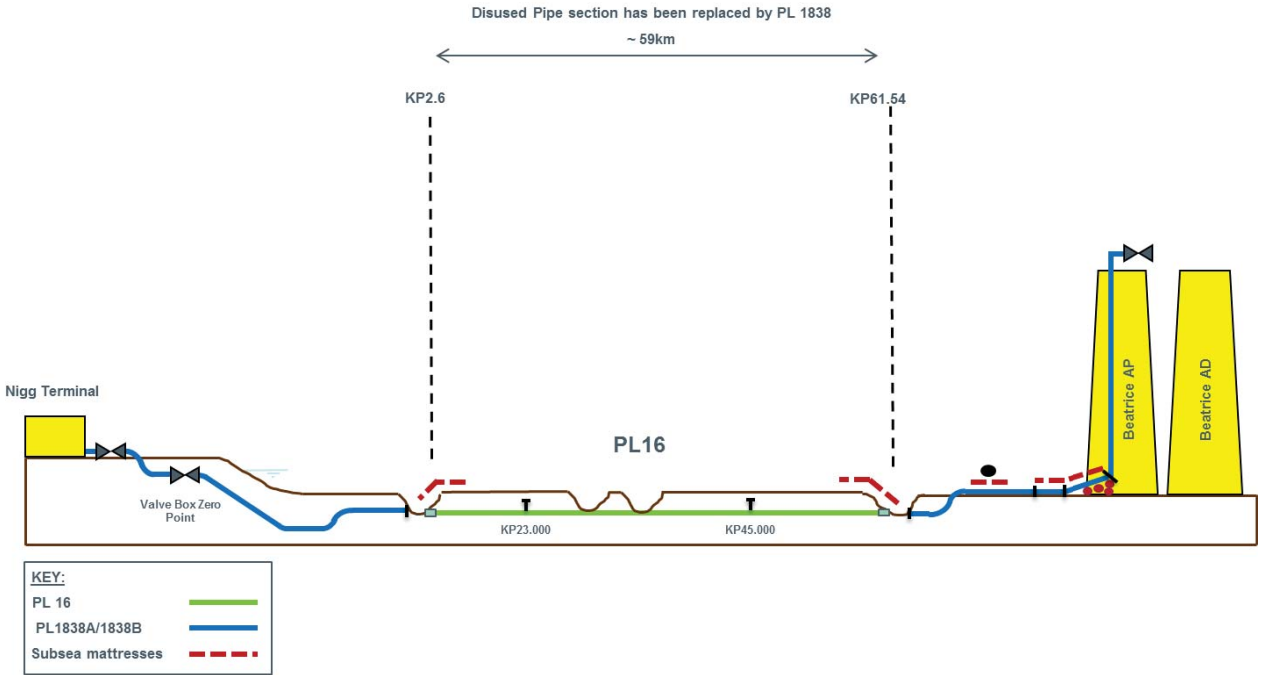


PL1838 is still in use, and will be utilised as part of the wells plugging campaign. It will be cleaned after the campaign is completed.

PL16

PL16 is the 59km abandoned section of the original export pipeline from Beatrice AP to Shandwick Bay. This section remains trenched and buried, with both cut ends plugged and covered with mattresses. The section schematic is provided in Figure 9.

Figure 9 PL16 Pipeline Illustration

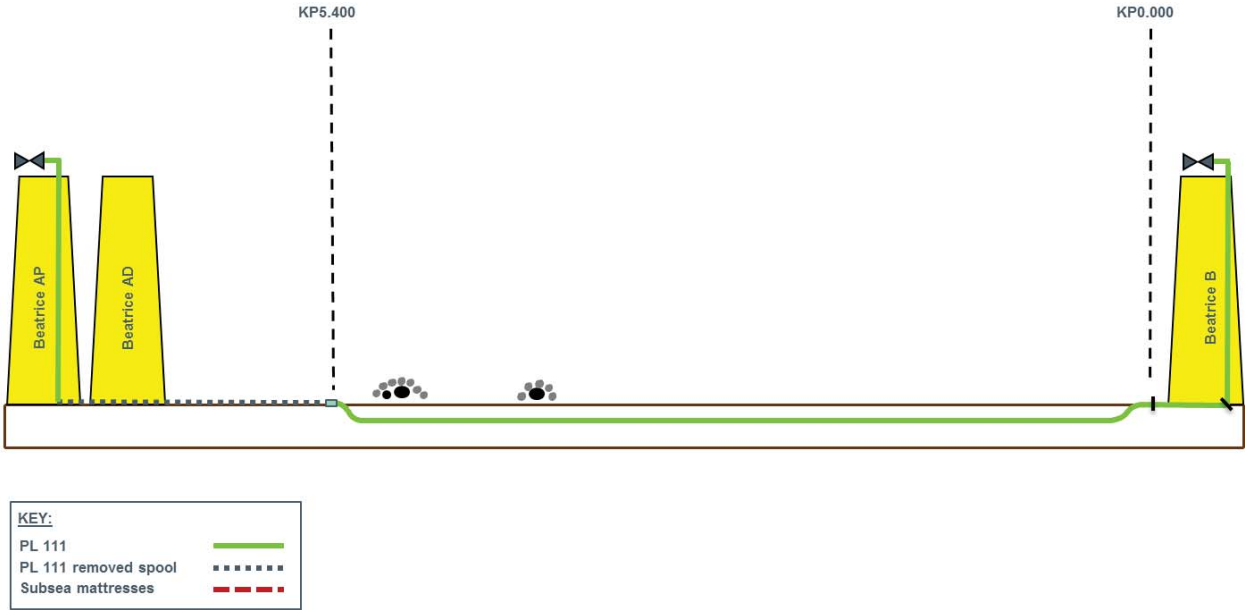


PL111

PL111 is the disused 8" WI pipeline between Beatrice AP and Beatrice B and is approximately 5.3km long. The pipeline is carbon steel and concrete coated and was trenched and backfilled along its length.

PL111 was tied into Beatrice AP via rigid spool pieces, however these were removed in 2008 to accommodate the new Jacky (Ithaca Energy Inc.) pipeline which re used the 8" PL111 riser on Beatrice AP. At Beatrice B, the pipeline was pulled into a J tube, therefore there are no spool pieces at this location. The section schematic is provided in Figure 10

Figure 10 PL111 Pipeline Illustration



PL112

PL112 is the disused 6" production pipeline between Beatrice B and Beatrice AP, it is approximately 5.2km long. The pipeline is carbon steel and concrete coated, it was trenched and backfilled along its length.

PL112 was tied into Beatrice AP via spool pieces, however these were removed in 2008 to accommodate the new Jacky (Ithaca Energy Inc.) pipeline which re used the 6" PL112 riser on Beatrice AP. At Beatrice B, the pipeline was pulled into a J tube, therefore there are no spool pieces at this location.

A 1.55km section of PL112 was replaced in 2004, the new section was named PL112A. The replacement line was laid in parallel and the tie in point was at KP3.95. PL112 was cut and two Z shaped spools with Hydratight MORGRIP® connectors were used to join the replacement pipe to the existing pipeline.

The following pipelines are covered under this section:

- PL112 – Beatrice B to tie in point on PL112A (KP 0.0 – KP 3.95);
- PL112X – Redundant Section (KP 3.95 – KP 5.4);
- PL112A – Tie in point on PL112 to Beatrice AP (KP 3.95 – KP 5.4).

The section schematic is provided in Figure 11and Figure 12.

