

Shell U.K. Limited



BRENT FIELD TOPSIDES DECOMMISSIONING PROGRAMME



Submitted to the UK Department for Business, Energy and Industrial Strategy

Shell Report Number BDE-F-TOP-AA-5880-00001

19th July 2018

Final

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1 EXECUTIVE SUMMARY

1.1 Introduction

After more than 40 years of production, the Brent Field is reaching the end of its economically-viable life. There are no viable alternative uses for any of the installations in future oil and gas production, whether from the Brent Field or from other adjacent hydrocarbon reserves. The installations in the Brent Field must, therefore, be decommissioned.

The decommissioning of the Brent Field, which comprises four platforms, twenty-eight pipelines and four subsea structures with a total mass of approximately 1.8 million tonnes, has required an extensive period of planning and consultation which started in 2006. Permitted programmes of work (plugging and making safe the wells, dismantling the topsides) are now being undertaken offshore and onshore, and it is planned that all the decommissioning work will be completed by about 2023.

We submitted the first Decommissioning Programme (DP), the *Brent Delta Topside Decommissioning Programme* [1] in February 2015 and this was approved in July 2015. The Brent Delta topside was successfully removed as a single lift in April 2017. The Brent Alpha platform and the Brent Bravo platform ceased production in November 2014, and it is likely that Brent Charlie (which is still in production) will cease production in the near future.

A consultation draft of the *Brent Field Decommissioning Programmes* (DP) [2] was submitted to BEIS in January 2017. This DP described our proposals for decommissioning the facilities in the Brent Field, including proposals for decommissioning of the topsides of Brent Alpha, Brent Bravo and Brent Charlie. The Programmes were subject to a sixty day of public consultation between 8 February and 10 April 2017, and BEIS carried out a simultaneous consultation with other government departments.

The consultations provided the opportunity for consultees to raise comments on our topsides proposals. In accordance with UK decommissioning procedures BEIS has had sight of our response to the comments raised by consultees in relation to topsides and have informed us that they are satisfied that they have been addressed appropriately and that no further consideration of proposals for the topsides is required as full removal is mandatory under *OSPAR Decision 98/3 on the Disposal of Offshore Installations* [3].

As is to be expected when decommissioning involves large steel jackets or concrete gravity based structures, BEIS's consideration of decommissioning proposals for these structures occurs over an extended timeframe to enable a robust review. Removal of topsides has no bearing on identified options for decommissioning of the Brent Alpha jacket or the Brent Gravity Based Structures (GBS) or for the management of materials in the base of the Brent GBS legs.

In these particular circumstances, BEIS recognises that execution of topsides removals can allow decommissioning to be executed cost effectively, to the benefit of the taxpayer and without prejudice or compromise to the feasible decommissioning options for the jacket or GBS. To this end, BEIS has agreed that our proposals for decommissioning the Brent Alpha, Brent Bravo and Brent Charlie topsides can be removed from the current Brent Field DP and form this separate, topsides-only, DP.

After detailed technical and engineering studies we have decided to remove the Brent Alpha and Brent Bravo topsides using the single lift vessel (SLV) *Pioneering Spirit*. The topsides will be transported to the Able Seaton Port (ASP) facility at Teesside, operated by Able UK Limited (Able), for dismantling, recycling and disposal. The Brent Charlie topside will also be removed by SLV, but its dismantling and disposal will be subject to a separate decision by the Owners.

Through this *Brent Field Topsides Decommissioning Programme* the owners seek approval to remove the Bravo, Alpha and Charlie topsides in a phased programme of work, planned to be completed by about 2023. This will expedite removal and avoid the need for several years of monitoring and maintenance to ensure the structural integrity of the topside for removal at a later date.

1.2 Decommissioning Programme

This document contains one DP, for the three remaining topsides in the Brent Field – Brent Alpha, Brent Bravo and Brent Charlie. It is submitted by the co-venturers Shell U.K. Limited (Shell, operator) and Esso Exploration and Production UK Limited (Esso) both being the recipients of a Section 29 Notice, and throughout this document the terms ‘owners’, ‘we’, and ‘our’ refer to the co-venturers Shell and Esso.

The owners of the installations are Shell U.K. Limited (Shell, the operator) 50%, and Esso Exploration and Production UK Limited (Esso) 50%.

In accordance with the *Petroleum Act 1998* [4] and the *DECC Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998* [5], the owners as Section 29 Notice Holders seek approval from the Department for Business, Energy and Industrial Strategy (BEIS¹) to decommission these topsides by removing them completely and returning them to shore for recycling and disposal.

In conjunction with public, stakeholder and regulatory consultation completed on 10 April 2017, this DP is submitted in compliance with regulatory requirements and BEIS² guidelines. It describes the principles of the removal activities, summarises the schedules of offshore and onshore work associated with the three topsides which are estimated to be completed by the end of 2023, and presents an assessment of the environmental impacts of the proposed programme.

1.3 Overview of Installations being Decommissioned

Table 1 provides an overview of the facilities being decommissioned and Table 2 provides information about the Section 29 Notice Holders for the Brent Field.

Table 1 Installations being Decommissioned.

Field Name		Quad/Block	
Brent Field		UKCS Block 211/29	
Surface Installation			
Total Number	Type	Location	Weight
1	Brent Alpha Topside	61° 02.063'N 01° 42.221'E	Approx. 15,068 tonnes
1	Brent Bravo Topside	61° 03.320'N 01° 42.682'E	Approx. 23,636 tonnes
1	Brent Charlie Topside	61° 05.738'N 01° 43.206'E	Approx. 30,423 tonnes
Production Type	Water Depth (m)	Distance from Nearest UK Coastline (km)	Distance to Median Line (if less than 5km)
Gas and oil	142	136	N/A

¹ In July 2016 the Department of Energy and Climate Change (DECC) was replaced by Department for Business, Energy and Industrial Strategy (BEIS) and further reference to DECC should be taken as BEIS. However, at that time a number of DECC regulatory responsibilities also transferred to the new Oil and Gas Authority (OGA) and where this is the case that will be notified accordingly.

² Whilst the DECC Guidance Notes were revised in April 2018 and are now titled the BEIS Guidance Notes, all the Brent Field decommissioning documentation has been prepared in line with the DECC Guidance Notes V6 2011. Therefore, further reference will be to the DECC Guidance Notes.

Table 2 Details of the Section 29 Notice Holders.

Section 29 Notice Holder	Registration Number	Equity Interest (%)
Shell U.K. Limited	140141	50
Esso Exploration and Production UK Limited	207426	50

1.4 Partner Letter of Support

Shell has prepared this DP in accordance with Section 29 of the Petroleum Act 1998, on behalf of the owners of the installations.

By a letter dated 16 May 2018, presented at the end of this Executive Summary, Esso has confirmed that it supports the proposals described in this DP, for the decommissioning of the Brent Alpha, Brent Bravo and Brent Charlie topsides.

1.5 Summary of Proposed Programme of Work

Table 3 provides a summary of the proposed programme for decommissioning the Brent Field topsides.

Table 3 Summary of Proposed Decommissioning Programme.

Selected Option	Reason for Selection	Proposed Decommissioning Solution
1. Brent Alpha, Bravo and Charlie Topsides		
Complete removal, onshore dismantling, recycling and disposal.	Complies with requirements of OSPAR Decision 98/3 [3].	The three Brent topsides will each be removed in one piece by an SLV. The Brent Alpha and the Brent Bravo topsides will be transferred to a barge at a nearshore site for back-loading to the ASP facility at Teesside. The onshore dismantling of the Brent Charlie topside will be subject to a separate decision by the Owners. For all three topsides, some equipment may be re-used but the majority of material will be recycled. Non-recyclable material will be disposed of to landfill.
2. Brent Alpha, Bravo and Charlie Wells		
Plug and Abandon.	Meets OGA and HSE regulatory requirements.	All the Brent wells have been, or are being, plugged and made safe in accordance with the Oil & Gas UK <i>Guidelines for the Suspension and Abandonment of Wells</i> [6].
3. Interdependencies		
There are no alternative uses for any of the Brent platforms and BEIS have confirmed that they can be decommissioned. There are no alternative uses for the topsides of any of the Brent platforms. Neither the platform wells nor any equipment or facility on the topsides are needed to complete any technically feasible decommissioning options for managing the sediments in the oil storage cells of the Brent Bravo or Brent Charlie GBSs. Pipelines to and from the three installations will have been emptied and flushed, as appropriate and feasible, before the topsides are removed.		

1.6 Field Location including Field Layout and Adjacent Facilities

Figure 1 shows the location of the Brent Field, and Figure 2 shows the general arrangement of the four installations in the Field. The removal of the remaining three Brent topsides and their transportation to shore will have no effects on or implications for any other facility either within or beyond the Brent Field.

Figure 1 Location of the Brent Field and the Brent Platforms

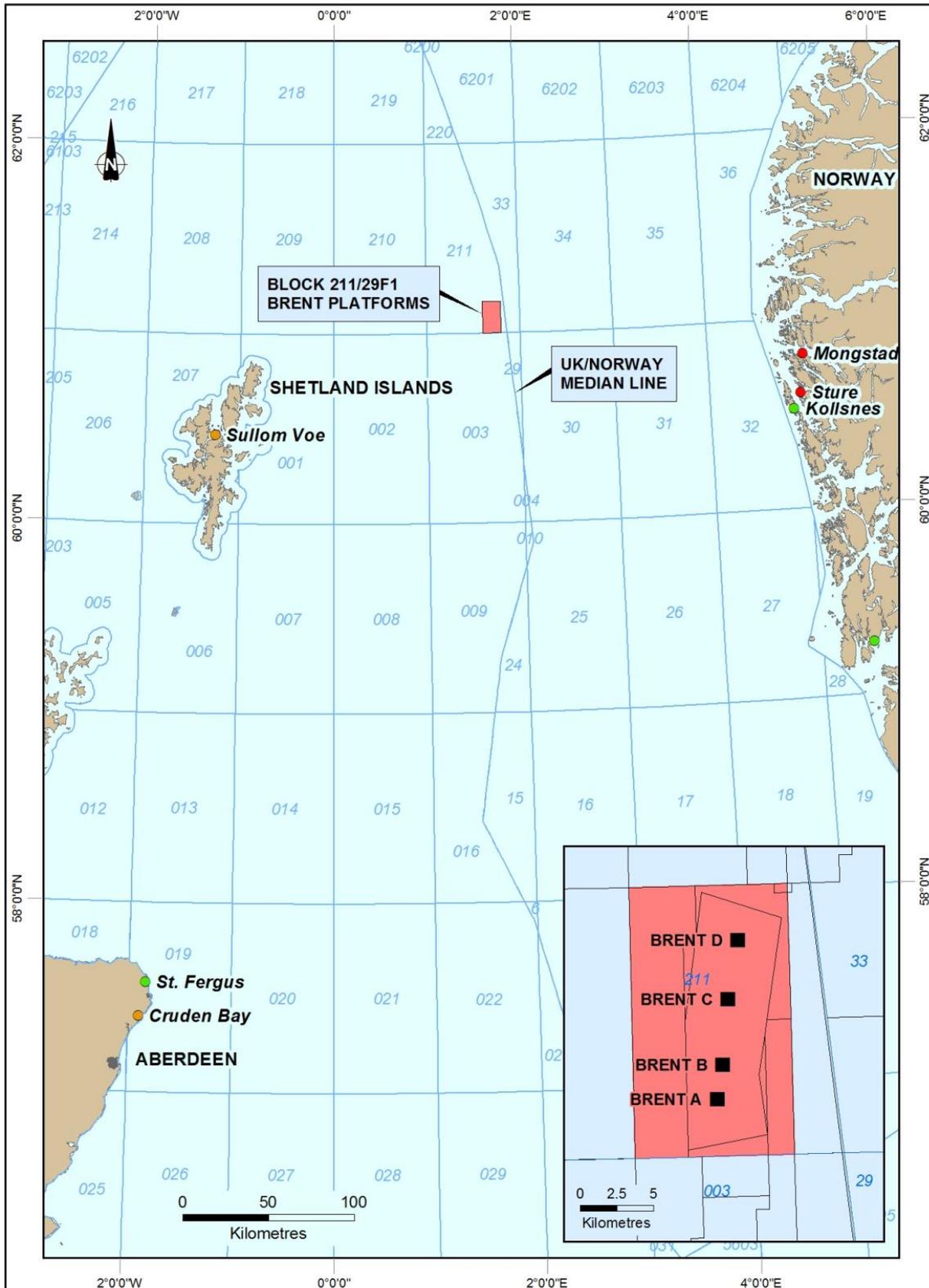
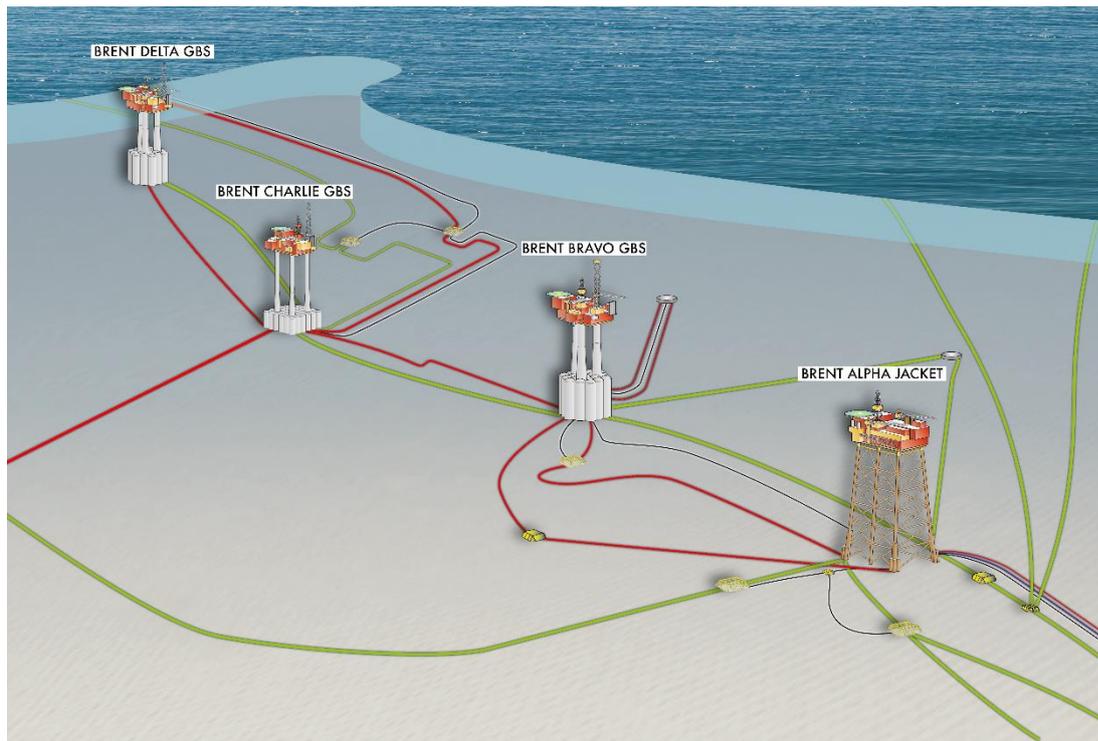


Figure 2 The General Arrangement of Installations in the Brent Field



1.7 Public Consultation

The Brent Alpha, Bravo and Charlie topsides formed part of the draft Brent Field DP that was submitted for Public Consultation on 7 February 2017, and the sixty-day period of consultation that closed on 10 April. During this period we received comments concerning the decommissioning of the topsides and our responses, are presented in this DP (Section 8.9). The data, narratives and recommendations in the DP have been reviewed, as appropriate, in the light of all the comments that we received, and edited or updated as necessary.

1.8 Industrial Implications

We have selected the SLV *Pioneering Spirit* to remove all three Brent topsides. This unique vessel is capable of lifting topsides of up to 48,000 tonnes quickly and efficiently in one piece for onshore dismantling. This will significantly reduce the duration, risk and cost of decommissioning the topsides of large production platforms, which is typically achieved by dismantling them module by module at the offshore location.

At the same time, we have assessed how our topsides could be dismantled and recycled, and this has included a detailed review of the dismantling capabilities and capacities of a large number of sites in the UK and across Europe. After a comprehensive commercial tendering exercise we identified the Able UK Limited ASP facility at Teesside as having the necessary facilities, space and experience to deal with the topsides that would be delivered by the SLV. Able are in the process of dismantling the Delta topside, and we have now placed a contract with them for the dismantling of the Brent Alpha and Brent Bravo topsides. The dismantling of the Brent Charlie topside will be subject to a separate decision by the Owners.

We worked with Able to upgrade their onshore facilities, including the construction of a new quay and the strengthening of the lay-down area for topsides. This enabled the Brent Delta topside to be safely delivered to the ASP facility in May 2017 where it is currently being dismantled. The investment that has been made on Teesside will support employment now and in the future as Able enlarge their capabilities, broaden their services, provide additional training to their workforce, and increase their experience in large-scale decommissioning.

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**PARTNER LETTER OF SUPPORT FROM
ESSO EXPLORATION AND PRODUCTION UK LIMITED**



Esso Exploration and Production UK Ltd.
1 Union Wynd
Aberdeen AB10 1SL

Department for Business, Energy and Industrial Strategy
Offshore Decommissioning Unit
AB1 Building, 3rd floor
Crimon Place
Aberdeen
AB10 1BJ

19th July 2018

Dear Sir or Madam

**PETROLEUM ACT 1998
BRENT FIELD TOPSIDES DECOMMISSIONING PROGRAMME**

Receipt of your letter dated 12th December 2014 regarding the abandonment programme for the Brent Field installations, including the topsides, is confirmed.

This letter confirms that Shell U.K. Limited is authorised to submit an abandonment programme relating to the topsides of the Brent Alpha, Brent Bravo and Brent Charlie platforms as directed by the Secretary of State on the above date.

Esso Exploration and Production UK Limited confirms its support of the proposals detailed in the Brent Field Topsides Decommissioning Programme which Shell U.K. Limited submitted for approval in July 2018.

Yours faithfully

A handwritten signature in blue ink, appearing to be "JG", written over a light blue circular stamp.

John Gillies
Joint Interest Project Manager

For and on behalf of Esso Exploration and Production UK Limited

2 BACKGROUND INFORMATION

2.1 The Brent Field

The Brent Field and its pipeline system are located in Block 211/29 of the UK sector of the North Sea, approximately 136km northeast of the Shetland Islands (Figure 1). The Field is part of the extensive oil and gas infrastructure which has been established over the last 40 years in the East Shetland Basin; there are 11 platforms, 3 floating installations, 17 templates and 4 subsea clusters within 25km of the Brent installations.

The Field is served by four installations, each comprising a substructure for the support of the topsides. At Brent Alpha, the substructure is a steel jacket, fixed in place by steel piles driven into the seabed. At Bravo, Charlie and Delta the substructure is a concrete Gravity Base Structure (GBS) comprising a matrix of large storage cells (called the caisson) made of reinforced concrete. The GBSs are held in place by their own weight, additional solid ballast (in Bravo and Delta), and vertical skirts and dowels that penetrate up to 9m into the seabed.

2.2 Managing Declining Production

The Brent Field was discovered in 1971 and production started in 1976. In total, 146 wells and side-tracks have been drilled, accessing all parts of the extensive Brent reservoir.

We completed a major restructuring programme (called the Long-term Field Development project, LTFD) in 1996 and this changed the Field from producing predominantly oil to producing predominantly gas. This boosted production and extended field life by approximately 10 years. Further upgrades, reconfigurations and management of the provision and distribution of fuel gas from Brent Charlie have all contributed to maximising production and minimising costs. In recent years, therefore, Alpha has produced oil and some gas, Bravo and Charlie have produced mostly gas, and Delta has produced mostly oil.

Plateau production levels were achieved in 1985 for oil and in 2002 for gas, and since these dates production of both oil and gas have declined significantly. Despite detailed investigations since 2006, no viable or economically sustainable programmes or measures can be put in place to extend production.

2.3 Planning for Decommissioning

In 2006 we initiated detailed discussions with DECC (now BEIS) about possible dates for the cessation of production (CoP) from the four installations. These discussions examined the fiscal, economic, technical and safety implications both for ourselves as owners and for the UK Government. As these progressed it became clear that, despite earlier hopes that it would be economically viable to continue production on some platforms and thus carry out a phased cessation of production, all four platforms were rapidly coming to the end of production.

Three of the four Brent platforms have now ceased production (Table 4) and we have reached agreement with the OGA that Brent Charlie will cease production in the near future.

Table 4 CoP Dates for Three Brent Platforms.

Platform	Date of CoP
Alpha	1 November 2014
Bravo	1 November 2014
Delta	31 December 2011

2.4 Brent Decommissioning Programmes

In February 2015 we submitted the first Decommissioning Programme (DP), for the Brent Delta Topside [1], and this was approved in July 2015. The Brent Delta topside was successfully removed as a single lift in April 2017.

A consultation draft of the Brent Field DP [2] was submitted to BEIS in January 2017. This DP described our proposals for decommissioning the facilities in the Brent Field, including proposals for decommissioning of the topsides of Brent Alpha, Brent Bravo and Brent Charlie. The Programmes were subject to a sixty day of public consultation between 8 February and 10 April 2017, and BEIS carried out a simultaneous consultation with other government departments.

The consultations provided the opportunity for consultees to raise comments on our topsides proposals. In accordance with UK decommissioning procedures BEIS has had sight of our response to the comments raised by consultees in relation to topsides and have informed us that they are satisfied that they have been addressed appropriately and that no further consideration of proposals for the topsides is required as full removal is mandatory under OSPAR Decision 98/3 [3].

As is to be expected when decommissioning involves large steel jackets or concrete gravity based structures, BEIS's consideration of decommissioning proposals for these structures occurs over an extended timeframe to enable a robust review. Removal of topsides has no bearing on identified options for decommissioning of the Brent Alpha jacket or the Brent GBSs, or for the management of materials in the base of the Brent GBS legs.

In these particular circumstances, BEIS recognises that execution of topsides removals can allow decommissioning to be executed cost-effectively, to the benefit of the taxpayer and without prejudice or compromise to the feasible decommissioning options for the jacket or GBSs (as was conducted with Brent Delta). To this end, BEIS has agreed that our proposals for decommissioning the Brent Alpha, Brent Bravo and Brent Charlie topsides can be removed from the current Brent Field DP and form this separate, topsides-only, DP.

This DP presents the recommendations for the decommissioning of the remaining three topsides in the Field, Brent Alpha, Brent Bravo and Brent Charlie. More detailed information on the topsides and the proposed programmes of work for them are presented in the *Brent Topsides Decommissioning Technical Document* (TD) [7], which supports this DP.

3 DESCRIPTIONS OF THE ALPHA, BRAVO AND CHARLIE TOPSIDES

3.1 Description of Topsides

The topsides on Brent Alpha, Brent Bravo and Brent Charlie comprise several decks containing the living quarters, power generation, drilling derrick, process systems and all the other facilities required for the operation of a production platform. Figure 3 to Figure 5 show the general arrangement of such facilities on the Alpha, Bravo and Charlie topsides respectively (note that the topsides will not be split into three deck levels for removal). Detailed descriptions and inventories of the topsides of all the platforms are given in the Brent Topsides TD [7]. Table 5 presents a summary of the physical characteristics of each topside; the Bravo topside is similar in all important respects to the Delta topside.

Table 5 Summary Physical Data on Brent Topsides.

Data	Installation		
	Alpha	Bravo	Charlie
Number of decks or levels	3	3	3
Approximate footprint area (m)	81 x 37	73 x 46	80 x 49
Approximate maximum height (m) (Note 1)	46	42	57
Total mass (tonnes) (Note 2)	16,000	24,100	31,000

- Notes:
1. From the cutline on the legs to the helideck, excluding the drill derrick and flare tower. Charlie is higher because most of the 15.7m long steel transition piece will be removed with the topside.
 2. Without inventory and before preparation for lifting.