Figure 11 PL112/PL112X Pipeline Illustration

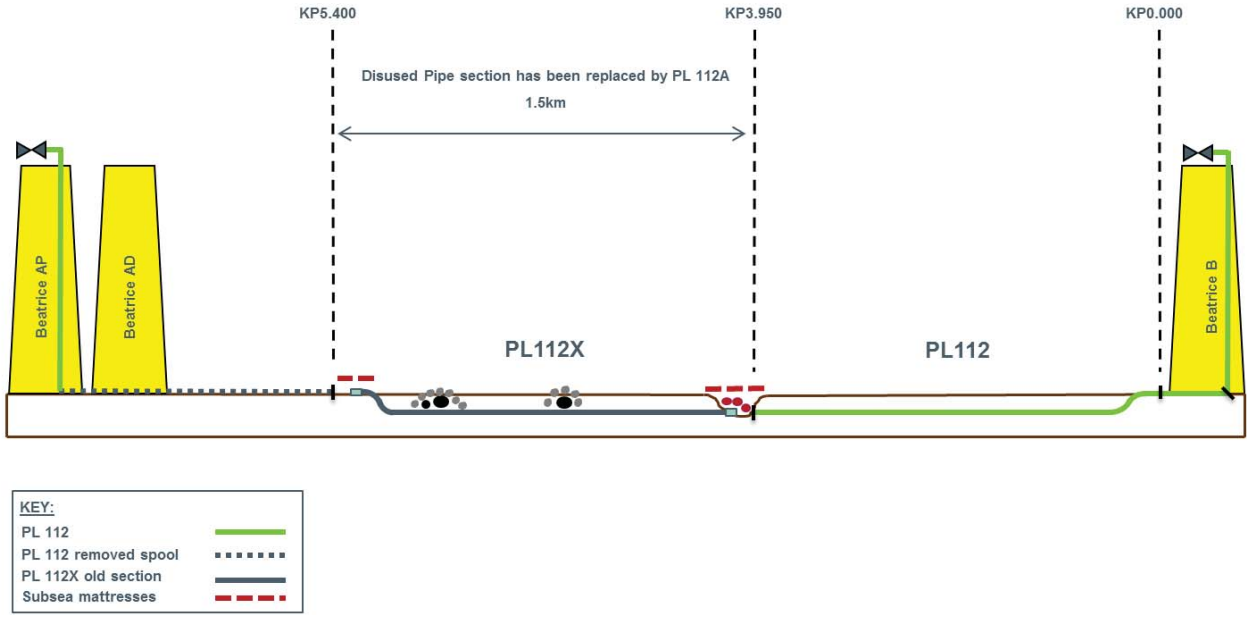
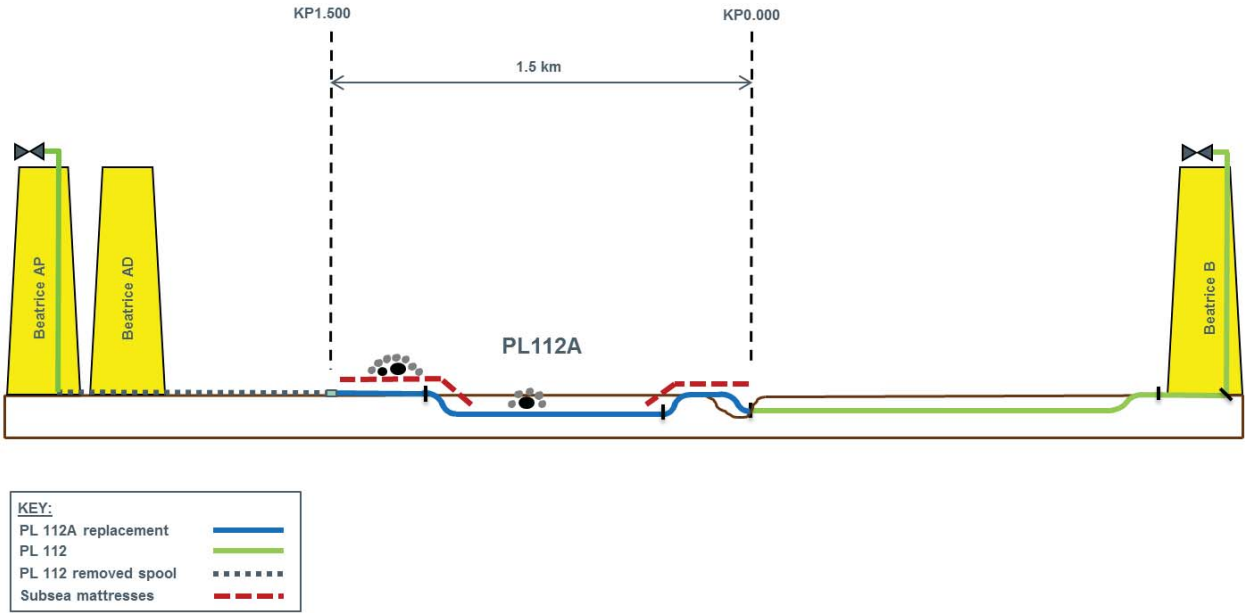


Figure 12 PL112A Pipeline Illustration



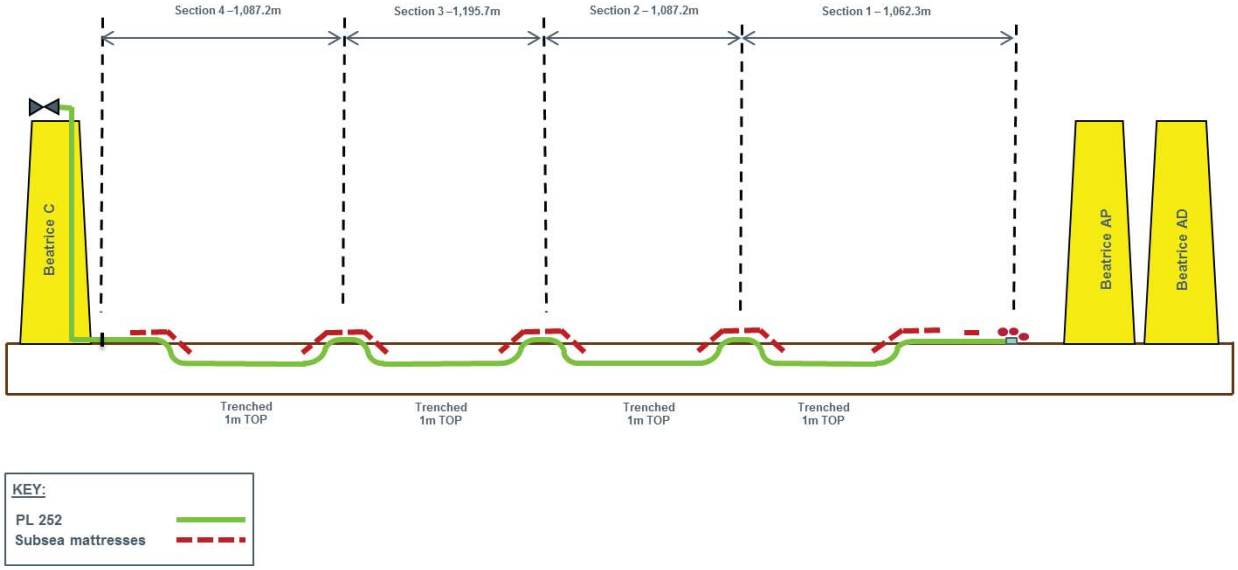
PL252

PL252 is the disused 8" flexible WI pipeline between Beatrice AP and Beatrice C, it is approximately 4.8km long. The flexible line was laid in 5 parts, and connected via Coflexip flange connectors. The pipeline was laid and trenched simultaneously, however there were 5 areas found to be not in the trench or on the seabed. These areas were subsequently covered in grout injected mattresses for protection.

In 2005 the pipeline was disconnected from Beatrice AP to allow the new power cable (PL2331) which connects Beatrice AP to the demonstrator wind turbine generators A and B to be installed. The pipeline was pulled back and the pipe end was plugged and covered with sandbags. A single concrete mattress was laid to flatten the raised loop on the pulled back section of pipeline.

There are six locations were mattresses are reported, with 10 grout filled mattresses and 43 Flexible concrete mattresses. The section schematic is provided in Figure 13.

Figure 13 PL252 Pipeline Illustration



PL4331 - Dunbeath Power Cable

The 108mm diameter of PL4331- Dunbeath power cable supplies 33kV power to Beatrice AP platform. It is approximately 26km long and was installed in 1987. The power cable is surface laid at the nearshore end from KP0.00 to KP2.825 with the surface laid section housed in a steel tube protection caisson. The power cable and protection caisson transition to an average burial depth of 0.9m below seabed and the power cable then runs fully buried to the Alpha complex.

The transition and exposed section of line where it ties into AP (KP25) is covered by mattresses for protection which is equivalent of 100m of cover approximately. The section schematic is provided in Figure 14.

Figure 14 PL4331 -Dunbeath Power Cable Illustration

PL4330 - Beatrice AP to Beatrice B Power Cable

The 74mm diameter power cable PL4330 running between Beatrice AP and Beatrice B is approximately 6.3km long and is buried. It is an 11kV feeder cable used to supply power to Beatrice B.

The transition and exposed section of line where it ties into Beatrice AP (KP0.00) and to Beatrice B (KP5.68) is covered by 10 grout injected mattresses for protection, approximately 100m in total. The section schematic is provided in Figure 15.

Figure 15 PL4330 - Beatrice AP to Beatrice B Power Cable Illustration

PL2331 -Wind Turbine Power Cable

PL2331 is the power cable that connects Wind Turbine Generators (WTG) A & B to Beatrice AP platform. The power cable was installed in 2007 and is approximately 2.9km long.

The power cable is installed from Beatrice A to a junction box on WTG A and then on to WTG B in a continuous length.

The power cable crossing over the 16" Export pipeline PL1838 (KP1.72 -KP1.75) is an exposed section of power cable with flexible concrete mattresses below to support the power cable above PL1838.

Exposed sections of power cable where it transitions to tie-in to the Beatrice AP and WTG A and WTG B are not protected by mattresses, instead are protected by grout bags.

Figure 16 PL2331 Power Cable Illustration

Other general observations from the Pipelines and Umbilicals Status Review that were considered during the CA are as follows:

Generally, all the trenched and buried pipelines and power cables in the Beatrice field show good depth of cover greater than 0.6m over the pipeline and power cable length apart from the ends.

There are no significant mid-pipeline exposures across the field. There are midline exposures on three pipelines and one power cable, these are:

- PL1838 - 16" Oil Export has one which is 0.5m long;
- PL16 - 16" Oil (now disused) has 11 separate and small exposures ranging from 3m to 95m long; with total combined exposure length of 309m;
- PL252 – 8" water injection has one exposure which is 4m long;

- PL2331 – Power cable to wind turbines has one exposure which is 12m long;

The survey data indicates that the exposures on the pipelines are either reducing or not changing significantly over the years. The exposures are also mainly found at the ends of the pipelines and trench transitions.

APPENDIX D – PRE-SCREENING OF OPTIONS

Pre-Screening Results

The results of the Option Screening Study for each pipeline, power cable and mattress decommissioning option are summarised in Table 14. The key to the symbols is presented in Table 13

Table 13 Recommended Action Key

Key	Recommended action
✗ (NTF)	Not Technically Feasible; do not carry forward option to CA.
✗ (N/A)	Not Applicable; do not carry forward option to CA.
✗ (screening)	Screen out option based on qualitative assessment; do not carry forward option to CA.
✓	Carry forward option to CA.