Figure 3 The Three Main Deck Levels on the Brent Alpha Topside

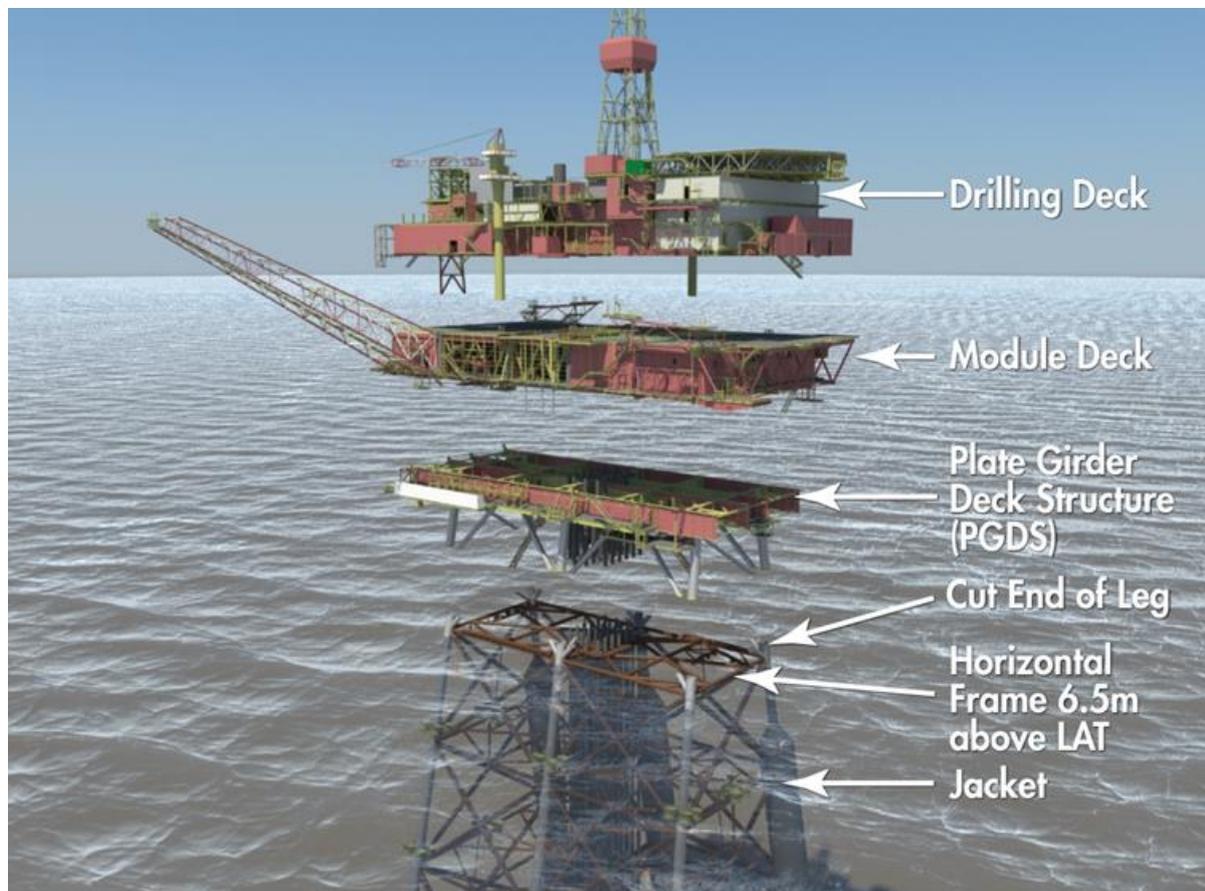


Figure 4 The Three Main Deck Levels of the Brent Bravo Topside

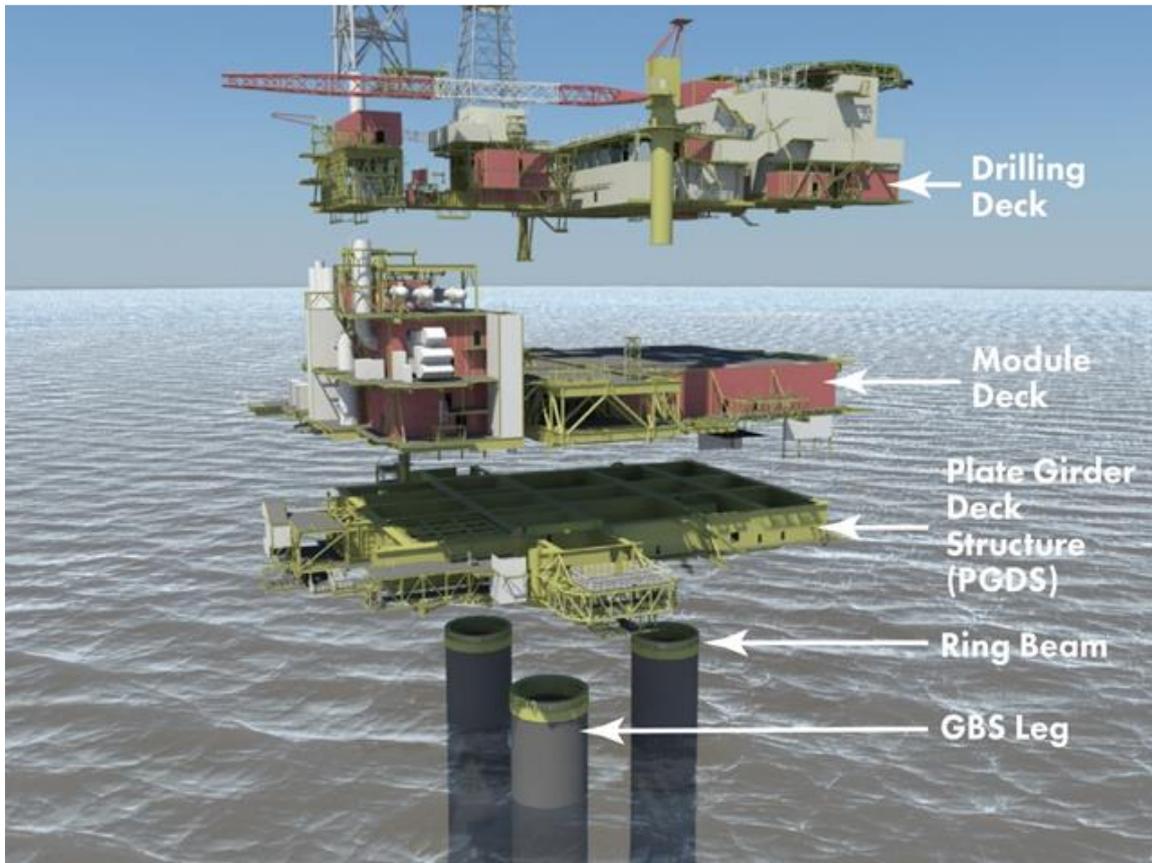
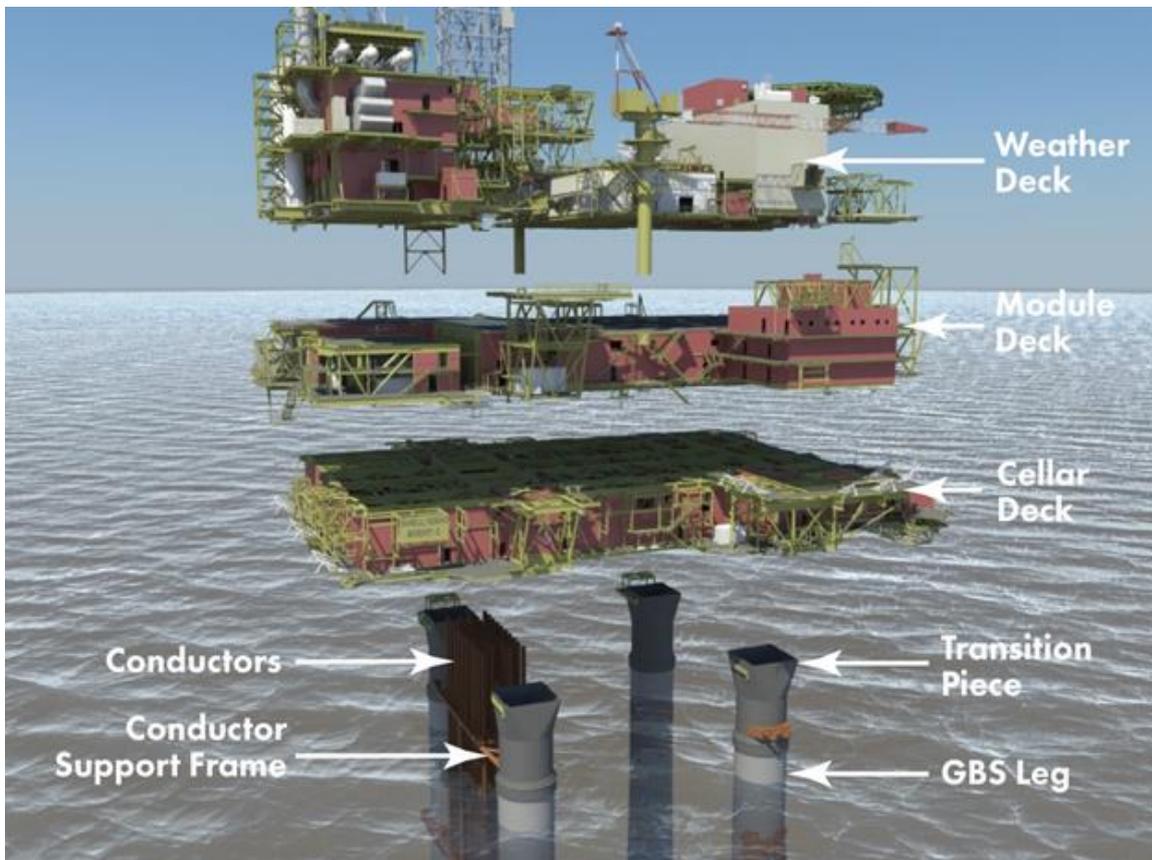


Figure 5 The Three Main Deck Levels of the Brent Charlie Topside



3.2 Inventory of Materials

We have completed a detailed assessment of the locations and quantities of all the different types of materials on and in each of the topsides (Table 6).

Table 6 Estimated Inventory of Topsides Materials.

Material	Unit	Alpha	Bravo	Charlie	Notes
ABS	tonnes	2	2	2	Plastic pipes
Ac 228	MBq	NQ	NQ	NQ	In smoke detectors
Alloy steel	tonnes	216	285	329	Pipework, pumps
Aluminium	tonnes	419	15	15	Anodes, engines
Aluminium bronze	tonnes	1	1	1	Pumps
Americium 241	MBq	5	16	20	Smoke detectors
Anodes (total)	Tonnes	419			See Aluminium and Zinc
Asbestos blue	tonnes	NQ	NQ	NQ	Not yet quantified
Asbestos white/brown	tonnes	NQ	NQ	NQ	Not yet quantified
Asbestos (total)	tonnes	4	9	9	Insulation, gaskets
Batteries	tonnes	28	16	36	Various battery sets
Brass	tonnes	1	1	1	Pumps, piping
Bronze	tonnes	1	1	1	Pumps, piping
Buna	tonnes	1	1	1	O-ring seals
Butyl rubber	tonnes	2	2	2	O-ring seals
Carbon steel	tonnes	11,921	19,572	25,448	Structural steel, equipment
Cement (powder)	tonnes	2	NQ	NQ	Residual bulk material
Ceramics	tonnes	5	5	5	White ware
Chartex/fire protection	tonnes	27	103	122	Penetrations
Chromium	tonnes	NQ	NQ	NQ	Alloy steel only
Copper	tonnes	107	222	281	Pipes, cables, transformers
Copper nickel alloys	tonnes	67	174	229	Pipe-valves, pumps
Cork	tonnes	2	2	2	Lifebuoys
Cotton	tonnes	2	5	5	Bedding
Diesel	m ³	<1	<1	<1	Bulk and day tanks
Drill cutting residues	tonnes	12	12	12	Behind shale shakers
EPDM	tonnes	23	5	23	Cables
Ethylene/polypropylene	tonnes	72	46	120	Cables
Fire foam	m ³	10	10	10	Firefighting systems
Fluorescent tubes	nos.	1,396	2,984	3,116	Lighting
Formica	tonnes	2	2	2	Living areas
Glass	tonnes	5	5	5	Living areas
GRP	tonnes	7	21	16	Replaced floor grids
Graphite/charcoal	tonnes	0.1	0.1	0.1	Water filters
Gun metal	tonnes	1	1	1	Pumps, valves
Halon (CFC)	kg	0	0	0	Has been removed
Heli-fuel	m ³	<1	<1	<1	Volume for safe operations

Table 6 Estimated Inventory of Topsides Materials, Continued.

Material	Unit	Alpha	Bravo	Charlie	Notes
Inconel/nimonics	tonnes	6	13	13	Generators
Insulation	tonnes	31	99	83	Structures, pipes
Iron (cast)	tonnes	3	3	3	Weights
Lead	tonnes	11	6	13	Batteries
LSA scale (NORM)	tonnes	22	43	323	Pipework, vessels
Lube oil	m ³	<1	<1	<1	Compressors, generators
Melamine	tonnes	1	1	1	Laminates
Mercury (lamps only)	grams	15	32	33	Lamps
Monel	tonnes	0.1	0.1	0.1	Pumps and valves
Neoprene	tonnes	5	5	5	Various
Nickel	tonnes	NQ	NQ	NQ	Alloy steel only
Ni-resist	tonnes	10	10	10	Pump valves
Nylon	tonnes	10	10	10	Electrical equipment, rope
Paint	tonnes	930	961	899	Paint on structural steel
Pb-210 (NORM)	MBq	13	513	411	LSA scale and sludge
PCBs	ppm	<5	<5	<5	Residues in transformer oil
PTFE	tonnes	0.1	0.1	0.1	Seals
Plastics	tonnes	4	3	4	Floor coverings
PVC	tonnes	32	19	65	Cable covering
Radium (Ra-226) (NORM)	MBq	376	734	3,141	LSA scale and sludge
Radium (Ra-228) (NORM)	MBq	261	663	1,340	LSA scale and sludge
Residual hydrocarbons	tonnes	7	<1	<1	Walls of pipes and tanks
Rubber	tonnes	20	20	20	Floor coverings
Sewage	tonnes	1	1	1	Sewage system bilges
Smoke detectors	number	384	510	560	Smoke detectors
Stainless steel	tonnes	459	1,349	1,732	Pipes and vessels
Stellite	tonnes	NQ	NQ	NQ	Valve facings
Tin	tonnes	1	1	1	Solder
Titanium	tonnes	28	31	32	Pipes and machines
Wood	tonnes	20	20	20	Accommodation
Zinc	tonnes	537	532	519	Anodes, galvanising
Total mass (approximate)	tonnes	15,068	23,636	30,423	69,127

Notes:

ABS, Acrylonitrile Butadiene Styrene
 Ac, Actinium
 CFC, Chlorofluorocarbon
 EPDM, Ethylene propylene diene monomer
 GRP, Glass-reinforced Plastic
 LSA, Low Specific Activity
 NQ, Not Quantified
 NORM, Naturally Occurring Radioactive Material

Pb, Lead
 PCB, Polychlorinated Biphenyls
 PTFE, Polytetrafluoroethylene
 PVC, Polyvinylchloride
 Ra, Radium

4 IMPLICATIONS FOR DECOMMISSIONING OTHER INFRASTRUCTURE AND MATERIALS

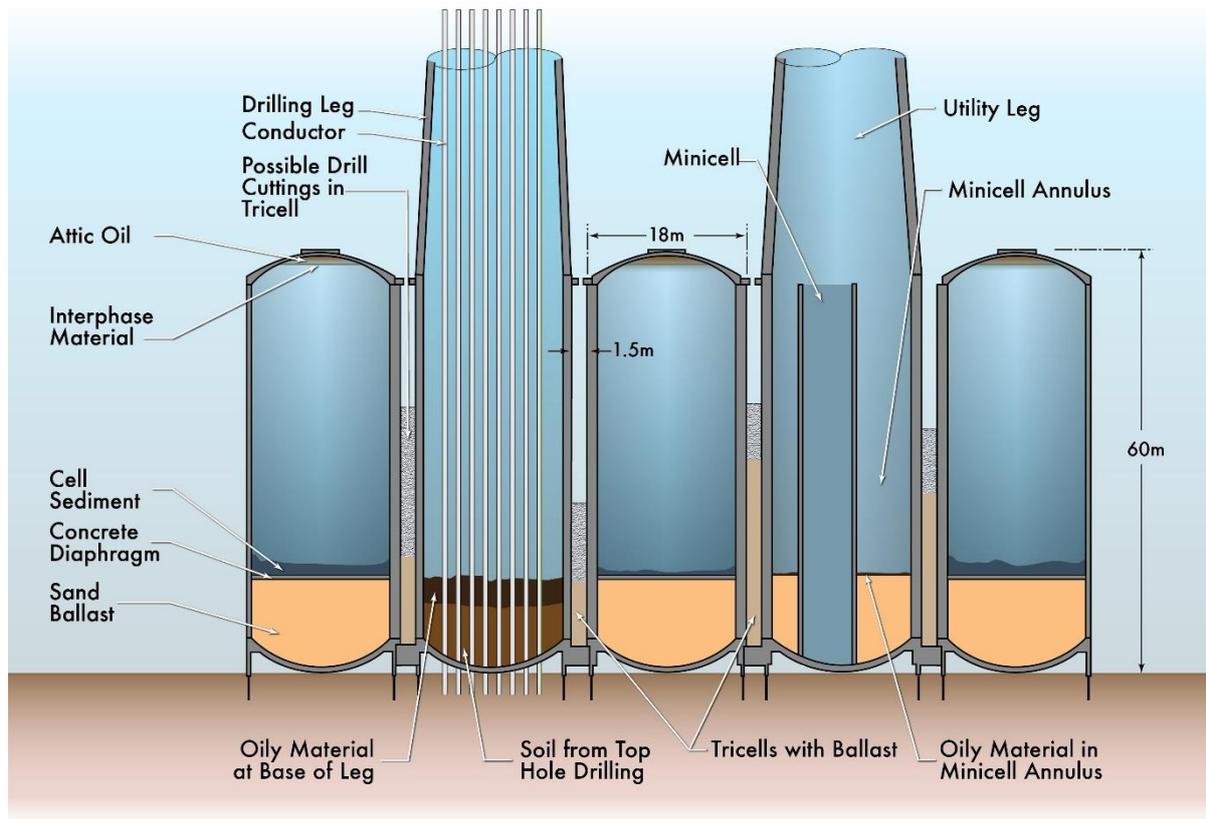
4.1 Introduction

We have reviewed the removal of the remaining Brent topsides to determine if this would have any implications for the decommissioning of the Bravo and Charlie GBSs or materials in and around these GBSs. Figure 6 presents a stylised cross-section of the Bravo GBS showing the locations of all the materials or components discussed in this section. The origin and nature of all these materials, and available data from samples that have been obtained, is presented in detail in the *Brent GBS Cell Contents Technical Document* [8].

This section briefly describes the following aspects of the Brent Topsides Decommissioning Programme and summarises our conclusions on the use of the topsides in their execution:

1. Alternative uses for the Alpha, Bravo and Charlie installations.
2. Decommissioning options for the Alpha, Bravo and Charlie installations themselves.
3. Decommissioning the conductors inside the drilling legs of the Bravo GBS, the external conductors on the Charlie GBS, and the external conductors on the Alpha steel jacket.
4. The use of Brent topsides or wells for managing drill cuttings on the seabed at all three sites or on the tops of the GBS cells.
5. The use of the topsides or wells for managing the contents of the GBS oil storage cells.
6. The use of the Bravo topside or wells for managing material that has accumulated in the minicell annulus in the utility leg of the Bravo GBS.
7. The use of the Bravo topside or wells for managing material that has accumulated in the drilling legs of the Bravo GBS.
8. The use of Bravo topside or wells for managing material that has accumulated in the tri-cells of the Bravo GBS (the tri-cells are described in Section 4.3.6).

Figure 6 Location of Other Materials and Components in the Bravo GBS



4.2 Implications for Decommissioning other Structures

4.2.1 Introduction

As a result of the detailed assessments we have completed we consider that no technically feasible option for decommissioning or managing any other part of the Alpha, Bravo and Charlie installations, or any other structure in the Brent Field, would be prejudiced or foreclosed by the removal of the three topsides. The following sections summarise our assessments.

4.2.2 Alternative uses of Brent Installations including Topside

To support the Brent Field DP we performed several studies to investigate the possibility of re-using the installations and their topsides. This work was described in detail in the Brent Field DP [2].

We have not identified any further uses for any of the installations either in their current locations or at other sites. In addition, we have concluded that it would not be technically feasible or commercially viable to use any of the installations for carbon capture and storage (CCS). Our examination of the viability of CCS considered the Brent Field as a whole, including its present structures, geology and the pipeline system serving it.

4.2.3 Decommissioning the Brent Alpha Steel Jacket

We have completed detailed assessments describing and assessing the technically feasible options for decommissioning the Alpha steel piled jacket (the substructure on which the topside is located). These options were subjected to a full Comparative Assessment (CA) according to the OSPAR 98/3 framework. The specific CA for the Alpha jacket is fully documented in the *Brent Alpha Jacket Decommissioning Technical Document* [9] and summarised in the Brent Field DP [2].

All the practically-available options for decommissioning the Alpha steel jacket, including those that would result in the full removal of the whole jacket, would require the removal of the topside as a pre-cursor. The installation is too heavy to be lifted or refloated with the topside in place. Although short sections of conductors and casings have been removed as part of the P&A campaign (to plug and make safe the wells), the bulk of the conductors and casings would not be removed using topside facilities but by a heavy lift vessel (HLV) after the removal of the topside.

The preparations currently being undertaken on this installation, and the subsequent removal of the Alpha topside, do not preclude or prejudice the options for the Alpha jacket.

4.2.4 Decommissioning the Bravo and Charlie GBSs

4.2.5 Introduction

We have completed detailed assessments describing and assessing the technically feasible options for decommissioning the Brent GBSs and these options were subjected to a full CA according to the OSPAR 98/3 framework. The specific individual CAs for the Bravo and Charlie GBSs are fully documented in the *Brent Bravo, Charlie and Delta GBS Decommissioning Technical Document* [10] and summarised in the Brent Field DP. The preparations currently being undertaken on the GBSs, and the subsequent removal of the Bravo and Charlie topsides, do not preclude or prejudice these options.

4.2.6 Bravo GBS

At present, all the conductors, pipework and structural items in the drilling legs and the utility leg are secure, and the various checks and sweeps that we plan to perform in the legs during the 'engineering-down' of the GBS will provide assurance that these internal structures will remain secure after the removal of the topside. If the GBS legs were to be partially removed at some time in the future, any external preparatory work for cutting would be carried out just before the cutting operation began and would not require the presence of the topside. In the drilling legs, the upper parts of the conductors would be cut and removed by an HLV before the legs were cut. In the utility leg, we have identified an optimum cut zone (at about 69m below the lowest astronomical tide (LAT)) which minimises the amount of internal architecture and pipework that would have to be cleared by a work-class remotely-operated vehicle (WROV), and are evaluating whether to mark up the potential cut lines before the topside is removed.

We appreciate that if legs had to be removed some time in future, it is very likely that much of the pipework and steel architecture in the legs would have corroded and could have fallen into the cut zone where it might obstruct the diamond wire cutting (DWC) machine. We have confirmed, however, that the cut zone could be surveyed and any debris cleared by a WROV deployed through an access hole cut into the side of each leg. A study by Dr Tech. Olaf Olsen, *Brent GBS Leg Removal: Feasibility Assessment of Specific Issue* [11], the designers of the Delta GBS, has shown that a 2m by 2m access hole would not be likely to affect the structural integrity or the stability of the leg.

We have studied the degradation and collapse of the GBS legs after the topside and the plate girder deck support (PGDS) have been removed leaving all three legs free-standing (that is, not linked by the PGDS) and fitted with concrete caps. The most likely scenario is that the legs would degrade and fail at around sea level, where exposure to wave action is greatest. The processes, rates and effects of wave action and corrosion in this zone would not be affected by the removal of the topside. A full examination of possible degradation scenarios for the GBS legs and caisson is presented in the Brent Bravo, Charlie and Delta TD [10] and summarised in the Brent Field DP.

4.2.7 Charlie GBS

The pipework and structural items in all four legs on Charlie are currently secure, and the various checks and sweeps that we plan to perform in the legs during the 'engineering-down' of the GBS will provide assurance that these internal structures will remain secure after the removal of the topside. If the GBS legs were to be partially removed at some time in the future, any external preparatory work for cutting would be carried out just before the cutting operation began and would not require the presence of the topside.

Optimum cut zones will be identified in each leg ahead of removing the topside to minimise the amount of internal architecture and pipework that would have to be cleared by a WROV. Similar to Bravo, if the legs had to be removed at some time in the future we would deploy an WROV through an access hole cut into the side of each leg to assess and deal with any obstructions to the DWC machine.

We have studied the degradation and collapse of the GBS legs after the topside and the cellar deck have been removed leaving all four legs free-standing (that is, not linked by the cellar deck) and fitted with concrete caps. The most likely scenario is that the legs would degrade and fail at around sea level, where exposure to wave action is greatest. The processes, rates and effects of wave action and corrosion in this zone would not be affected by the removal of the topside. A full examination of possible degradation scenarios for the GBS legs and caisson is presented in the Brent Bravo, Charlie and Delta TD [10] and summarised in the Brent Field DP.

4.2.8 Decommissioning the Conductors

The topsides on all three installations will be removed after the satisfactory completion of all the programmes to plug and make safe the platforms' wells.

On Bravo the conductors are located inside the two drilling legs, whereas on Charlie they are located externally between two of the legs, held in place by horizontal steel conductor guide frames. On Alpha the conductors are externally located within the framework of the jacket, and held in place by horizontal steel conductor guide frames.

On all three installations, the upper parts of the conductors and their casings have been, or will be, removed to just below the topside separation leg cut height (e.g. +1.6m LAT for Bravo) as part of the wells P&A programme. The lower parts of the external conductors and casings for Alpha and Charlie will be removed by an HLV after the removal of the topsides; the removal of the topsides is therefore a necessary pre-cursor to the final part of the programme of work to remove the conductors and casings.

The removal of the topsides therefore does not prejudice or prejudice the outcome of our CAs for the GBSs and the Alpha footings or the recommendations for these substructures that will be presented in the relevant TDs and the Brent Field DP; it keeps open all technically feasible options for the GBSs and the Alpha jacket.

4.3 Inter-relationships with Decommissioning Materials in and around the GBSs

4.3.1 Introduction

The GBSs contains solid and liquid materials that have accumulated or been deposited during the 35 years of operation. We have examined how these materials could be managed and in particular whether the existing topside, equipment and facilities could play a part in retrieving, managing or disposing of these materials.

4.3.2 Decommissioning the GBS Cell Contents

Sampling operations successfully performed at Delta in the summer of 2014 have confirmed that the contents of the former oil storage cells on Bravo and Charlie comprise the following four types of material:

1. Attic oil: a small volume (approximately 50m³ per cell) of crude oil trapped in the top of each cell, above the oil export line³.
2. Interphase material: an emulsion of oil in water with some sediment particles, lying beneath the attic oil. Together, the attic oil and interphase material represent an estimated volume of between 60m³ and 160m³ of material that will be removed from each cell.

³ Due to the configuration of the oil export lines, we do not expect there to be significant volumes of attic oil in the Bravo oil storage cells.

3. Water: a mixture of seawater and produced water⁴.
4. Sediment: a viscous mixture comprising approximately 50% water, 25% oil and 25% sand particles.

The attic oil and interphase material on the GBSs (where present) will be removed and taken to shore for treatment and disposal.

The current preferred method for recovering the remaining oil and interphase material from the storage cells after CoP is to create a small (3.5 inch diameter) access hole in each cell and install temporary flexible pipelines across the tops of the cells so that the attic oil and interphase material from all the cells can be collected into a single receptor cell; the fluid extracted will be replaced by water from the receptor cell. All this work would be performed utilising a remotely operated vehicle (ROV) from a vessel and would not require the topside to be in place.

The access hole to each cell will be closed after the attic oil and interphase material has been extracted. The oil amalgamated in the receptor cell will be pumped to a tanker and taken to shore for recycling. As this material is pumped out from the receptor cell it will be replaced by raw seawater. During pumping operations the cells will be fully flooded and this operation will not have any detrimental effect on the structural integrity of the cells or the GBS caisson.

This concept will be applied to all three GBSs but various opportunities are still being investigated to take advantage of differences between the platforms. For instance, while the topsides are in place, we are taking the opportunity to either re-use existing fill line or vent line pipework to remove the attic oil; or deploy a remotely operated vehicle (ROV) from the topside to create the subsea access hole and carry out the transfer activities as described as above.

For the cell sediment, engineering study work conducted to date has also led to the conclusion that all of the feasible remediation options are better carried out without the support of the topside. The detailed engineering justifications are provided in the Brent Field DP and in the supporting GBS Contents TD [8] but the main findings that support the conclusion that vessel-based remediation options would be better than topside-based options are summarised below.

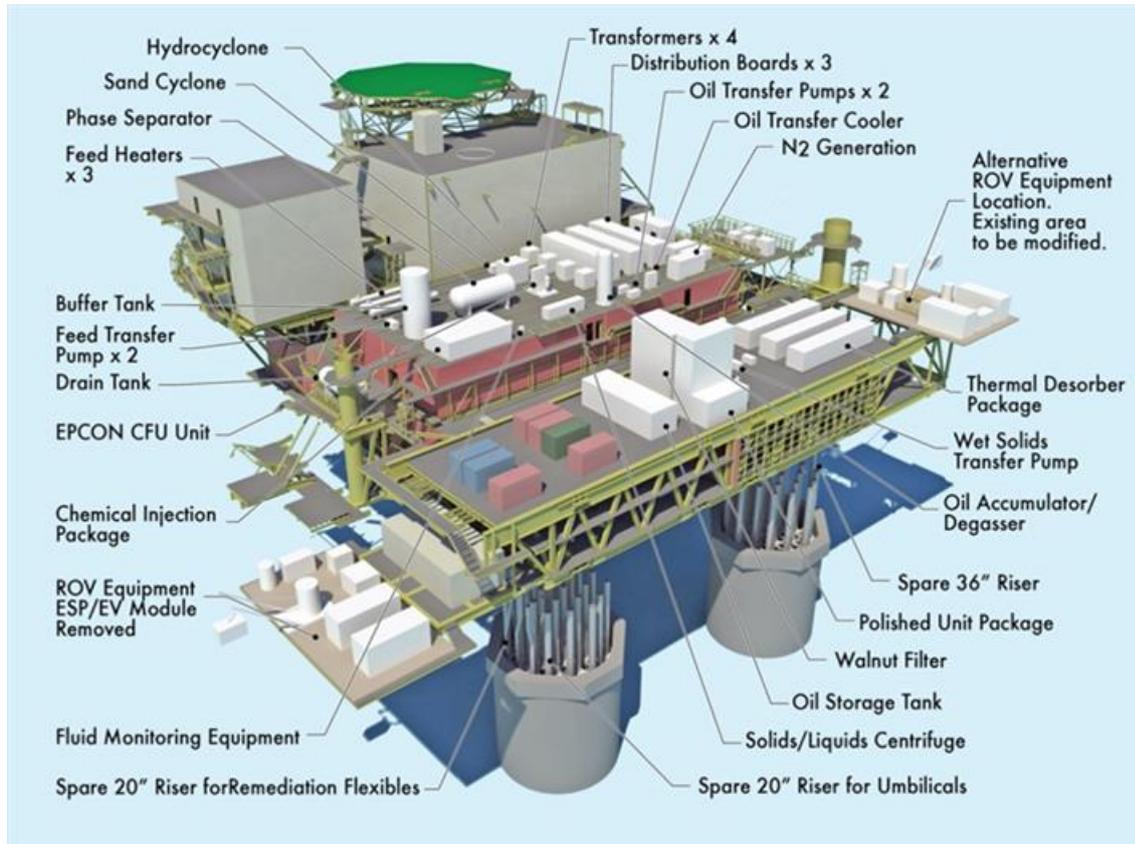
During our identification and investigation of technically feasible options for the remediation of the cell sediment, extensive consideration was given to concepts deployed from or making use of the topside. We completed detailed assessments of how the existing topside modules and infrastructure might be modified and/or replaced in order to handle or treat the estimated volumes of materials and sediment in various possible remediation options. We then summarised the advantages and disadvantages of platform-based options compared to vessel-based options with respect to such issues as 'maintenance of drawdown', 'deployment of equipment on the cell top', 'weather sensitivity', 'footprint for equipment' 'discharges to sea', 'transportation to shore' and 'power supply'. Figure 7 shows a possible concept for the arrangement of remediation process equipment on a GBS topside; the available footprint is insufficient for topside processing, even after removal of non-essential modules. We concluded that although the use of the topside appeared to be of interest for some lengthy remediation options, that is those of more than 18 months duration, it also implied major constraints that significantly outweighed the benefits.

The installation and operation of a waste treatment plant on the topside poses excessive challenges with respect to the required footprint and power generation, it limits subsea access to some of the cells, and requires the continuation of drawdown⁵ and all the utility and support services necessary on a manned platform.

⁴ Produced water is water that is naturally produced from the reservoir.

⁵ The drawdown system is a feature of the platform which maintains the pressure of fluids inside the storage cell at approximately 4 bars below the pressure of the surrounding sea. This is required at all times while the topside is in place and manned. This implies that any new subsea access created through the concrete wall of the storage cell while the topside was still in place would have to be designed to maintain that pressure difference at all times.