Table 14 Pipelines and Power Cables Pre-screening Recommendations

GROUP FOR CA	COMPONENT TYPE / AS-LAID CONDITION	AGREED GROUPINGS	BOUNDARY	1. FULL REMOVAL			2. REMEDIATE IN SITU			3. LEAVE IN SITU
				a). By Reverse Reeling	b). By Reverse S-Lay	d). By CUT and Lift	a). Exposed sections rock covered	b). Exposed sections trenched and buried	c). Exposed sections Cut and Removed	Do Nothing
PIPELINES										
A	Offshore: Rigid pipeline Concrete coated Trenched and buried	PL16: 16" Oil (now disused)	KP25.0 – KP61.64	✗ (NTF)	✓	✗ (screening)	✓	✓	✓	✓
		PL111: 8" WI (now disused)	Entire length							
		PL112: 6" Oil (now disused)	Entire length							
B	Offshore: Rigid pipeline Trenched and buried	PL1838: 16" Oil Export	KP25.0 – KP66.96	✓	✓	✗ (screening)	✓	✓	✓	✓
		PL112A: 6" Oil (now disused)	Entire length							
C	Offshore: Flexible pipeline Trenched and buried	PL252: 8" WI (now disused)	Entire length	✓	✓	✗	✓	✓	✓	✓
D	Nearshore: Inside the area of special environmental interest To mean low water mark	PL1838: 16" Oil Export	KP2.66 – KP25.0	✗ (NTF)	✓	✗ (screening)	✓	✓	✓	✓
		PL16: 16" Oil (now disused)	KP0 – KP25.0							

Table 14 Continued

GROUP FOR CA	COMPONENT TYPE / AS-LAID CONDITION	AGREED GROUPINGS	BOUNDARY	1. FULL REMOVAL			2. REMEDIATE IN SITU			3. LEAVE IN SITU
				a). By Reverse Reeling	b). By Reverse S-Lay	d). By CUT and Lift	a). Exposed sections rock covered	b). Exposed sections trenched and buried	c). Exposed sections Cut and Removed	Do Nothing
POWER CABLES										
E	Offshore: Trenched and buried	PL4331 - Dunbeath to Beatrice A Power Cable	KP2.82 – KP26.0	✓	✓	✗ (screening)	✓	✓	✓	✓
		PL4330 - Beatrice A to Beatrice B Power Cable	Entire length							
		PL2331: Wind Turbine Generator Power Cable	Entire length							
F	Nearshore: Inside the area of special environmental interest To mean low water mark	PL4331 - Dunbeath to Beatrice A Power Cable	KP 0 – KP2.82	✓	✓	✓	✓	✗ (screening)	✗ (N/A)	✓

Table 14 Continued

GROUP FOR CA	CURRENT CONDITION	MATTRESS TYPES / AGREED GROUPINGS	NUMBER	1. LEAVE IN SITU AND:			2. REMOVAL FOR ONSHORE DISPOSAL:	
				a. Do nothing	b. Rock cover	c. Relocate and bury	a. Remove via Debris Basket	b. Remove via grab excavator
MATTRESSES								
G	Exposed but not removable in one piece due to condition	Flexible concrete mattresses	21 (assumed 10% of total number of mattresses)	✗ (screening)	✓	✗ (screening)	✓	✗ (N/A)
H	Exposed but not removable in one piece due to design	Grout filled mattresses	37	✓	✓	✗ (screening)	✓	✗ (screening)

Pre-Screening Basis of Results

The Option Screening Study [8], should be referenced for the detailed evaluation, however the results from this study are summarised here for clarity.

Pipelines Groupings

Full Removal by Reverse Reeling (Option 1a):

Group A and Group D pipelines have concrete coatings. It is not technically feasible to reverse reel concrete coated pipelines and this option has therefore been discounted for these pipelines groups at the pre-screening stage.

Full Removal by Reverse S-Lay (Option 1b):

The Option Screening Study highlighted that there is also no industry track record of concrete coated pipelines being reverse S-Laid. Although this will be a consideration when evaluating S-Lay for these pipelines groups, it was considered appropriate to carry reverse S-Lay forward into the CA Evaluation Workshop and therefore this option was not discounted at pre-screening.

Full Removal by Cut and Lift (Option 1c):

Whilst technically feasible, this option was screened out in the Option Selection Study for all pipelines groups. The option was screened out due to the relative duration of the offshore project activity compared to all other options considered. The activity using cut and lift techniques to remove the pipeline is estimated to take at least ten times longer than any of the Full Removal options considered and more than 20 times longer than the remediate in-situ options.

This results in significant risk exposure to the project team and divers over a prolonged period, lasting more than one season and causes significant disturbance to the seabed, whilst the activity is undertaken.

Remediate in-situ (Option 2a, 2b and 2c):

All options were considered feasible and recommended to be carried forward to the CA Evaluation Workshop for all pipelines groups.

Leave in-situ / Do Nothing (Option 3a)

Whilst the Option Selection Study recognised that this option provided the greatest residual risk to other users of the sea, in terms of potential snagging by trawling equipment on exposed sections of pipeline and that this will be a key consideration during the CA Evaluation Workshop, the recommendation was that these options should be carried forward to the CA Evaluation Workshop for all pipelines groups.

Power Cable Groupings

The Option Screening Study recommended that all decommissioning options should be carried forward to the CA evaluation workshop, with the following two exceptions.

Full Removal by Cut and Lift (Option 1c):

The option was screened out for power cable Group E due to the relatively long duration of the offshore project activity compared to all other options considered. The activity using cut and lift techniques to remove the power cable is estimated to take at least 20 times longer than any of the Full Removal options considered and more than 40 times longer than the remediate in-situ options.

The option was not screened out for power cable Group F as due to its shorter length (approx. 2 km), its location nearshore, that it is surface laid and is housed in a protective steel caisson, means that the overall duration of cut and lift is not significantly different from the other Full Removal options. The recommendation was that this option should be carried forward to the CA Evaluation workshop for power cable Group F. However, after completion of the pre-screening study Repsol Sinopec Resources UK confirmed they are contractually obliged to remove the 26km PL4331 - Dunbeath to Beatrice A power cable and intend to do so, as such has not been subjected to CA.

Remediate in-situ (Option 2b – Exposed Sections Trenched and Buried):

Power cable Group F (approximately 2km section of the PL4331 - Dunbeath power cable as it approaches nearshore) originally had to be surface laid as the soil conditions in the area did not allow trenching and burying the full length.

Therefore, trenching and burying of this exposed section as a decommissioning option will still not be possible and has been screened out in the Option Selection Study and will therefore not be carried forward as an option in the CA Evaluation Workshop

Remediate in-situ (Option 2c – Exposed Sections Cut and Removed):

Power cable Group F is surface laid its entire length, therefore removal by cut and lift techniques will be evaluated under Option 1c. Option 2c is not applicable as it is identical to Option 1c.

Mattress Groupings

The Option Screening Study recommended that all decommissioning options should be carried forward to the CA evaluation workshop for the Mattress Groups, with the following exceptions.

Leave in-situ and Do nothing (Option 1a):
This option was considered as not appropriate for Mattress Group G, due to their design and potential snagging hazard this would not be acceptable from a safety risk perspective to leave in place. For the small quantity assumed that cannot be removed by standard means, removal by debris baskets or rock cover was considered more appropriate.

The recommendation from the screening study was that this decommissioning option should be discounted and not carried forward to the CA Evaluation Workshop for Mattress Group G.

This option remains valid for Mattress Group H.

Leave in-situ and Relocate and Bury (Option 1c)

The Option Selection study recommended that this option for both Mattress Groups G and H be screened out on the basis that:

- It would create significantly more seabed disturbance than all other options;
- It would take significantly longer to achieve than all the other options, with the increased risk exposure duration and costs involved;
- There is limited industry track record with this approach.

It was also considered inappropriate that if the mattresses could be mobilised and lifted from their current location, then merely relocating them could be considered dumping, when they could be removed for onshore disposal.

The recommendation from the screening study was that this decommissioning option should be discounted and not carried forward to the CA Evaluation Workshop.

Remove via Grab Excavator (Option 2b)

The Option Selection study recommended that this option for both Mattress Groups G and H be screened out on the basis that:

- This option had the greatest amount of vessel over side working and therefore safety risk;
- Materials are returned to the vessel deck in the excavator claws before being transferred to container, potential for unsecured load and hence increased safety risk;
- More seabed disturbance than Option 2a – removal via basket

The recommendation from the screening study was that this decommissioning option should be discounted and not carried forward to the CA Evaluation Workshop.

APPENDIX E - CA METHODOLOGY ADOPTED

Agreed Evaluation Method

The OGUK Guidelines [9] provide advice on the different CA methods that may be considered.

It was agreed that a combination of Method B – Narrative + Scoring and Method C - Narrative + Scoring + Weighting should be adopted. A summary of Method B and C, extracted from the OGUK Guidelines [9], is provided below:

- Method B - Narrative + Scoring:
  - Normally adopted where a fully qualitative method (Evaluation Method A) does not give adequate clarity in the differences in performance between the options being considered or where the Company prefers to adopt a numerical scoring approach, the latter being the case for the Beatrice Project;
  - A simple scoring mechanism has been developed to enable the differentiators between the options across the criteria to be rationalised and compared.
- Method C - Narrative + Scoring + Weighting:
  - Applicable where Method B is deemed as not sufficiently robust by the project team, or where the conflicts or trade-offs cannot be demonstrated adequately by narrative alone;
  - Method C is an extension of Method B, uses the scores developed by Method B and involves applying weighting the criteria, in order to derive an overall measure of performance for each option. This allows the options to be directly compared using a single scale, in order to support the narrative outcome of the CA ToR and report.

The evaluation method consisted of the application of scores between 0 and 10, where 0 is the best performing option against the sub-criteria being evaluated and 10 is the worst performing option. Where possible, scores were allocated on a linear basis across the options based on relative performance of each option.

It was agreed that a qualitative assessment would be acceptable for this CA. Where quantitative data was available, this was utilised to derive qualitative ranking. e.g. the following is available:

- Energy and Emissions estimates for each option;
- Level 2 estimated durations for each activity;
- Quantities of rock cover required for the rock cover options in tonnes;
- Quantities of materials returned onshore for recycle or disposal;
- Level 1 cost estimates derived from the vessel durations multiplied by norms. [Note 5]

This information was prepared and presented as a fact sheet at the workshop and can be made available upon request.

[Note 5] The cost information is confidential and has been removed from the copy of the fact sheets.

APPENDIX F - METHODS FOR DETERMINING WEIGHTINGS

The weightings for main criteria and sub-criteria were developed using a technique known as pairwise comparison to calculate the weightings to be used.