Figure 7 Schematic showing Possible Arrangement of Remediation Process Equipment on a GBS Topside⁶



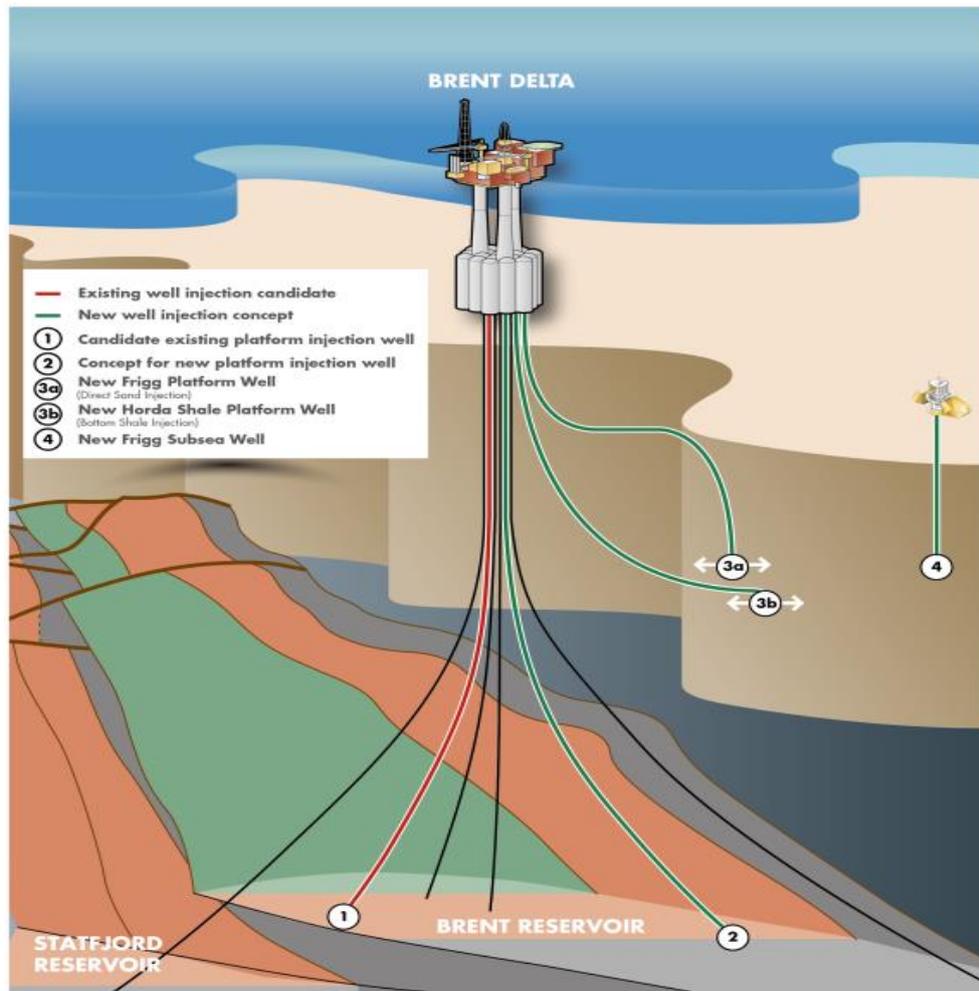
We also concluded that the existing pipework into the cells poses overwhelming limitations to the deployment of any kind of tooling for carrying out cell sediment remediation. The pipes are 10 inch and 12 inch in diameter and have from two to six 90° bends depending on their location, and after more than 35 years' service their structural integrity is not known and probably poor. These constraints and characteristics prohibit the deployment through the existing pipework of the tools that would be required to remediate the cell sediments, with the inevitable consequence that a new subsea access would be needed for each storage cell. Once this conclusion was reached and verified it quickly became apparent that the presence of the topside would impose two severe limitations to the creation of a new subsea access. Firstly, the design of the cell-top equipment would be more onerous because the drawdown would still be in place and, secondly, the presence of the over-hanging topside would impose limitations on the deployment of equipment directly over and onto the cell top (either from a vessel or from the topside itself). Although features such as power, utilities and space are readily available on both the topside and vessels, they are expected to require considerably more maintenance on the topside due to its age.

We have carried out a series of detailed technical studies using specialist contractors to determine if cell fluids and/or solids could be disposed of via existing wells, new wells drilled from the GBS platforms or new remote subsea wells⁷, as illustrated in Figure 8.

⁶ This example is for Delta, but the Bravo topside has a very similar configuration and available footprint (Delta topside is 72m x 47m and Brent Bravo is 73m x 46m). Charlie has a different configuration and a slightly larger footprint of 80m x 49m.

⁷ A remote subsea well is one drilled from a stand-alone drilling rig rather than from an existing platform.

Figure 8 Diagrammatic Representation of Five Downhole Disposal Options for Cell Contents



The findings of these studies (which have been reviewed by the Independent Review Group (IRG)⁸, supplemented for the particular topic of re-injection by experts in drilling and geology), indicate that re-injection of cell sediment from existing or new platform-based wells would pose so many technical issues that the likelihood of failure would be unacceptably high. The existing GBS platform wells are not suitable for use as injectors because of their integrity. It is not possible to drill new platform wells into the Brent formation because this formation is highly depleted and even with wellbore strengthening techniques the well(s) could not be completed to the required functional standard. It is not possible to drill injectors into the Frigg sandstone formation with sufficient offset from existing GBS wellbores, and alternative targets in the Horda shale are not able to accept the large daily volumes of material that would be required in an economically viable operation.

⁸ All the important supporting studies informing the Brent Decommissioning Programme have been scrutinised by an independent review group (IRG) chaired by Professor John Shepherd of Southampton University. Professor Shepherd appointed a team of leading academics from across Europe, comprising technical, engineering and environmental experts, and their remit was to review and report on the completeness, objectivity and rigour of supporting studies and the validity of the conclusions or findings. In February 2017, the IRG published a final report on its assessments which may be found at the Brent Decommissioning website <http://www.shell.co.uk/sustainability/decommissioning/brent-field-decommissioning/brent-field-stakeholder-engagement/irg.html>. We did not have any editorial control over the IRG's report on its findings.

Based on those findings, we have concluded that the only feasible re-injection option that can be carried forward into our CA for the GBS cell sediment is the option of using new remote subsea wells dedicated to the re-injection of solids and fluids. Our assessment of the technical feasibility of re-injection is described in the Contents TD [8] and summarised in the Brent Field DP.

The conclusions of these engineering studies therefore led us to discount the use of the topside to support any of the remediation options for cell sediment. We finally selected the following five remediation options for the detailed CA of the GBS cell sediment; all of those that involve remediation are vessel-based and do not require the use or presence of the topsides:

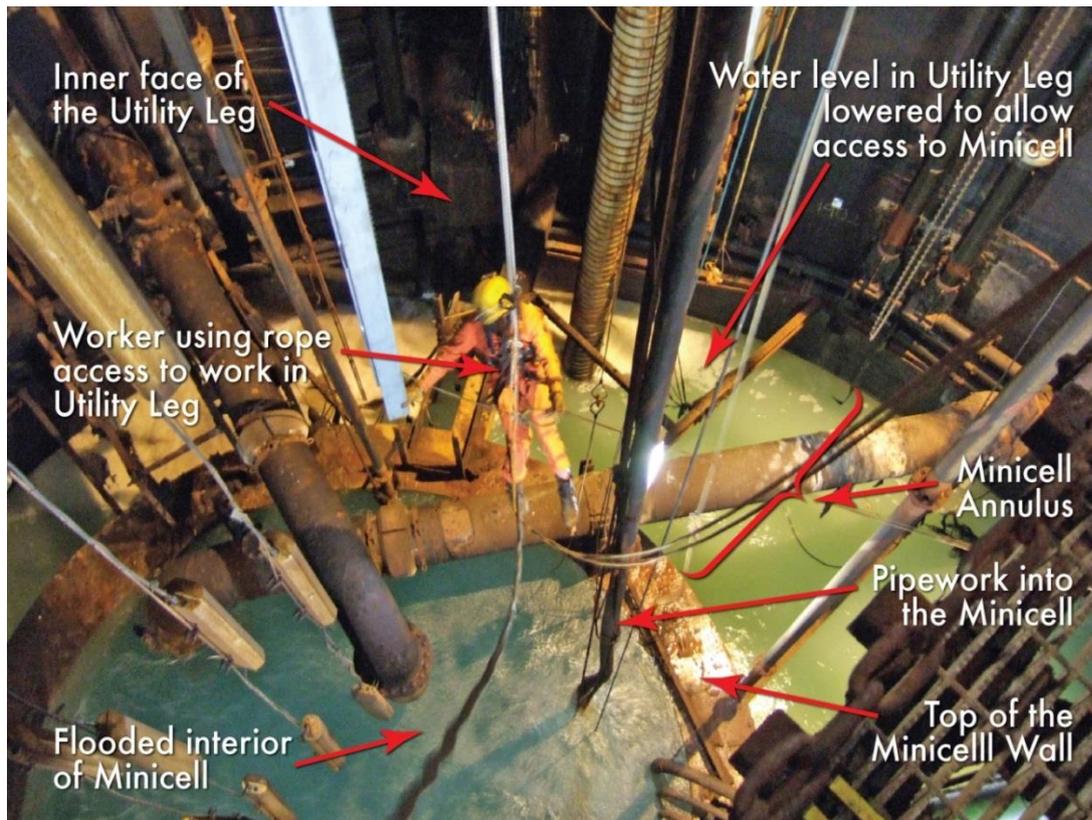
1. Remove and Re-inject: Remove the sediment and the water and re-inject the slurry into new subsea wells.
2. Vessel to Onshore: Remove the sediment and the water and take to shore for treatment and final disposal.
3. Leave in place and treat biologically: Leave the sediment and the water in place and treat *in situ* biologically.
4. Leave in place and cap: Leave the cell sediment in place and cover it with a layer of capping agent. Treat the water *in situ* biologically.
5. Leave in place: Leave the cell sediment and water phase in place untreated.

Sediment remediation options would be more efficiently performed from a vessel with the topside no longer in place because this would give much easier access to all the cells. In the event where treatment would not be required for the cell sediment but would be required for the water phase, we have identified options to remediate the water phase either with or without the topside. The options for cell sediment and cell water and the associated CA are fully documented in the GBS contents TD and summarised in the Brent Field DP. For the reasons stated above, removing the GBS topsides will not prejudge the outcome of that submission.

4.3.3 Decommissioning Material in the Minicell Annulus

The minicell is a self-contained cylindrical compartment located at the bottom of the utility leg on Bravo. It is approximately 60m high and was constructed so that pipework at the bottom of the utility leg could be accessed without having to de-water the whole of the leg. Figure 9 is a view looking down the utility leg to the circular top of the minicell; the annulus is the water-filled space between the wall of the leg and wall of the minicell.

Figure 9 View Down the Utility Leg showing the Top of the Minicell and the Minicell Annulus



During maintenance work on pipework inside the minicell in the mid-1990s oily material was found at the bottom of the minicell; the origin of this material is not clear. In order to complete the work this material was moved into the minicell annulus and it now lies on top of the original 25m thick layer of ballast sand in the annulus.

In order to identify the recommended management option for this material, which forms part of the GBS inventory, we conducted a sampling operation in 2010 on Delta to measure its volume and characterise its composition. The oily material lying at the bottom of the Delta minicell annulus was estimated to be between 0.6m and 1.2m thick, corresponding to volumes of 135m³ and 270m³. For the purposes of engineering remediation options, and for the assessment of potential environmental impacts, a volume of contaminated materials of 250m³ has been assumed.

Chemical analysis confirmed that the main constituents were degraded hydrocarbons along with traces of heavy metals which probably originated from corroding pipework in the utility leg.

We used this information to identify the following possible remediation options for this material:

1. Remove and Re-inject: Remove the material at the bottom of the minicell annulus and re-inject it in new subsea wells or existing wells on another Brent platform either before or after the removal of the topside.
2. Vessel to onshore: Remove the material at the bottom of the minicell annulus and take it to shore for treatment and final disposal either before or after the removal of the topside.
3. Leave in place and treat biologically: Leave the material at the bottom of the minicell annulus in place and treat it *in situ* biologically either before or after the removal of the topside.
4. Leave in place and cap: Leave the material at the bottom of the minicell annulus in place and cover it with a layer of capping agent either before or after the removal of the topside.
5. Leave in place: Leave the material at the bottom of the minicell annulus in place untreated.

These options were suitably developed to enable a CA to be performed for the material in the minicell annulus on Delta. At the time we conducted the CA for Bravo, no samples of the material in the Bravo

minicell annulus were available; we therefore assumed that the Bravo minicell annulus contained the same type and amount of material as found in the Delta minicell annulus. Subsequent sampling in Bravo, conducted in 2017, confirmed that the nature of this material was similar to that found in the Delta annulus. The total volume of material in the Bravo annulus could not be determined with accuracy because the corer failed to penetrate through to the clean sand ballast below the oily material. A volume of contaminated material of 250m³ was therefore assumed to be present.

These CAs are presented in full in the GBS Contents TD [8] and summarised in the Brent Field DP.

As the CA for Bravo has options for the management of the materials in the minicell annulus that are performed after removal of the topside, we are satisfied that the outcome of the CA will not be prejudged by topside removal.

4.3.4 Decommissioning Material in the Drilling Legs

The two drilling legs on Brent Bravo each contain 19 conductors but no sand ballast (Figure 6); there is no utility leg as such on Brent Charlie, and the conductors are external.

No samples of the material in the Brent Bravo Drilling Legs were available at the time we conducted the CA for this material; we therefore assumed that the Brent Bravo Drilling Legs contained the same type and amount of material as the Brent Delta Drilling Legs.

As part of the requirement to provide a detailed inventory of the contents of the Delta GBS we performed sampling programmes and investigations to establish the nature of any material located at the bottom of each drilling leg. The offshore investigations have shown that various materials have accumulated at the bottom of the drilling legs on Delta, from two main sources:

1. Drill cuttings created during the installation of the conductors. This is top soil which entered the leg through the annulus between the conductor and the conductor sleeve at the bottom of the leg. The conductors were installed using seawater and they penetrated clean (non-oil bearing) geological formations, so the corresponding cuttings from this activity are believed to be clean.
2. Deposits of oily material that may have originated from accidental spillages in the well bay.

In order to identify the most appropriate management option for the material that has accumulated in the Delta drilling legs we conducted sampling operations to measure its volume and characterise its composition. The chemical analysis confirmed that the main components were hydrocarbons along with traces of heavy metals which have probably come from corroding pipework. The materials we collected appeared to be similar to a degraded oil-based mud (OBM).

The overall volume of contaminated material has been derived from measurements made during the sampling operation carried out in May 2013 for the West leg and in September 2014 for the East leg. Through manual probing, it was found that in the East drilling leg the sediment/water interface lies at a height of between 1.71m and 4.85m above the base of the leg. This equates to a volume of material that ranges from 112m³ to 834m³, with an average of 474m³. Although the gradient of concentration identified on the sediment core shows that the contaminated sediment layer on top of the clean cuttings is less than 1m thick, the whole amount of material has been considered because it would not be easy to remove only the contaminated layer. For the purpose of the CA, a conservative volume of 500m³ was assumed for the East leg.

In the West drilling leg, the sediment/water interface lies at a height of between 5.9m and 8.9m above the base of the leg. This equates to a volume of material that ranges from 1,082m³ to 1,827m³, with an average of 1,455m³. If it is assumed that the volume of clean cuttings in the West leg should be similar to that in the East leg, this leaves a layer of contaminated material on top of the clean cuttings that is approximately 2m to 5m thick. Several sediment sampling operations were attempted in the West drilling leg but every time the penetration of the gravity corer was limited to less than 1m. Therefore, it was not possible to find the position of the interface between the clean cuttings and the contaminated top layer in the West leg. As with the East leg, we have taken into account the that the whole volume of material would have to be managed. For the purpose of the CA, therefore, a conservative volume of 1,500m³ was assumed for the West leg.

At the time of completing the CA of options for the material in the GBS drilling legs, no samples had been obtained from the Bravo drilling legs. For the CA of the material in the Bravo drilling legs, we therefore assumed that its drilling legs contained the same type and amounts of material as had been found in the Delta drilling legs. (The Bravo drilling leg sampling operation has now been completed. The analytical results are currently being processed to verify that the initial CA and the corresponding recommendation, informed by the data collected for Delta, are still valid).