An explanation of this technique and an example of the pairwise calculations and tables developed to arrive at the weightings are included for reference below. A full set of calculations and tables specific to this scope can be made available upon request.

- This method allows a concentration on the comparison of only two criteria at a time. Thereby, the effort required to compare each criterion with every other one which increases rapidly when handling many criteria is reduced;
- The matrix used can be set up on a spreadsheet with formulae to calculate the geometric mean and hence the weighting;
- This table automatically calculates the geometric mean and hence the relative weightings of each criterion which would be used during the evaluation. For each pairwise comparison, it must be determined which of the two criteria is the most important and by how much.

The table below is an example of a pairwise comparison of the main criteria and was used to explain the process to the Methodology Workshop participants.

		a	b	c	d	e	Geometric Mean	Weighting
	Criteria	Safety	Environment	Technical	Societal	Economic		
a	Safety	1	a1	a1	a3	a1	2.00	34
b	Environment		1	bc	b3	b1	1.32	23
c	Technical			1	c3	c1	1.32	23
d	Societal				1	e3	0.33	5
b	Economic					1	0.87	15
							5.84	100

A scale can be agreed which provides guidance on the magnitude of importance of one criterion against another. The table below is an example of such a scale.

Letter Code	**Example**	**Definition**	**Numerical Score**
Letter code x Letter code	bc	Criteria are deemed equally important	1
Letter code 1	a1	Moderate importance of one criteria over the other	2
Letter code 2	b2	Strong importance of one criteria over the other	3
Letter code 3	b3	Very strong importance of one criteria over the other	4

The appropriate letter code is then entered into the table for pairwise comparison, the letter denotes which criterion has higher importance and the letter code (1,2 or 3) denotes the scale of the importance. The codes are automatically converted into a numerical score (1 to 4) and each the geometric mean is then calculated for the primary criterion from these scores.

The overall weighting for each criterion is calculated by dividing the geometric mean of the criterion by the sum of all geometric mean values.

Pairwise Comparison Results

The following tables record the results of the pairwise comparison completed during the Methodology Workshop for the main criteria provided, as a worked example.

Similar tables were produced to record the results of the pairwise comparison completed for each of the sub-criteria and these can be made available upon request.

Main Criteria

Resultant Weightings:

		a	b	c	d	e	
		Safety risk	Environment	Technical	Societal	Economic	Weighting
a	Safety	1	a1	a2	a3	a2	40%
b	Environment		1	b1	b2	b2	26%
c	Technical			1	c1	ce	14%
d	Societal				1	d2	11%
e	Economic					1	9%

Calculation:

		a	b	c	d	e	
		Safety risk	Environment	Technical	Societal	Economic	Geographic Average
a	Safety risk	1	2	3	4	3	2.352158045
b	Environment	0.5	1	2	3	3	1.551845574
c	Technical	0.333333333	0.5	1	2	1	0.802741562
d	Societal	0.25	0.333333333	0.5	1	3	0.659753955
e	Economic	0.333333333	0.333333333	1	0.333333333	1	0.517281858
							5.883780994

APPENDIX G – QUALITATIVE SCORING GUIDE TABLES

Scoring Range

The reference scale agreed at the Methodology Workshop was 0 to 10, where 10 is worse than 0. It is highlighted that preference scales should be linear (so, for example, on a scale of 0 to 10 the improvement from 5 to 0 is 5 times as good as the improvement from 1 to 0.

Quantitative data was available to inform some of the sub-criterion evaluation, however, it was agreed that all scores would be allocated on a qualitative basis.

For qualitative criteria, defining a set of fixed scales for each CA was used, i.e. options have been scored and will generally lie somewhere between these two points:

Safety and Environmental scoring was informed by the fact sheets and outputs prepared from the HIRA and ENVID

Guide tables proposing a scale to be adopted for the other criterion were prepared and agreed to support the assessment as described below.

Scoring Guide Tables

Safety

Scores were allocated at the HIRA for each of the decommissioning options and for each safety sub-criterion. The scores allocated were based on a Repsol Sinopec Resources UK standard RAM, these scores were used during the CA workshop to rank the decommissioning options from a safety perspective.

Therefore, no Guide Tables were necessary to support the assessment for safety criterion.

The HIRA process is described, and the HIRA output summary sheet is provided, in Appendix H.

Environmental

Scores were allocated at the ENVID carried out 13th July 2017, for each of the decommissioning options and for each environmental sub-criterion. The resultant ENVID scoring and fact sheets were used at the CA workshop to inform the assessment.

Therefore, no Guide Tables are provided for the environmental criterion

The ENVID process is described, and the ENVID output factsheets are provided in, Appendix I.

Technical

Guide Table 15 and Table 16 were adopted at the CA Evaluation Workshop, to inform the participants and to ensure a consistent understanding and method of allocating scores.

Table 15 Scoring the sub-criterion "Risk of major project failure"

Basis of Score		
Score	**Potential for schedule overrun**	**Ease of recovery from excursion**
0	No problems anticipated High level of confidence that schedule slippage can be accommodated within contingency and float in the plan	Assets and equipment are available offshore, in the field, to facilitate recovery and stabilise the situation after an incident Speed of recovery is anticipated to be swift with a limited impact on schedule No greater perceived risk to marine assets, or to personnel than during the routine operation
2.5	Potential for minor problems only Delay to completion of project by up to 15% of overall schedule	Assets and equipment are immediately available from offshore to facilitate recovery and stabilise the situation after an incident Speed of recovery is anticipated to be swift once the required assets and equipment arrives Limited impact on planned campaign schedule is anticipated, as remaining planned activities can continue in the interim No greater perceived risk to marine assets, or to personnel than during the routine operation
5	Potential for Significant Problems Delay to completion of project by over 15% but less than 30% of overall schedule	Assets and equipment are available in a reasonable timeframe from onshore to stabilise the situation after an incident Speed of recovery is anticipated to be longer than above due to some re-engineering pf activities being required Considerable impact on the planned campaign schedule is anticipated, as remaining planned activities cannot continue in the interim No greater perceived risk to marine assets, or to personnel than during the routine operations
7.5	Potential for Major Problems Delay to completion of project by over 30% but less than 60% of overall schedule	Re-engineering required to develop procedures and identify assets and equipment to stabilise the situation after an incident Speed of recovery is anticipated to be slow due to re-engineering and procurement of new equipment Significant impact on the planned campaign schedule as remaining planned activities cannot continue Risk to marine assets and/or personnel
10	Potential for Catastrophic Problems: High risk that the construction and development of marine assets and supporting equipment will not be completed successfully. Project re-definition required	Major re-engineering required developing procedures and identifying assets and equipment to stabilise the situation after an incident Speed of recovery is anticipated to be very slow or not possible Significant impact on the entire project schedule and company reputation Significant risk to marine assets and/or to personnel

Table 16 Scoring the sub-criterion "Technology demand / track record"

Basis of Score		
Score	**Technology demands**	**Availability / track record**
0	Vessels and supporting equipment are industry-standard with good track record of successful operation as proposed No vessel development required No equipment development required	Vessels and equipment availability is good across a large group of suppliers and has been used successfully on multiple directly comparable assets in the past The supply chain has the expertise and assets to handle the completion of the project and are generally readily available in the present market
2.5	Vessels are industry standard with a good track record of successful operation as proposed Methods proposed require using existing supporting equipment differently which may require some minor development; however, it is anticipated that this can be completed successfully ahead of the project schedule	Vessels and equipment are available but limited and to only a few suppliers who have successfully implemented on directly comparable assets in the past A reduced supply chain has the expertise and assets to handle the completion of the project and are generally readily available in the present market The wider supply chain does not have the track record but may have assets to handle the completion of the project if given the opportunity to develop.
5	Vessels are industry standard but will be used in different mode for operation proposed. Some trials may be required Methods proposed require use of existing supporting equipment differently which will require development; however, it is anticipated that this can be completed successfully ahead of the project schedule	Vessels and equipment are available but limited and to a single supplier who have successfully implemented on multiple directly comparable assets in the past The wider supply chain does not have the track record but may have assets to handle the completion of the project if given the opportunity to develop
7.5	New vessels and or equipment proposed Design approved and major construction contracts awarded There is certainty within the industry that this will be available ahead of the project schedule	Vessels and equipment are available but limited and to a few supplies, but have not been used in directly comparable assets in the past The supply chain does not have the track record but may have assets to handle the completion of the project if given the opportunity to develop
10	Vessels and or supporting equipment not available for operation as proposed Development is underway but is uncertainty within the industry that this will be completed successfully ahead of the project schedule	Vessels and equipment are available but limited and to a single supplier but have not been used in directly comparable assets in the past The wider supply chain does not have the type of vessel or equipment proposed

Societal

It was agreed at the Evaluation Workshop on 19th and 20th July that Table 17, Table 18 and Table 19 would be utilised to inform the participants and to ensure a consistent understanding and method of allocating scores.

Table 17 Scoring the sub-criterion "commercial impact on fisheries and tourism"

Basis of Score		
Score	**Impact During Operation**	**Long Term Impact**
0	No impact or short-term disruption may occur, but similar to existing disruptions caused from time to time by oilfield activities	No impact
2.5	Exclusion zones to approx. 25% of worksites to be imposed for <25% duration of operations	Option results in additional areas of ground or water column becoming inaccessible to fishing (either tangibly or *de facto*) to extent that up to 1% additional area is lost to fishing
5	Exclusion zones to approx. 50% of worksites to be imposed for <50% duration of operations	Option results in additional areas of ground or water column becoming inaccessible to fishing (either tangibly or *de facto*) to extent that up to 5% additional area is lost to fishing
7.5	Exclusion zones to approx. 75% of worksites to be imposed for <75% duration of operations	Option results in additional areas of ground or water column becoming inaccessible to fishing (either tangibly or *de facto*) to extent that up to 7.5% additional area is lost to fishing
10	Exclusion zones to all worksites to be imposed for entire duration of operations	Option results in additional areas of ground or water column becoming permanently inaccessible to fishing and tourism (either tangibly or *de facto*) to extent that more than 10% additional area is lost to fishing

Table 18 Guide for scoring the sub-criterion "socio-economic impact – communities/ amenities" – negative impact

Basis of Score	
Score	**Potential Socio-Economic negative impact**
0	No change or impact on communities or amenities
2.5	Short-term (< 6 months) impact on local communities causing nuisance for some aspects of the operations, but would cease and revert to previous condition on completion of specific short term operations. Short-term (< 6 months) impact on local amenities for some or all of the operations, but would cease and revert to previous condition on completion of operations, without the need for mitigation
5	Some impact on local communities, leading to some actual deterioration in quality of life. Deterioration would exist while actual operations were being carried out, but would essentially cease as soon as operations were completed, and quickly revert to pre-operation condition Some impact on local amenities, leading to some actual deterioration in amenities. Deterioration would exist while actual operations were being carried out. Some mitigation / remedial work would be required when operations were completed to restore amenities to pre-operational condition
7.5	Significant and long-term (> 1 year) impact on local communities, leading to noticeable deterioration in quality of life during the operations. However, this would persist for short term (< 1 year) after actual operations had ceased Significant and long-term (> 1 year) impact on local amenities, leading to noticeable deterioration during the operations. Mitigation / remedial work, taking less than 1 year, would be required when operations were completed to restore amenities to pre-operational condition
10	Significant and long-term (> 1 year) impact on communities, leading to noticeable deterioration in quality of life. This would persist for more than 1 year after actual operations had ceased Significant and long-term (> 1 year) impact on local amenities, leading to noticeable deterioration during the operations. Extensive mitigation / work, taking more than 1 year, would be required when operations were completed to restore amenities to something resembling pre-operational condition, although full restoration would be unlikely

Table 19 Guide for scoring the sub-criterion "socio-economic impact – communities/ amenities" – positive impact

Basis of Score	
Score	**Potential Socio-Economic positive impact**
0	Maximum amount of materials returned to shore for dismantling and recycle, which generates increased employment for existing business, albeit short term
5	Some materials returned to shore for dismantling and recycle, may will result in additional work for existing business, albeit short term. No new employment
10	No positive impact on businesses, communities or amenities

Economic

Cost Comparison:
Actual values are confidential are not reported in the CA Report, but have been reported to BEIS separately.

To identify the cost variance of each option is reported as a function of the lowest to highest cost option in % terms (100% lowest others 110%,120% etc.) and, to put the variance of cost into context, it is also reported in relation to the current Asset Retirement Obligation estimate held by Repsol Sinopec Resources UK for the Beatrice subsea facilities decommissioning. This figure was reported [x%] in the workbook and is the percentage of the option cost in relation to the ARO overall estimate.

Cost Risk / Uncertainty:
Guide Table 20 was adopted at the CA Evaluation Workshop, to inform the participants and to ensure a consistent understanding and method of allocating scores.

Table 20 Guide for scoring the sub-criterion "Cost Risk / Uncertainty"

Basis of Score	
Score	**Cost Risk / Uncertainty**
0	Scope well defined and understood Contractors and suppliers budget quotations available to support the estimates Level 3 (or better) bottom-up estimate developed
2.5	Scope well defined and understood Level 3 (or better) estimate developed using recognised and validated estimating tools Validated cost basis using current industry norms for all elements of scope No contractors and suppliers budget quotations have been sought
5	Some uncertainty in minor parts of the scope and equipment used, no major uncertainties Level 2 estimate developed using recognised and validated estimating tools and current norms Validated cost basis using industry norms, some minor information gaps in norms No removals contractors and suppliers budget quotations have been sought
7.5	Some uncertainty in some parts of the scope and equipment used Level 1 estimate developed using validated estimating tools and current norms Validated cost basis using industry norms, some significant information gaps in norms due to costs of new / emerging equipment rates not being available No removals contractors and suppliers budget quotations have been sought
10	Uncertainty in many areas of the scope and in equipment used Order of Magnitude (OOM) estimate only developed

APPENDIX H - HIRA PROCESS AND RESULTS

The approach adopted at the HIRA was to review the nodes and generate a list of hazards.

HIRA Nodes

The Nodes agreed prior to the HIRA are identified in Table 21

Table 21 HIRA Nodes

Node	Description	Details
1	Subsea Pipelines and Power Cables	1. Remove all by: a) reverse reeling, b) reverse s-lay and c) cut and lift.
		2. Remediate in-situ by: a) rock cover exposed sections, b) trench and backfill exposed sections and c) cut-and -lift exposed sections
		3. Leave in-situ/ Do Nothing
2	Flexible Mattresses and Grout Filled Mattresses	1. Leave in-situ.
		2. Remove for onshore disposal.

Note: It is assumed that all prefabricated flexible concrete mattresses will be removed except those unremoveable due to their condition.

Hazards and Guidewords

A set of Hazards and Guidewords were adopted for each node to impose some structure to the HIRA, these are set out in Table 22 and are clarified further in the HIRA Report [10].

Table 22 Hazards and Guidewords

Hazards	Guidewords
Release	Gas Liquid Condensate Venting/flaring Other
Fire	Fuel Electrical Ignition Relief Smoke & Gas Ingress
Explosion	Fuel Confinement / Congestion

Hazards	Guidewords
Impact	Lifting Maintenance Mechanical failure Rotating Machinery
Structural Failure	Primary structures Temporary structures
Environment	Volatiles Liquids Solids Waste Types
Chemicals	Types Handling Protection & Storage
Transport	Road Shipping Submarines Fishing Vessels Other
Material Problems	Corrosivity Other
Climatic	Earthquake Extreme Weather
Occupational	Helicopter Diving Operations Hot/Cold Surfaces/Fluids Working at Height Noise Other
Escape, Evacuation and Rescue	Escape Routes Escape Systems Evacuation Systems Rescue Systems and Procedures Life Saving Appliances Other
Simultaneous Operations	Construction Strategy Tie-ins (Shutdown Requirements) Concurrent Operations (Drilling, Well Work-overs) Noise / Vibration Hot Work Lifting/Dropped Objects Interface – Shutdown / Blowdown / Emergency Shutdown Construction Workforce – Transport and Accommodation

Risk Assessment Matrix (RAM)

To enable the HIRA to provide scores that could be presented at the CA Evaluation Workshop, the existing Repsol Sinopec Resources UK, Risk Assessment Matrix (RAM) was adopted and modified to enable scores to be applied to each decommissioning option against each guide word. The RAM used at the HIRA is provided in Table 22 .

Figure 17 Risk Assessment Matrix (RAM)

CONSEQUENCE				SEVERITY	LIKELIHOOD				
People / Safety	Environment	Asset / Business / Production Change (annualised)	Reputation		Very Unlikely A freak combination of factors would be required for an incident to result 1	Unlikely A rare combination of factors would be required for an incident to result 2	Possible Could happen when additional, unusual factors are present but otherwise unlikely to occur 3	Likely Not certain to happen under normal conditions but could happen if a predictable additional factor was present 4	Very Likely Almost inevitable that an incident would result. 5
P	E	A	R		A	B	C	D	E
Two or more fatalities	Critical Release: Release from a catastrophic pipeline failure or free flowing hydrocarbons from the reservoir (either from a well or uncontrollable release from the topsides). Released mass ≥30 tonnes.	Extensive damage - Multiple system damage. Business value change >£10m >100k boe.	Serious international reputation impact. Revocation of Permit or corporate prosecution.	5	Medium / Alert	Medium	High	High	High / Alarm 25
Single Fatality or Total Permanent Disability	Major Release: ≥20 and <30 tonnes hydrocarbon or non-PLONOR chemical.	Major damage - system shutdown. Business value change <£10M >10k boe.	Major national reputation impact. Prohibition notice.	4	Low / Caution	Medium	Medium	High 16	High
Major Injury *Includes injuries requiring >7 consecutive days off work as per RIDDOR definition*	Serious Release: ≥1 and <20 tonnes hydrocarbon or non-PLONOR chemical.	Moderate damage - system requires some isolation. Business value change <£1M >1k boe.	Local reputation impact. Improvement notice or enforcement notice.	3	Low	Low	Medium 9	Medium	High
Moderate Injury *Includes injuries requiring 3 or more consecutive days off work and recordable under RIDDOR.*	Minor Release: <1 tonne hydrocarbon or non-PLONOR chemical. >10 tonnes of a PLONOR chemical.	Minor damage - system requires partial isolation. Business value change <£500k >100 boe.	Internal reputation impact. Informal notification of opportunities for improvement or letter.	2	Very Low / Care	Low 4	Low	Medium	Medium
Minor Injury *Injuries requiring <3 days off work, or no time off. Not recordable or reportable under RIDDOR.*	Negligible Release: Release of 10 tonnes or less of a PLONOR chemical. None or minimal clean-up required. *PLONOR: Considered to pose little or no risk to the environment*	Slight damage - system still safe to operate. Business value change <£100K <100 boe.	Scrutiny from Internal Auditor - ICP Action	1	Very Low 1	Very Low	Low	Low	Medium
No Injury	No release or environmental impact	No damage / cost	No impact	0	Very Low				

HIRA Output Summary

The HIRA process utilised pre-prepared HIRA worksheets to undertake an assessment for each decommissioning method and for each Safety sub-criteria in turn i.e. Separate worksheets were assessed for

- Project Risk to Personnel Offshore
- Project Risk to Other Users of the Seas (during Project Operations)
- Project Risk to Personnel Onshore
- Residual Risk to Other Users of the Sea

Detailed HIRA worksheets were populated for each Safety sub-criteria and are included in the HIRA Report [10]. The scores from these worksheets were summarised and summated for each Decommissioning Option and for each Safety Sub-Criteria.