We used the information gained on the volume and nature of the material in the Delta drilling legs to identify the following possible remediation options for the material in the Bravo drilling legs. All of these options could be performed with or without the topsides in place:

1. Remove and Re-inject: Remove the material at the bottom of the drilling legs and re-inject it in remote new subsea wells or existing wells on another Brent platform.
2. Vessel to onshore: Remove the material at the bottom of the drilling legs and take it to shore for treatment and final disposal.
3. Leave in place and treat biologically: Leave the material at the bottom of the drilling legs in place and treat it *in situ* biologically.
4. Leave in place and cap: Leave the material at the bottom of the drilling legs in place and cover it with a layer of capping agent.
5. Leave in place: Leave the material at the bottom of the drilling legs in place untreated.

These options were developed to enable a CA to be performed for the material in the drilling legs and this is presented in full in the GBS Contents TD [8] and summarised in the Brent Field DP. As the CA includes credible options that can be performed after removal of the Bravo topside we are satisfied that the outcome of this CA will not be prejudged by the removal of the Bravo topside in 2019.

4.3.5 Decommissioning Seabed and Cell-top Drill Cuttings

On the seabed at the base of the GBSs and on the tops of the oil storage cells, and on the seabed under and around the Alpha footings, there are historic accumulations of drill cuttings that were generated using OBM. Recent surveys, together with long-term fate modelling, have demonstrated that, with the exception of the cell-top drill cuttings pile on Charlie, none of these cuttings piles exceeds the thresholds for 'rate of oil loss' and 'persistence over the area of seabed contaminated' laid down in *OSPAR Recommendation 2006/5 on a Management Regime for Offshore Cuttings Piles* [12].

In order to access the oil storage cells on the GBSs, however, some amounts of cuttings would have to be displaced or removed from the tops of the cells so that the necessary access equipment could be deployed through a hole drilled in the concrete dome. Regardless of the volumes of cuttings involved, such operations would be conducted subsea from a surface vessel and would not require any use of, or interactions with, the topsides or any of their facilities.

4.3.6 Decommissioning Drill Cuttings in the GBS Tri-cells

The tri-cells are the triangular spaces formed between the circular walls of the cells on Bravo (Figure 6). There are no tri-cells on the Charlie GBS.

There are 22 tri-cells on the Bravo GBS each extending the full height of the storage cells, and they contain varying amounts of solid ballast. The volume of the void space above the ballast in each cell ranges from 414m³ to 596m³ and the total void space in the tri-cells is estimated to be 12,039m³. Since the top of each tri-cell is open to the sea and the cell-tops are partially covered by a layer of drill cuttings that had been discharged under permit from the drill cuttings chute which terminates above the cell-tops, it is reasonable to assume that the tri-cells also contain some amount of drill cuttings.

If derogation were granted for the Bravo GBS, any drill cuttings in the tri-cells would remain undisturbed. It is very unlikely that any programme of work that may be undertaken to manage the drill cuttings on the tops of the cells or the materials in the oil storage cells, the minicell annulus or the drilling legs, would disturb the tri-cell cuttings. Our assessments have shown that if tri-cell cuttings have the same chemical characteristics as

the cell-top and seabed OBM cuttings piles, then they would not exceed either of the thresholds in OSPAR Recommendation 2006/5 for the management of drill cuttings. In such circumstances the recommended option for these cuttings piles is to leave them in place, undisturbed, for natural degradation. If remedial work were required on the tri-cell drill cuttings, our judgment is that it would be much easier to perform any operations after the topside had been removed, when a vessel could work over the top of the caisson and gain more direct access to all of the cells.

4.3.7 Conclusions

Consideration of the application to remove the GBS topsides can be de-coupled from decisions about the management or fate of any of the above materials for the following reasons:

- Attic oil: We have committed to removing the attic oil and the best way of doing this is through new subsea access holes drilled into the cap of every cell. The oil will either be evacuated, under permit, via the oil export pipeline before the removal of the topsides or pumped to a vessel for recycling onshore after the removal of the topside
- Interphase material: We have committed to removing this material at the same time as we remove the attic oil. It will either be evacuated with the attic oil, under permit, via the oil export pipeline or pumped to a vessel and returned to shore for recycling and/or disposal after removal of the topside
- Water: The remediation of the water phase will be linked to the selected remediation option for the cell sediment. If treatment were not required for the cell sediment but was required for the water phase, we have identified options to remediate the water phase both before and after removal of the GBS topsides. The topsides are therefore not required to deal with the water phase. As with the attic oil and interphase material, however, we do not preclude the use of the topsides and platform-based ROVs to optimise this recovery and bring forward part or all of this work if the technical development/engineering progresses before the planned lifts
- Cell sediment: Detailed studies have shown that there are no technically feasible options for the management of this material that require the use of the GBS topsides or their existing facilities, or the existing GBS platform wells or any new wells that could be drilled from the GBSs. The GBS topsides would, therefore, not be required in any management option for the cell sediment. We have completed CAs of options for the management of this material and these are presented in full in the GBS Contents TD [8] and summarised in the Brent Field DP [2]
- Material in minicell annulus: We have completed CAs of options for the management of this material and these are presented in full in the GBS Contents TD and summarised in the Brent Field DP. The options include credible options for both the treatment and the removal of this material either before or after the removal of the GBS topsides
- Material in drilling legs: We have completed CAs of options for the management of this material and these are presented in full in the GBS Contents TD and summarised in the Brent Field DP. The options include credible options for both the treatment and the removal of this material either before or after the removal of the GBS topsides
- Drill cuttings in tri-cells: If present, we would recommend that any cuttings in the tri-cells should be left in place, undisturbed to degrade naturally. If for any reason the tri-cell cuttings had to be removed any such operation would be conducted from a vessel, not from the GBS topsides

5 PROGRAMME OF WORK FOR REMOVING AND DISPOSING OF TOPSIDES

5.1 Introduction

A separate DP for the Delta topside [1] was approved in July 2015, and since the submission of the Consultation draft of the Brent Field DP in February 2017 the Brent Delta Topside has been successfully removed by the SLV *Pioneering Spirit* and delivered to the ASP facility at Teesside. The description and illustration of the proposed programmes of work to remove the Alpha and Bravo topsides by SLV therefore draws on the information and experience we have now gained with the Delta topside. The Charlie topside will probably be dealt with in a very similar way to achieve the same objectives, but will be subject to a separate decision by the Owners.

We have not been able to identify any technically feasible and economically viable alternative uses for any of the Brent facilities, either for oil and gas or non-oil and gas opportunities. Accordingly, all the installations will have to be decommissioned and their topsides will be completely removed regardless of which decommissioning option is approved for the substructure.

The sections below summarise our proposed generic programme of work for removing the Alpha, Bravo and Charlie topsides. Although details of the programmes of work will vary from installation to installation, the Alpha, Bravo and Charlie topsides are not so different in terms of their structure and components that unique programmes have to be devised for each one. The procedures used to strengthen the topsides before lifting, and to set-down and support the topsides on the cargo barge, may not be exactly as described below. In particular, the configuration of the jacket and PGDS supporting the topside on Alpha will require a specially-designed lifting arrangement.

5.2 Methods for the Removal of Brent Topsides

5.2.1 Introduction

The topsides of the Alpha, Bravo and Charlie platforms are large, heavy and complex structures (Section 3). Their size and weight inform the range of technically feasible options available for their removal, and the safety risks and costs of each main type of removal option.

All of the Alpha topside was put in place after the jacket had been floated out to the Field and piled to the seabed. It is not technically possible to return the topside to shore by either refloating the jacket or lifting the jacket with the topside in place.

On Bravo and Charlie, major components of the topside were put in place on top of the legs before the installation was floated to the Field and ballasted down onto the seabed. However, as described in detail in the Bravo, Charlie and Delta GBS Decommissioning TD [10], and summarised in the Brent Field DP [2], it is not technically feasible to remove the topsides to shore by refloating either of these installations; the weight of the installations has increased, and it is not possible to achieve enough buoyancy for successful and safe refloating and onshore dismantling.

5.2.2 Technically Feasible Options for Topsides

We reviewed possible methods for removing the whole of each topside, considering its weight and construction, and its original method of placement. Historically, topsides have been removed by one of three methods:

1. Heavy lifting: The whole of the topsides is removed in one piece using a heavy lift vessel. A small number of cuts are needed to separate the topside from the substructure, but considerable planning is required to ensure that the topside is strong enough to be lifted away as a single unit.
2. Offshore dismantling: Large sections, components or modules in a topside are separated from the rest of the topside offshore, and removed in a series of lifts by a heavy lift vessel.
3. Piece-small dismantling: The topside is cut into a large number of small pieces and components which are removed individually or in skips.

5.2.3 Proposed Removal Method

After detailed technical and engineering studies we have decided to remove the Brent Alpha and Brent Bravo topsides using the single lift vessel (SLV) *Pioneering Spirit*. The topsides will be transported to the Able Seaton Port (ASP) facility at Teesside, operated by Able UK Limited (Able), for dismantling, recycling and disposal. The Brent Charlie topside will also be removed by SLV, but its dismantling and disposal will be subject to a separate decision by the Owners.

5.3 Decommissioning the Brent Field Wells

Since 1974 a total of 399 wellbores (388 excluding wells where conductors only were run) have been drilled in the Brent Field, from 154 platform well slots and the 3 subsea wells at Brent South.

The campaign to 'plug and make safe' the Brent wells began in 2004 with the three Brent South subsea wells. All of the Brent Field wells are being decommissioned in accordance with the Oil and Gas UK (OGUK) *Guidelines for Suspension and Abandonment of Wells* [6].

The campaign to 'plug and make safe' the Brent platform-based wells started in December 2008 and will continue until about 2020. All the work is carried out from the platforms as part of the end-of-life activities before and after CoP. The programmes use the existing drilling derricks and other equipment on the platform, and are carried out under all necessary permits, including those required under the *Offshore Chemicals Regulations* [13].

Details of the P&A programme, and information on the status of every Brent Field well, is provided in the Brent Field DP [2]. In summary, as of 1 April 2018, the status of the wells on the Brent installations was as follows: Alpha, permanent barriers have been set on 14 of the 28 wells; Bravo, all 37 wells have been fully decommissioned; Charlie, 5 of the 40 wells have been decommissioned.

5.4 Condition of Facilities after CoP

Bulk hydrocarbons are present in the process system and in the general inventory of the various tanks and pipes on the topsides. The fuel gas parts of the topsides process systems are still in use on Alpha and Bravo (Charlie is not yet in CoP). When the process systems are no longer required after CoP, we will complete and record a programme of draining, purging, flushing and venting, following a Shell work instruction, as was carried out on Delta. As a safety measure, additional vents may be created at selected locations in the topside process system to ensure they are not recharged from any trapped inventories. All drained systems will be left open to the atmosphere to allow free-venting to occur so that gases do not build up.

Pipes and tanks in the topsides will be cleaned to the extent required to ensure that there is no risk to personnel or the environment during the removal of the topside, but final cleaning may be undertaken onshore where cleaning can be carried out more efficiently and safely.

The removal of hydrocarbons that are not part of the process system will be performed in a second scope which we call 'Environmental Cleaning'. This scope consists of a third party carrying out a full survey of the inventory offshore, and then completing a programme of work to remove the full inventory. This work is tracked and audited, recording details of all the materials removed and their final destination and disposal. The drainage systems on the platform will continue to operate as normal while the inventories of oils and chemicals on the platform are reduced. After CoP the majority of the chemical tanks will not be needed, and will be drained down and flushed. The drains tank 'oil side' will continue to be pumped to storage cells until the final export run.

Due to the location of the topside lifting points on Bravo, the open hazardous drains tank has to be removed (a similar scope of work was executed on Delta). Before this tank is removed the affected drains will be surveyed to verify the sources/modules currently feeding into the drains and the location of any inventory nearby that could potentially leak to the drains.

Each drain gully will then be dealt with on a case-by-case basis. For example, where a piece of equipment regularly discharges into a drain, the drain will be plugged and a routine established to regularly check and pump out the drain gully. The majority of module drains (not exposed to weather) will be flushed and blocked, and so will not be left open to sea. The remaining drains (exposed to weather) will be jetted to

remove any contaminants but will be left open to sea; temporary bunding will be installed around any remaining source of contamination and this will be regularly monitored.

The risk of contamination of the drains will thus be minimised as a result of a much-reduced inventory and the management of the drains system.

The F-gas (fluorinated gases) inventories are needed to support the HVAC⁹ system, galley equipment and other essential utilities until the topsides are down-manned. The leak-testing of F-gases will continue as per the Regulations while the platform is manned. Consequently, this inventory will still be present on the topsides during the period between down-manning and topside lift.

Once a topside has been loaded-in, the F-gas inventory will be removed as part of the initial dismantling scope. A specialist contractor will be engaged to remove this material and the records will be provided to Shell as part of the Waste Map (i.e. part of our Duty of Care assurance).

If there is a scenario where a topside is unmanned and a leak test is due, then we will discuss the situation with the Regulator to identify an appropriate and safe way forward.

5.5 Preparation of Topsides for Removal

After the completion of the P&A programme, the topsides will be prepared for decommissioning and will change from operating in a 'hot' mode to a 'cold' mode. Stocks of chemicals will be reduced to the minimum required for the safe operation of the platform. All pressurised hydrocarbons will be removed from the topsides systems. Measures will be taken offshore to ensure that piping, tanks, vessels and void spaces are either drained, or suitably closed or sealed, to minimise the risk that contaminants would be spilled during removal or transit. All hydrocarbons and other wastes collected by these procedures will be contained, collected and transported to shore for recycling or disposal.

The topsides modules will be strengthened with additional steel plates, because they were not designed to be lifted away in one piece. Carefully designed lifting points will be attached on the underside of the supporting structure (Module Support Frame (MSF) or Truss Deck) to receive the loads exerted by the SLV's lifting beams. Most of this work will be undertaken from temporary scaffolding built under the MSF.

On Brent Delta, because of the long interval between cutting the legs in 2016 and removing the topside in 2017, we attached 'shear restraints' inside the legs. These strong steel structures, each weighing some 36 tonnes, were bolted in place just at the height of the cut line to ensure that the topside remained firmly in place after the cuts had been made. A restraining system may also be required on Bravo and Charlie.

No significant environmental impacts are expected from any of these preparatory activities.

On the GBS legs and on the Alpha jacket, as a precaution, we will remove down to about -20m LAT any external steel risers and caissons that could damage the hull of the SLV in the unlikely event of an interaction with the GBS.

5.6 Cutting the Legs

All the cuts will be made using a DWC system. On Alpha, the DWC will be deployed by a suitable vessel to make 18 cuts at approximately 6.5m above sea level. On the GBSs, the legs will be cut *from the inside* by making a series of DWC cuts 'on the tangent' through holes drilled in the legs. On Bravo, the legs will be cut at a height of approximately 19.8m above sea level, but on Charlie, with its long steel transition piece, the cuts will be made at approximately 7m above sea level, that is below the existing steel transition piece.