Note: Since a five by five RAM was adopted to derive the scores, such that severity and likelihood could each be scored 1 to 5. This caused the scoring range to be between 1 to 25 when severity and likelihood were combined. These scores therefore were subsequently translated from 1 to 25 to 0 to 10 to match with the agreed CA score range of 0 to 10.

Examples of this translation method are provided below:

a. A score of 4 on the severity scale and 4 on the likelihood scale would be calculated as a score of 16 (or 65% of the maximum possible score of 25). This would be translated to a score of 6.5 on the 0 to 10 range

b. A score of 2 on the severity scale and 4 on the likelihood scale would be calculated as a score of 8 (or 35% of the maximum possible score of 25). This would be translated to a score of 3.5 on the 0 to 10 range

c. A score of 5 on the severity scale and 5 on the likelihood scale would be calculated as a score of 25 (or 100% of the maximum possible score of 25). This would be translated to a score of 10 on the 0 to 10 range

d. Where the risk assessment identified a likely (4) fatality (5) i.e. 20 or above on the RAM this was allocated as score of 10 on the 0 to 10 range.

Figure 18 and Figure 19 are copies of the summary table/ fact sheets presented and used at the CA Evaluation workshop. More detailed worksheets are provided in the HIRA Report [10].

Figure 18 Node 1: Pipelines and Power Cables

OPTION	HAZARD (GUIDEWORD)	Project Risk (Offshore Personnel)			Project Risk (Other Sea Users)			Project Risk (Onshore Personnel)			Residual Risk (Other Sea Users)		
		Option A	Option B	Option C	Option A	Option B	Option C	Option A	Option B	Option C	Option A	Option B	Option C
OPTION 1 - TOTAL REMOVAL BY: a) Reverse Reeling; b) Reverse S-Lay; c) Cut-and Lift	Release, GW - Other (wax, NORM)	2	4	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Fire, GW - Fuel	3	3	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Fire, GW - Electrical	3	3	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Fire, GW - Ignition	3	3	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Impact, GW - Lifting	6	12	12	N/A	N/A	N/A	12	12	12	N/A	N/A	N/A
	Impact, GW - Mechanical Failure	5	4	0	N/A	N/A	N/A	9	9	9	N/A	N/A	N/A
	Impact, GW - 3rd Party Vessel (snaggings)	N/A	N/A	N/A	5	5	5	N/A	N/A	N/A	5	5	5
	Transport, GW - Road	N/A	N/A	N/A	N/A	N/A	N/A	15	15	15	N/A	N/A	N/A
	Transport, GW - Shipping	N/A	N/A	N/A	N/A	N/A	N/A	4	4	4	N/A	N/A	N/A
	Occupational, GW - Helicopter	0	15	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Occupational, GW - Diving Ops	0	0	8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Occupational, GW - Hot/Cold Surfaces	N/A	N/A	N/A	N/A	N/A	N/A	6	6	6	N/A	N/A	N/A
	Occupational, GW - Noise	N/A	N/A	N/A	N/A	N/A	N/A	3	3	3	N/A	N/A	N/A
	Occupational, GW - Other e.g. Congestion	6	9	9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Occupational, GW - Other e.g. Security	N/A	N/A	N/A	N/A	N/A	N/A	9	9	9	N/A	N/A	N/A
	Occupational, GW - Exposure time	6	9	12	N/A	N/A	N/A	9	9	9	N/A	N/A	N/A
	Occupational,Chemicals /Waste - Quantity	N/A	N/A	N/A	N/A	N/A	N/A	6	6	6	N/A	N/A	N/A
	SIMOPs, GW - Lifting / DO (Lifting vessel to transport vessel)	6	12	12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	SIMOPs, GW - Lifting / DO (transport vessel to quay)	6	12	12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	SIMOPs, GW - lifting / DO / cutting, cleaning, etc.	N/A	N/A	N/A	N/A	N/A	N/A	9	9	9	N/A	N/A	N/A
	SIMOPs, GW - vessel collision (projects)	0	9	9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	SIMOPs, GW - vessel collision (other user)	N/A	N/A	N/A	5	10	10	N/A	N/A	N/A	N/A	N/A	N/A
	Summation - Reverse Reeling (1a)	**46**			**10**			**82**			**5**		
	Summation - Reverse S-lay (1b)		**95**			**15**			**82**			**5**	
	Summation - Cut & Lift (1c)			**102**			**15**			**82**			**5**

OPTION	HAZARD (GUIDEWORD)	Project Risk (Offshore Personnel)			Project Risk (Other Sea Users)			Project Risk (Onshore Personnel)			Residual Risk (Other Sea Users)		
		Option A	Option B	Option C	Option A	Option B	Option C	Option A	Option B	Option C	Option A	Option B	Option C
OPTION 2: REMEDIATE IN-SITU (Trenched and Buried Sections Left In-Situ with exposed Sections) a) Rock-Covered; b) Trenched and Buried; c)Cut-and Removed	Release, GW - Other (wax, NORM)	0	0	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Fire, GW - Fuel	3	3	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Fire, GW - Electrical	3	3	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Fire, GW - Ignition	3	3	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Impact, GW - Lifting	0	0	8	N/A	N/A	N/A	0	0	8	N/A	N/A	N/A
	Impact, GW - Mechanical Failure	N/A	N/A	N/A	N/A	N/A	N/A	0	0	6	N/A	N/A	N/A
	Impact, GW - 3rd Party Vessel (snaggings)	N/A	N/A	N/A	10	5	5	N/A	N/A	N/A	10	5	5
	Transport, GW - Road	N/A	N/A	N/A	N/A	N/A	N/A	10	0	10	N/A	N/A	N/A
	Transport, GW - Shipping	N/A	N/A	N/A	N/A	N/A	N/A	4	0	0	N/A	N/A	N/A
	Occupational, GW - Diving Ops	0	0	8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Occupational, GW - Hot/Cold Surfaces	N/A	N/A	N/A	N/A	N/A	N/A	0	0	4	N/A	N/A	N/A
	Occupational, GW - Noise	N/A	N/A	N/A	N/A	N/A	N/A	0	0	2	N/A	N/A	N/A
	Occupational , GW - Other Congestion	0	6	9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	GW - Other e.g. Security	N/A	N/A	N/A	N/A	N/A	N/A	0	0	9	N/A	N/A	N/A
	Occupational , GW - Exposure	6	6	6	N/A	N/A	N/A	0	0	6	N/A	N/A	N/A
	Occupational,Chemicals, Waste - Quantity	N/A	N/A	N/A	N/A	N/A	N/A	0	0	4	N/A	N/A	N/A
	SIMOPs , GW - Lifting (rock loading)	1	0	8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	SIMOPs, GW - lifting / DO / cutting, cleaning, etc.	N/A	N/A	N/A	N/A	N/A	N/A	0	0	6	N/A	N/A	N/A
	SIMOPs, GW - vessel collision (other user)	N/A	N/A	N/A	5	10	10	N/A	N/A	N/A	N/A	N/A	N/A
	Summation - Rockdump exposed (2a)	**16**			**15**			**14**			**10**		
	Summation - Trench and backfill exposed (2b)		**21**			**15**			**0**			**5**	
	Summation - Cut out exposed (2c)			**52**			**15**			**55**			**5**

OPTION	HAZARD (GUIDEWORD)	Project Risk (Offshore Personnel)			Project Risk (Other Sea Users)			Project Risk (Onshore Personnel)			Residual Risk (Other Sea Users)		
		Option A	Option B	Option C	Option A	Option B	Option C	Option A	Option B	Option C	Option A	Option B	Option C
OPTION 3: LEAVE IN-SITU Do Nothing	Fire, GW - Electrical	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Fire, GW - Ignition	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Impact, GW - 3rd Party Vessel (snaggings)	N/A	N/A	N/A	25	N/A	N/A	N/A	N/A	N/A	25	N/A	N/A
	Occupational , GW - Exposure	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	SIMOPs, GW - vessel collision (other user)	N/A	N/A	N/A	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Summation - Leave in situ (3a)	**13**	**-**	**-**	**35**	**-**	**-**	**-**	**-**	**-**	**25**	**-**	**-**

Figure 19 Node 2: Mattresses

OPTION	HAZARD (GUIDEWORD)	Project Risk (Offshore Personnel)			Project Risk (Other Sea Users)			Project Risk (Onshore Personnel)			Residual Risk (Other Sea Users)		
		Option A	Option B	Option C	Option A	Option B	Option C	Option A	Option B	Option C	Option A	Option B	Option C
OPTION 1: LEAVE IN-SITU AND a) Do Nothing; b) Rock Cover; c) Relocate and Bury	Fire, GW - Fuel	3	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Fire, GW - Electrical	3	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Fire, GW - Ignition	3	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Impact, GW - Lifting	0	0	N/A	0	0	N/A	0	0	N/A	0	0	N/A
	Impact, GW - Mechanical Failure	N/A	N/A	N/A	N/A	N/A	N/A	0	0	N/A	N/A	N/A	N/A
	Impact, GW - 3rd party vessels (snagging)	0	0	N/A	10	5	N/A	N/A	N/A	N/A	10	N/A	N/A
	Transport, GW - Road	N/A	N/A	N/A	N/A	N/A	N/A	0	10	N/A	N/A	N/A	N/A
	Transport, GW - Shipping	N/A	N/A	N/A	N/A	N/A	N/A	0	4	4	N/A	N/A	N/A
	Occupational, GW - Diving Ops	0	0	N/A	0	0	N/A	N/A	N/A	N/A	0	0	N/A
	Occupational, GW - Hot/Cold Surfaces	N/A	N/A	N/A	N/A	N/A	N/A	0	0	4	N/A	N/A	N/A
	Occupational, GW - Noise	N/A	N/A	N/A	N/A	N/A	N/A	0	0	2	N/A	N/A	N/A
	Occupational, GW - Other e.g. Security	N/A	N/A	N/A	N/A	N/A	N/A	0	0	9	N/A	N/A	N/A
	Occupational, GW - Exposure Time	N/A	N/A	N/A	N/A	N/A	N/A	0	0	6	N/A	N/A	N/A
	SIMOPs, GW - lifting / DO / cutting,cleaning,etc.	N/A	N/A	N/A	N/A	N/A	N/A	0	0	6	N/A	N/A	N/A
	SIMOPs, GW - vessel collision (other user)	N/A	N/A	N/A	5	10	10	N/A	N/A	N/A	N/A	N/A	N/A
	Summation - Do nothing (1a)	**9**			**10**			**0**			**10**		
	Summation - Rock cover (1b)		**9**			**15**			**14**			**0**	
	Summation - Relocate & Bury (1c)												

OPTION	HAZARD (GUIDEWORD)	Project Risk (Offshore Personnel)			Project Risk (Other Sea Users)			Project Risk (Onshore Personnel)			Residual Risk (Other Sea Users)		
		Option A	Option B	Option C	Option A	Option B	Option C	Option A	Option B	Option C	Option A	Option B	Option C
OPTION 2: RECOVER BY: a) Debris Basket; b) Use Grab Excavator to Recover to Surface	Fire, GW - Fuel	3	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3	3	N/A
	Fire, GW - Electrical	3	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3	3	N/A
	Fire, GW - Ignition	3	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3	3	N/A
	Impact, GW - Lifting	8	8	N/A	N/A	N/A	N/A	8	8	N/A	8	8	N/A
	Impact, GW - 3rd party vessels (snagging)	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Structural Failure, GW - Temp Strucs	4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4	0	N/A
	Transport, GW - Road	N/A	N/A	N/A	N/A	N/A	N/A	10	10	N/A	N/A	N/A	N/A
	Transport, GW - Shipping	N/A	N/A	N/A	N/A	N/A	N/A	4	4	N/A	N/A	N/A	N/A
	Occupational, GW - Diving Ops	8	8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8	8	N/A
	Occupational, GW - Hot/Cold Surfaces	N/A	N/A	N/A	N/A	N/A	N/A	4	4	N/A	N/A	N/A	N/A
	Occupational, GW - Noise	N/A	N/A	N/A	N/A	N/A	N/A	2	2	N/A	N/A	N/A	N/A
	Occupational, GW - Other Congestion	6	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6	6	N/A
	Occupational, GW - Other e.g. Security	N/A	N/A	N/A	N/A	N/A	N/A	9	9	N/A	N/A	N/A	N/A
	Occupational, GW - Exposure Time	N/A	N/A	N/A	N/A	N/A	N/A	6	6	N/A	N/A	N/A	N/A
	SIMOPs, GW - lifting / DO / cutting, cleaning, etc.	N/A	N/A	N/A	N/A	N/A	N/A	6	6	N/A	N/A	N/A	N/A
	SIMOPs, GW - vessel collision (other user)	N/A	N/A	N/A	10	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Summation - Debris Basket (2a)	**35**			**10**			**49**			**35**		
	Summation - Grab Excavator (2b)		**31**			**10**			**49**			**31**	

APPENDIX I - ENVID PROCESS AND RESULTS

The ENVID participants reviewed the environmental and socio-economic impact significance for each decommissioning option for the following criteria and sub-criteria:

Criteria	Sub-Criteria
Environment	Marine impact of operations
	Energy, emissions, and resource consumption
	Impact on marine end points (legacy impact)
Societal	Commercial impact on fisheries and tourism
	Socio-economic impact on communities and amenities

It was necessary to determine the significance of the environmental/social impact of planned activities on each of the susceptible receptors.

The significance of the impacts was derived by considering the 'Receptor Sensitivity' in relation to the 'Magnitude of Effect' of the aspect.

Four categories of Receptor Sensitivity have been applied ranging from 'Low' to 'Very High' as guided by the Sensor Sensitivity table published as part of the EIA Report [3]. Definitions for the Magnitude of Effect on the receptors is also explained the EIA Report [3].

Prior to determining the Magnitude of Effect, industry recognised 'base case' mitigation measures are assumed to be applied e.g. it is assumed that contracted vessels are MARPOL 73/78 compliant.

The Receptor Sensitivity and Magnitude of Effect Tables provided in the EIA Report [3] were utilised to guide the ENVID participants in their evaluation of each decommissioning option.

The 'Receptor Sensitivity' and the 'Magnitude of Effect' were combined using the matrix presented below to determine the level of impact for planned activities.

		Receptor Sensitivity			
		(a) Low	(b) Medium	(c) High	(d) Very high
Magnitude of Effect	(0) Positive/No effect				
	(1) Negligible				
	(2) Minor				
	(3) Serious				
	(4) Major				
	(5) Critical				

(i) Positive / No effect significance	• Positive or no environmental or social impact. • No public interest or positive public support.
(ii) Low significance	• No/negligible environmental and social impact. • No concerns from consultees.
(iii) Moderate significance	• Discernible environmental and social impacts. • Requirement to identify project specific mitigation measures. • Concerns by consultees which can be adequately addressed by the Company.
(iv) High significance	• Substantial environmental and social impacts. • Serious concerns by consultees requiring Corporate support. • Alternative approaches should be identified.

The detailed results from the ENVID are provided in the ENVID Report [11], however the fact sheet which summarises these results and which was used to inform the CA Evaluation workshop is provided in Figure 20.

Although the fact sheet has allocated numerical scores, it was agreed at the CA Evaluation Workshop to report the difference between the impact significance as:

- Positive/ No Effect;
- Low;
- Moderate;
- High.

And in line with the tables above. Scores were then allocated at the CA Evaluation Workshop based on this categorisation.

Figure 20 ENVID Fact Sheet to support CA allocation of scores

Group ID	Basis of Score	Decommissioning Option						
		1. Total Removal			2. Remediate in-situ			3. Leave in-situ
		a. By Reverse Reeling	b. By Reverse S-Lay	c. By Cut-and-Lift	a. Exposed Sections Rock-Covered	b. Exposed Sections Trenched and Buried	c. Exposed Sections Cut and Removed	Do Nothing
A Offshore PL16 PL111 PL112 (total length c. 47 km of concrete coated lines) Total length of exposures 417 m of which 312 associated with PL16.	**Potential impact of accidental events (QL)**	NOT TECHNICALLY FEASIBLE		SCREENED OUT	Impact significance of an accidental event is same for all options and therefore should be ranked the same. As highest receptor sensitivity is very high (some Ramsar sites could be impacted) and magnitude of effect is ranked as critical, the impact significance in all cases is High. (Note the risk is medium given that the likelihood is considered remote). For CA give it all a ranking of 10 based on impact significance.			
	Disturbance to the seabed (QI)		Receptor sensitivity 'medium ', magnitude of effect is serious, - moderate significance 6		Receptor sensitivity 'medium', magnitude of effect minor, - low significance. 3	Receptor sensitivity 'medium', magnitude of effect minor, - low significance 3	Receptor sensitivity 'medium', magnitude of effect minor, - low significance) 3	0 (No Effect)
	Impact of underwater noise on marine mammals (QI)				Based on ENVID, the impact significance of noise from vessels was considered to be moderate given that the receptor sensitivity is high and magnitude of impact is considered to be minor. Rank all the same at 6 (moderate).			
	Energy use and Emissions (vessels and end points) (QI)		9,092 te CO2 (100%) 101,317 TJ (100%)		12,823 te CO2 (141%) 175,685 TJ (173%)	13,412 te CO2 (147%) 183,609 TJ (181%)	13,260 te CO2 (146%) 181,335 TJ (179%)	12,722 te CO2 (140%) 174,314 TJ (172%)
	Generation of waste/use of landfill (QI)				In ENVID impact of significance of waste was considered to be low (sensitivity is medium and magnitude of effect is minor). Hazardous waste also considered the low (assumes wax is used as energy source). As most is recycled - could consider all to be 3. For 'Do Nothing' option, the impact of waste is considered to be of 'No Effect'.			
	Impact of physical presence of materials left on the seabed (QI) *only on benthic species- not fishing.*		0 (No Effect)		(3) Low	0 (No Effect)	0 (No Effect)	0 (No Effect)
	Impact of long term degradation (QI) *wax at exposed sections and its impact*		0 (No Effect)		Magnitude scored as negligible and therefore impact significance is low (3)	(3) Low	(3) Low	(Receptor sensitivity is medium, magnitude of effect is considered minor - impact significance is low (3)

Group ID	Basis of Score	Decommissioning Option						
		1. Total Removal			2. Remediate in-situ			3. Leave in-situ
		a. By Reverse Reeling	b. By Reverse S-Lay	c. By Cut-and-Lift	a. Exposed Sections Rock-Covered	b. Exposed Sections Trenched and Buried	c. Exposed Sections Cut and Removed	Do Nothing
B Offshore PL16 PL1838 (KP25-KP66.96) PL112A (1.5 km) (total length c. 43.46 km of rigid lines) Total length of exposures 38m	**Potential impact of accidental events (QL)**			SCREENED OUT	Impact significance of an accidental event is same for all options and therefore should be ranked the same. As highest receptor sensitivity is very high (some Ramsar sites could be impacted) and magnitude of effect is ranked as critical, the impact significance in all cases is High. (Note the risk is medium given that the likelihood is considered remote). For CA give it all a ranking of 10 based on impact significance.			
	Disturbance to the seabed (QI)	Receptor sensitivity 'medium ', magnitude of effect is serious, - moderate significance 6	Receptor sensitivity 'medium ', magnitude of effect is serious, - moderate significance 6		Receptor sensitivity 'medium', magnitude of effect minor, - low significance. 3	Receptor sensitivity 'medium', magnitude of effect minor, - low significance. 3	Receptor sensitivity 'medium', magnitude of effect minor, - low significance. 3	0 (No Effect)
	Impact of underwater noise on marine mammals (QI)				Based on ENVID, the impact significance of noise from vessels was considered to be moderate given that the receptor sensitivity is high and magnitude of impact is considered to be minor. Rank all the same at 6 (moderate).			
	Energy use and Emissions (vessels and end points) (QI)	6,034 te CO2 (100%) 63,167 TJ (100%)	7393 te CO2 (123%) 81,469 TJ (129%)		10,817 te CO2 (180%) 151,048 TJ (239%)	10,905 te CO2 (180%) 152,236 TJ (241%)	10,875 te CO2 (180%) 151,745 TJ (240%)	10,754 te CO2 (178%) 150,198 TJ (238%)
	Generation of waste/use of landfill (QI)				In ENVID impact of significance of waste was considered to be low (sensitivity is medium and magnitude of effect is minor). Hazardous waste also considered the low (assumes wax is used as energy source). As most is recycled - could consider all to be 3 (low). For 'Do Nothing' option, the impact of waste is considered to be of 'No Effect'.			
	Impact of physical presence of materials left on the seabed (QI) *only on benthic species- not fishing.*	0 (No Effect)	0 (No Effect)		3 (Low)	0 (No Effect)	0 (No Effect)	0 (No Effect)
	Impact of long term degradation (QI) *wax at exposed sections and its impact*	0 (No Effect)	0 (No Effect)		(Magnitude scored as negligible and therefore impact significance is low) 3	3 (Low)	3 (Low)	(Receptor sensitivity is medium, magnitude of effect is considered minor - impact significance is low (3)