⁹ HVAC, Heating, Ventilation, Air-Conditioning

5.7 Removal of Topsides

The SLV will move into the Field and take station close to the platform, operating on Dynamic Positioning (DyP), and then will move under the topsides. The lifting beams of the Topside Lifting System (TLS) will be slid under the topsides and the dynamic lifting jacks will be located onto each of the lifting pads on the underside of the topsides. When all is ready, the hydraulically-operated jacks will be activated to carry out a 'fast lift' whereby the topsides are raised 1.5m clear of the tops of the legs in about 90 seconds. Once clear, the SLV will move away from the legs and begin the process of securing the topsides to the lifting beams, for transportation to shore (Figure 10).

Before leaving the Field, the SLV will place new 300 tonne concrete caps over the cut end of each GBS leg. On Bravo and Charlie, one of the caps will carry an Aid to Navigation (AtoN) (Figure 11). On Charlie, one of the legs will be fitted with a new 22m long steel extension piece in order to ensure that the AtoN is clear of wave action. On Alpha, if the upper jacket is not removed immediately after the removal of the topside, an AtoN will be designed and fitted to the top of the jacket, or a buoy positioned at the site, in order to meet the Consent to Locate requirements and to alert shipping.

We will submit appropriate navigation information to the UK Hydrographic Office (UKHO) so that Notices to Mariners can be issued.

The design and specification of the AtoNs, and appropriate measures for their maintenance, will be discussed and agreed with the relevant authorities, including the Northern Lighthouse Board.

We will consult with BEIS if we are unable to fit caps to the open end of each GBS leg or fit AtoNs after removal of the topsides.

In good conditions, it is planned that the whole lifting operation will take about 2 days and that the SLV will operate around each installation for a total of about 4 days. The majority of vessel activity associated with topside decommissioning will occur within the existing 500m safety zone. As shown in the schedule (Section 6), we plan to remove only one topside in any one summer season.

The topside will be considered 'cargo' in this phase of the project, and because it contains some hazardous materials that are subject to special permitting requirements, these materials will be itemised in the vessel's cargo manifest; all necessary permits and consents will have been obtained for the carriage and movement of these materials. The removal and transportation of Low Specific Activity (LSA) scale, for example, will be in accordance with the *Radioactive Substances Act (RSA) 1993* [14]. All sealed radioactive sources, for example in instruments and gauges, will be transported in accordance with the requirements of the *Radioactive Substances Exemption (Scotland) Order 2011*.

Figure 10 TLS Beams Extending from both Hulls of the Pioneering Spirit, in Preparation of the Brent Delta Lift, April 2017



Figure 11 Fitting the Concrete Caps and AtoN to the Brent Delta GBS Legs, April 2017

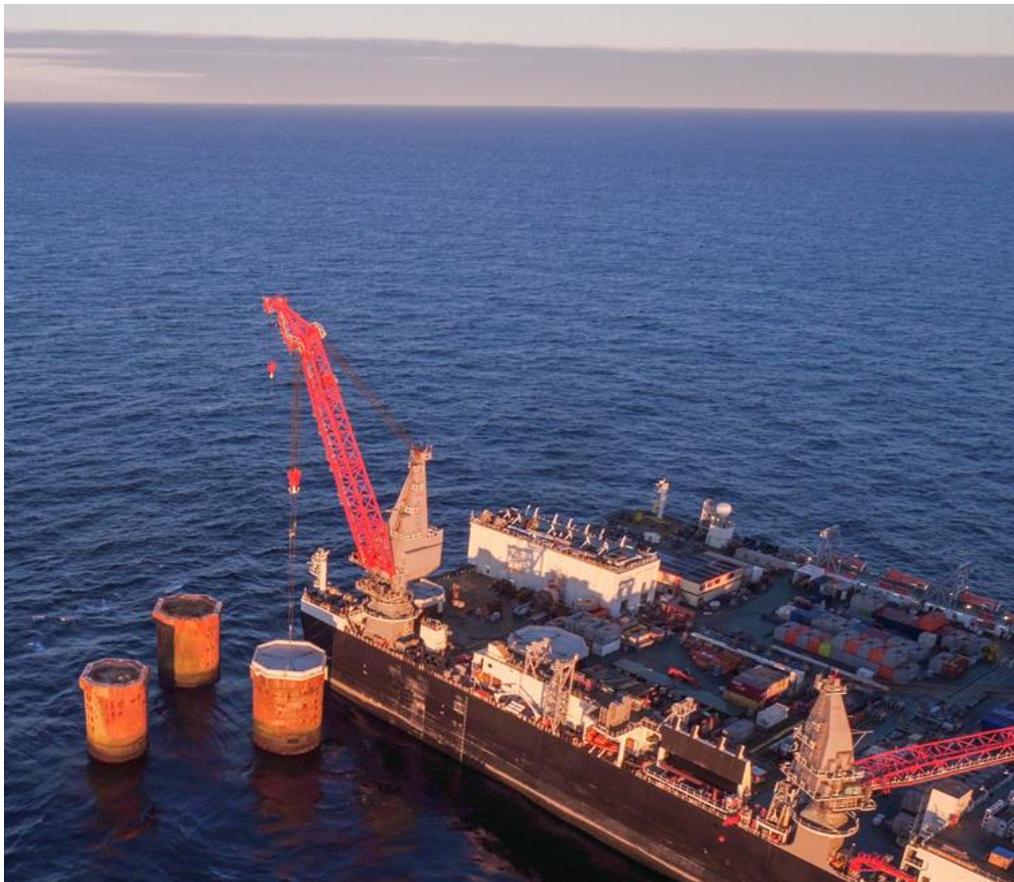


Figure 12 Condition of Brent Bravo GBS after Removal of Topside

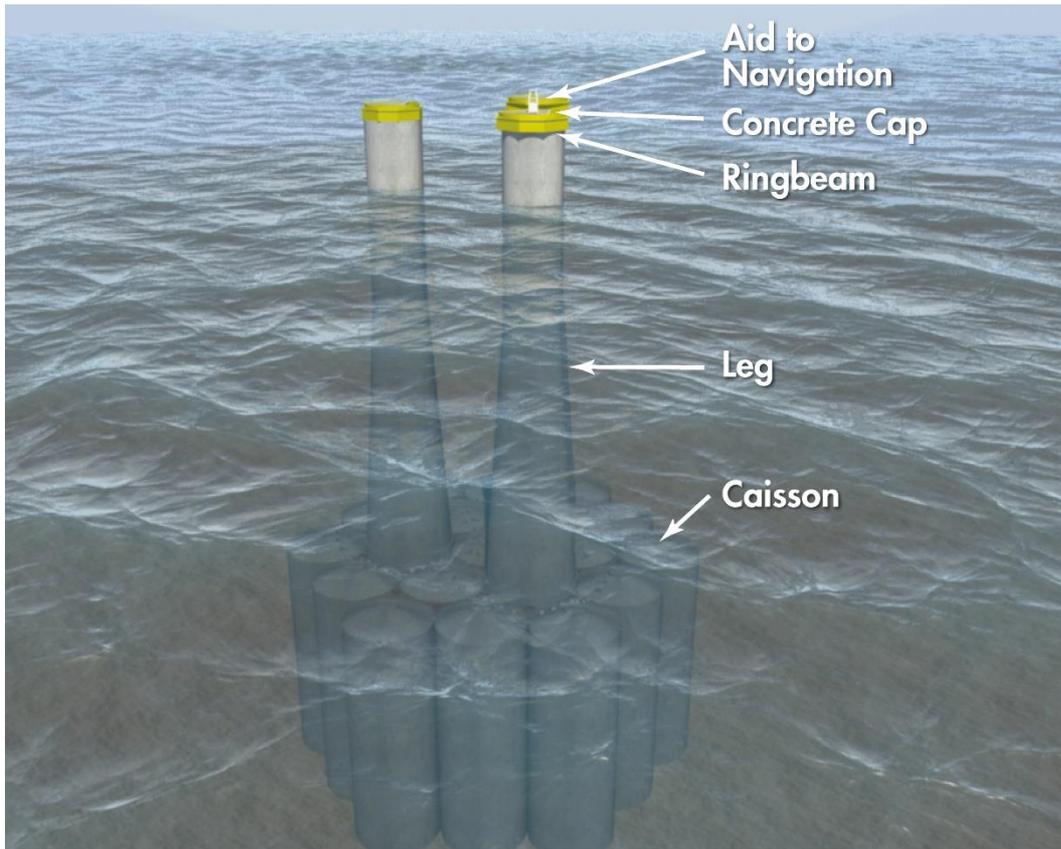


Figure 13 Condition of Brent Charlie GBS after Removal of Topside

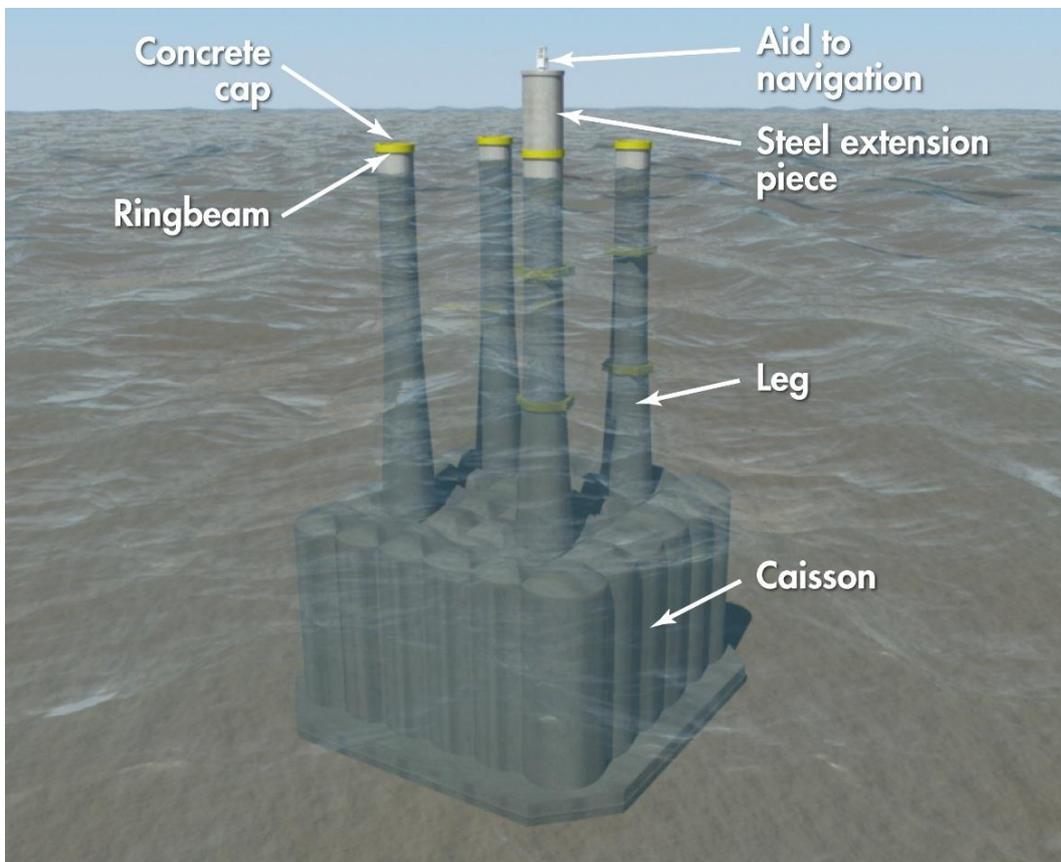


Figure 14 Top of the Brent Alpha Jacket after the Removal of the Topside

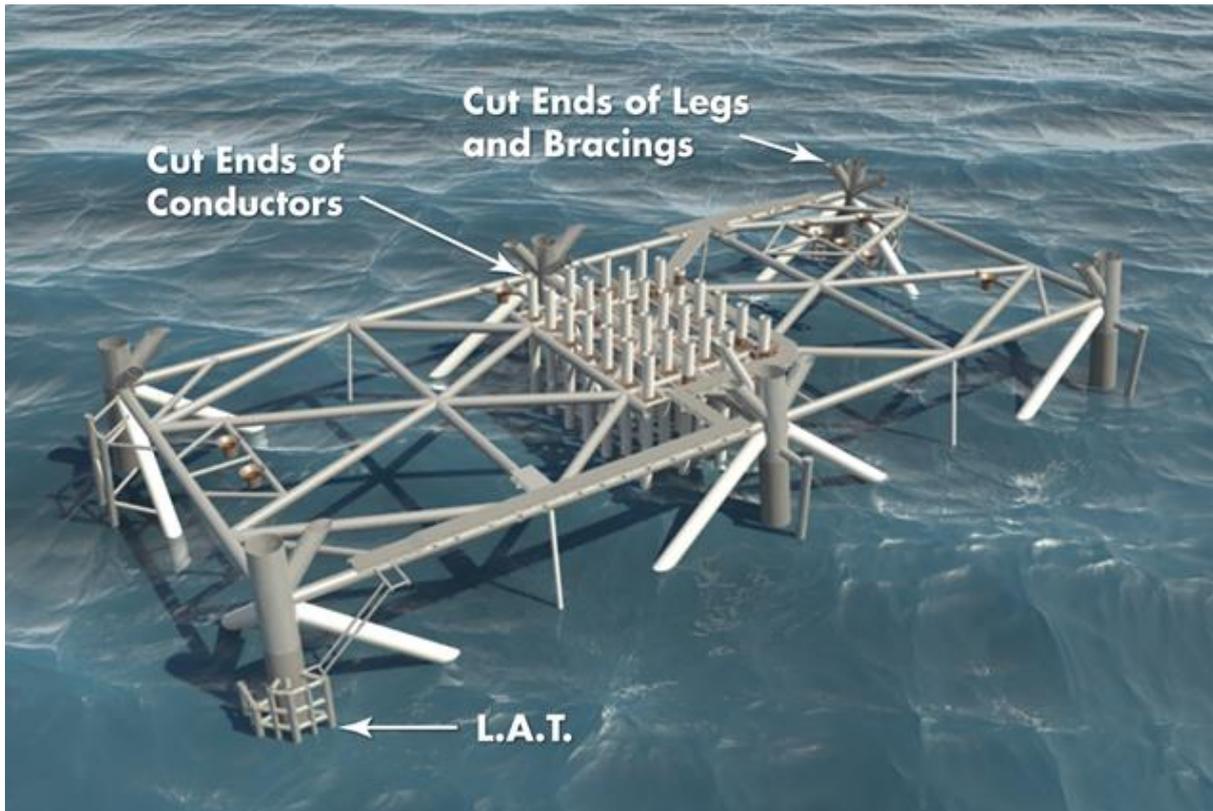


Figure 15 Transferring the Brent Delta Topside to Barge Iron Lady at Nearshore Transfer Site, May 2017