Group ID	Basis of Score	Decommissioning Option						
		1. Total Removal			2. Remediate in-situ			3. Leave in-situ
		a. By Reverse Reeling	b. By Reverse S-Lay	c. By Cut-and-Lift	a. Exposed Sections Rock-Covered	b. Exposed Sections Trenched and Buried	c. Exposed Sections Cut and Removed	Do Nothing
C PL252 4.5 km flexible pipeline trenched and buried 77 m of exposures	**Potential impact of accidental events (QL)**			SCREENED OUT	Impact significance of an accidental event is same for all options and therefore should be ranked the same. As highest receptor sensitivity is very high (some Ramsar sites could be impacted) and magnitude of effect is ranked as critical, the impact significance in all cases is High. (Note the risk is medium given that the likelihood is considered remote). For CA give it all a ranking of 10 based on impact significance.			
	Disturbance to the seabed (QI)	Receptor sensitivity 'medium ', magnitude of effect is minor, - low significance 3	Receptor sensitivity 'medium ', magnitude of effect is minor, - low significance 3		Receptor sensitivity 'medium', magnitude of effect minor, - low significance. 3	Receptor sensitivity 'medium', magnitude of effect minor, - low significance. 3	Receptor sensitivity 'medium', magnitude of effect minor, - low significance. 3	0 (No Effect)
	Impact of underwater noise on marine mammals (QI)				Based on ENVID, the impact significance of noise from vessels was considered to be moderate given that the receptor sensitivity is high and magnitude of impact is considered to be minor. Rank all the same at 6 (moderate).			
	Energy use and Emissions (vessels and end points) (QI)	767 te CO2 (100%) 8,734 TJ (%)	808 te CO2 (105%) 9,287 TJ (106 %)		1,155 te CO2 (151%) 15,399 TJ (176%)	1,386 te CO2 (181%) 18,512 TJ (211%)	1,324 te CO2 (173%) 17,587 TJ (201%)	1,081 te CO2 (141%) 14,400 TJ (165%)
	Generation of waste/use of landfill (QI)				In ENVID impact of significance of waste was considered to be low (sensitivity is medium and magnitude of effect is minor). Hazardous waste also considered the low (assumes wax is used as energy source). As most is recycled - could consider all to be 3. For 'Do Nothing' option, the impact of waste is considered to be of 'No Effect'.			
	Impact of physical presence of materials left on the seabed (QI) *only on benthic species- not fishing.*	0 (No Effect)	0 (No Effect)		3	0 (No Effect)	0 (No Effect)	0 (No Effect)
	Impact of long term degradation (QI) *wax at exposed sections and its impact*	0 (No Effect)	0 (No Effect)		(Magnitude scored as negligible and therefore impact significance is low) 3	3 (Low)	3 (Low)	(Receptor sensitivity is medium, magnitude of effect is considered minor - impact significance is low (3)

Group ID	Basis of Score	Decommissioning Option						
		1. Total Removal			2. Remediate in-situ			3. Leave in-situ
		a. By Reverse Reeling	b. By Reverse S-Lay	c. By Cut-and-Lift	a. Exposed Sections Rock-Covered	b. Exposed Sections Trenched and Buried	c. Exposed Sections Cut and Removed	Do Nothing
D Near shore PL1838 (concrete): KP2.66 to KP25 PL16: KPX - KP25 Total length of lines c 47 km Total length of exposures **0.73 m on PL1838. None on PL16 on nearshore section.**	**Potential impact of accidental events (QL)**	NOT TECHNICALLY FEASIBLE		SCREENED OUT	Impact significance of an accidental event is same for all options and therefore should be ranked the same. As highest receptor sensitivity is very high (some Ramsar sites could be impacted) and magnitude of effect is ranked as critical, the impact significance in all cases is High. (Note the risk is medium given that the likelihood is considered remote). For CA give it all a ranking of 10 based on impact significance.			
	Disturbance to the seabed (QI/Qn)		Receptor sensitivity 'high', magnitude of effect is serious, - moderate significance 6		Receptor sensitivity 'high', magnitude of effect negligible, - low significance, however still less than full recovery options 3	Receptor sensitivity 'high', magnitude of effect negligible, - low significance, however still less than full recovery options 3	Receptor sensitivity 'high', magnitude of effect negligible, - low significance, however still less than full recovery options 3	0 (No Effect)
	Impact of underwater noise on marine mammals (QI)				Based on ENVID, the impact significance of noise from vessels was considered to be moderate given that the receptor sensitivity is high and magnitude of impact is considered to be minor. Rank all the same at 6 (moderate).			
	Energy use and Emissions (vessels and end points) (QI)		9,316 te CO2 (100%) 102,546 TJ (%)		13,491 te CO2 (145%) 179,149 TJ (174%)	13,692 te CO2 (147%) 189,317 TJ (185%)	13,663 te CO2 (147%) 188,832 TJ (184%)	13,541 te CO2 (145%) 187,279 TJ (183%)
	Generation of waste/use of landfill (QI)				In ENVID impact of significance of waste was considered to be low (sensitivity is medium and magnitude of effect is minor). Hazardous waste also considered the low (assumes wax is used as energy source). As most is recycled - could consider all to be 3. For 'Do Nothing' option, the impact of waste is considered to be of 'No Effect'.			
	Impact of physical presence of materials left on the seabed (QI) *only on benthic species- not fishing.*		Low (takes into account nearshore and near sand banks)		Moderate (takes into account nearshore and near sand banks andfact that would be adding rock cover)	Low (takes into account nearshore and near sand banks)	Low (takes into account nearshore and near sand banks)	0 (No Effect)
	Impact of long term degradation (QI) *wax at exposed sections and its impact*		0 (No Effect)		Magnitude scored as negligible and therefore impact significance is low 3	Magnitude scored as negligible and therefore impact significance is low 3	Magnitude scored as negligible and therefore impact significance is low 3	(Receptor sensitivity is medium, magnitude of effect is considered minor - impact significance is low (3)

Group ID	Basis of Score	Decommissioning Option						
		1. Total Removal			2. Remediate in-situ			3. Leave in-situ
		a. By Reverse Reeling	b. By Reverse S-Lay	c. By Cut-and-Lift	a. Exposed Sections Rock-Covered	b. Exposed Sections Trenched and Buried	c. Exposed Sections Cut and Removed	Do Nothing
E Offshore power cables. Total length 32.37 km Total exposures 74 m	**Potential impact of accidental events (QL)**			SCREENED OUT	Impact significance of an accidental event is same for all options and therefore should be ranked the same. As highest receptor sensitivity is very high (some Ramsar sites could be impacted) and magnitude of effect is ranked as critical, the impact significance in all cases is High. (Note the risk is medium given that the likelihood is considered remote). For CA give it all a ranking of 10 based on impact significance.			
	Disturbance to the seabed (Ql/Qn)	Receptor sensitivity 'medium ', magnitude of effect is minor, - low significance 3	Receptor sensitivity 'medium ', magnitude of effect is minor, - low significance 3		Receptor sensitivity 'medium', magnitude of effect minor, - low significance. 3	Receptor sensitivity 'medium', magnitude of effect minor, - low significance. 3	Receptor sensitivity 'medium', magnitude of effect minor, - low significance. 3	0 (No Effect)
	Impact of underwater noise on marine mammals (Ql)				Based on ENVID, the impact significance of noise from vessels was considered to be moderate given that the receptor sensitivity is high and magnitude of impact is considered to be minor. Rank all the same at 6 (moderate).			
	Energy use and Emissions (vessels and end points) (Ql)	1,652 te CO2 (100%) 22,843 TJ (100%)	2,168 te CO2 (131%) 29,786 TJ (131%)		3,119 te CO2 (189%) 42,172 TJ (185%)	3,207 te CO2 (194%) 43,360 TJ (190%)	3,190 te CO2 (193%) 43,128 TJ (189%)	3,056 te CO2 (185%) 41,322 TJ (181%)
	Generation of waste/use of landfill (Ql)				In ENVID impact of significance of waste was considered to be low (sensitivity is medium and magnitude of effect is minor). Hazardous waste also considered the low (assumes wax is used as energy source). As most is recycled - could consider all to be 3. For 'Do Nothing' option, the impact of waste is considered to be of 'No Effect'.			
	Impact of physical presence of materials left on the seabed (Ql) *only on benthic species- not fishing.*	0 (No Effect)	0 (No Effect)		3 (Low)	0 (No Effect)	0 (No Effect)	0 (No Effect)
	Impact of long term degradation (Ql) *power cables so no wax*	0 (No Effect)	0 (No Effect)		0 (No Effect)	0 (No Effect)	0 (No Effect)	0 (No Effect)

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