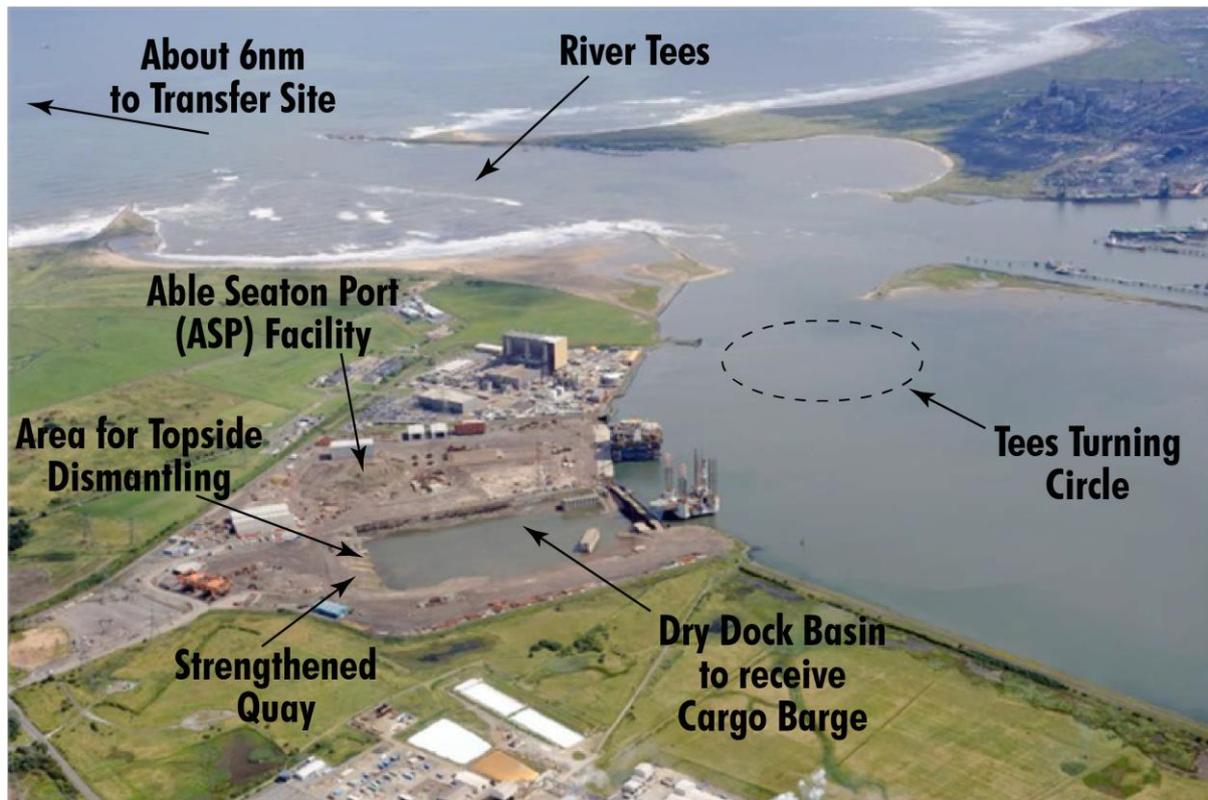
5.8 Onshore Dismantling

It will take the SLV about 2 days to transport a topside from the Field to the northeast coast of England. At a designated transfer site 5.5 nautical miles (nm) northeast of the River Tees, the topsides will be transferred from the SLV onto the new cargo barge *Iron Lady* (Figure 15). Barge transfer is required because the Able quayside is too shallow for the SLV. At the ASP facility, the topsides will be skidded off to the quayside at Quay 6 where they will be dismantled (Figure 16 and Figure 17). The dismantling of the Charlie topside will be subject to a separate decision by the Owners.

Figure 16 Delta Topside Skidded onto Quay 6 ASP Facility Teesside, May 2017



Figure 17 Aerial Photograph of the ASP Dismantling Facility on Teesside



The essence of the programme of work proposed by our dismantling and disposal contractor Able is to quickly reduce the height of each topside by cutting it into sections and pulling the sections to the ground, where it will be safer and easier to dismantle them. In this 'cut and pull' method, the internal and external walls will be partially cut by a variety of 'hot' and 'cold' cutting techniques, then connected by wire ropes to a large vehicle which will pull the section to the ground inside a designated drop zone (Figure 18). A thick bed of sand will be laid around the topside to absorb the shock of these falling sections. Figure 19 shows this procedure being enacted for the Brent Delta topside; a 300 tonne module is being pulled to the ground and falls on a bed of sand on the quay.

Dismantling operations at the ASP facility will be performed in accordance with *British Standard BS 6178:2011 Code of Practice for Full and Partial Demolition* [15].

Figure 18 Cut and Pull Method for Initial Dismantling of a Brent Topside at the ASP Facility

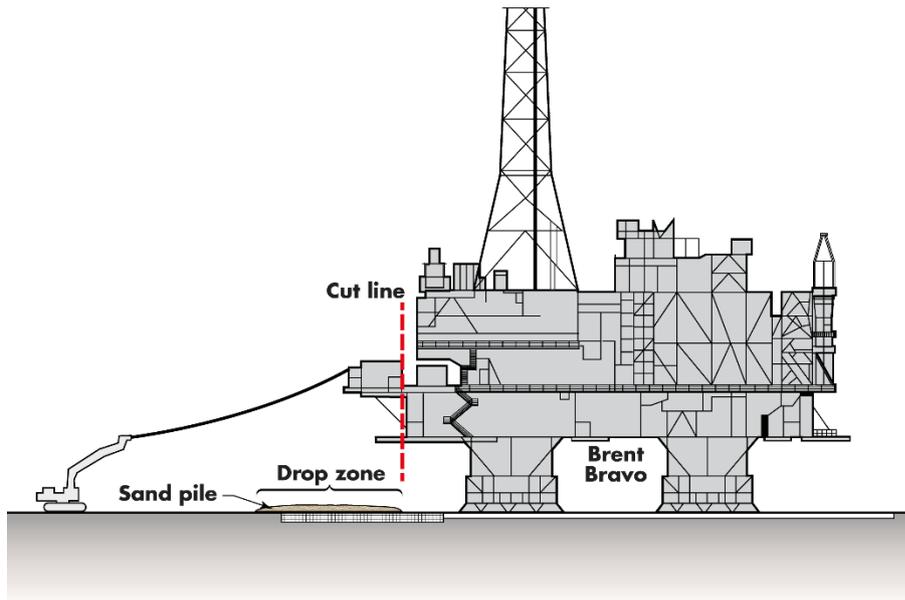
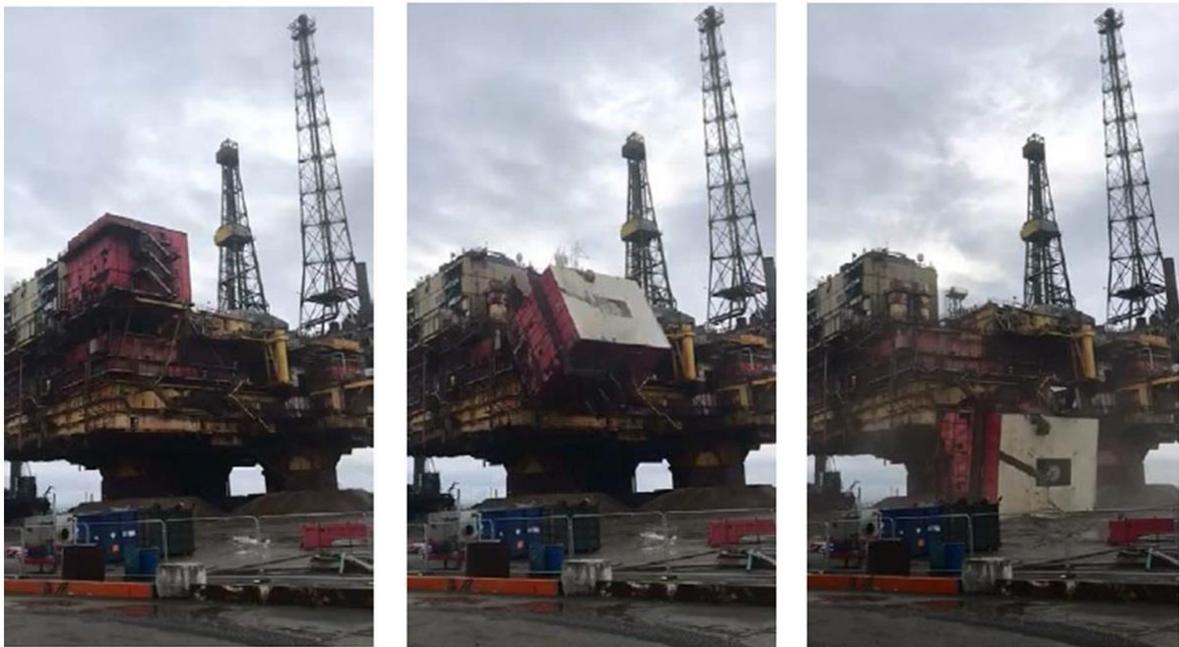


Figure 19 Removing a Large Topside Module by 'Cut and Pull'



5.9 Management, Recycling and Disposal of Waste

A description of onshore dismantling and the management and disposal of material is provided in the Topsides TD [7]. The programme of work for removing, dismantling and disposing of the Delta topside is described in a separate DP which has already been approved by BEIS [1].

Onshore dismantling will reduce the topsides into their component materials or 'waste streams'. These will be segregated and stored on site before being transported to other onshore facilities for re-use, recycling or disposal as appropriate. On the basis of the present topsides inventory, we plan to recycle at least 97% by mass of topsides material which is returned to shore (Table 6). All material will be tracked from its present offshore location to its final destination.

6 SCHEDULE

6.1 Introduction

Planning for the Brent Decommissioning Project began in 2006, the lengthy programme to plug and make safe the wells started in 2008, and preparatory work offshore on topsides modules and systems began in 2009. All this work was and is being done under all necessary permits and licences to prepare for decommissioning, and can be carried out in advance of the submission and approval of the Decommissioning Programmes. None of the preparatory work would or will foreclose or eliminate any feasible option for the decommissioning of any of the facilities.

6.2 Proposed Programmes of Work

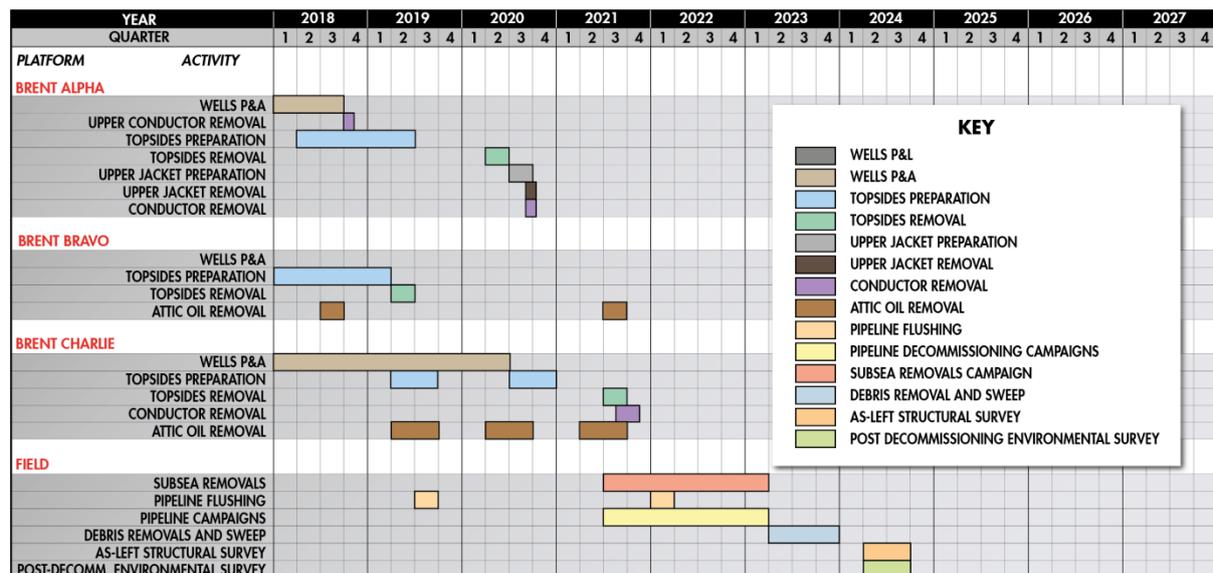
Figure 20 outlines the main phases of work in the decommissioning programmes and their approximate duration. This schedule has been developed with reference to:

- The agreed CoP dates for the installations
- The requirement to plug and abandon the wells safely and efficiently
- The operational and logistical interactions between the four installations, the Brent Field pipeline system, the export system, third-party pipelines and installations, and the Brent Bypass Project
- The time required to prepare and obtain approval for the necessary licences and consents
- The programme of work for removing the attic oil from the GBS oil storage cells

The exact timing and durations of activities will depend on many factors including the contractors selected, the equipment, vessels or procedures they propose to use, and the possibility of devising ‘campaigns’ to complete common or repeated operations in the most cost-effective way. We will continue to review and learn from our ongoing activities. We will subsequently discuss and agree with BEIS any changes to the proposed methods of execution outlined in this DP.

There are no licence conditions or environmental sensitivities (Section 2 and Section 7) that might influence the time of year when certain activities should be undertaken. We estimate that all the offshore and onshore operations associated with the topsides will be completed and verification and close-out reports submitted (Section 9) by 2023.

Figure 20 Indicative Timing and Duration of the Proposed Brent Field Decommissioning Programmes of Work



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7 ENVIRONMENTAL IMPACT ASSESSMENT

7.1 Introduction

DNV GL prepared the *Brent Field Decommissioning Environmental Statement* (ES) [16], on behalf of and as endorsed by Shell U.K. Limited and Esso Exploration and Production UK Limited, the Brent Field owners. The ES presents the results of the environmental impact assessment (EIA) which was completed in accordance with the requirements of the DECC Guidance Notes [5] and the UK *Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) (Amendment) Regulations* [17].

This section presents:

1. Descriptions of the environmental settings in which the topsides decommissioning activities will take place.
2. A summary of the methods that were used to assess the potential impacts of the proposed programmes of work.
3. A summary of the mitigation measures proposed to reduce or eliminate potential impacts.
4. A summary of comments received from Stakeholders and consultees on the proposed programmes of work to remove the topsides.

The EIA and ES are based upon the 2007 pre-decommissioning seabed and 2011 cell-top surveys by Gardline [18], [19] and [20]. During the preparation of the ES and the DP, a further pre-decommissioning survey was completed in 2015 by Fugro EMU and is presented in a series of Pre-Decommissioning Environmental Survey Data Reports [21], [22], [23], [24], [25], and a *Brent Field Temporal Report Block 211/29* [26] which examines changes in the extent of perturbation and effects on the benthos over time across the whole Field. The 2015 survey endeavoured to re-sample all the grab sample and reference stations from the 2007 surveys although this was not always possible. The core (box, core, ROV) sample stations were not revisited in 2015, although the 2015 survey did include the sampling of the Delta tri-cells and around the base of the Delta GBS; some of these stations are comparable with the 2007 core sample stations. The 2015 survey also sampled new areas of the seabed to fill in identified data gaps and sampled new reference stations for the Field.

The results from the 2015 seabed environmental survey were not available in time for the submission of the consultation draft DP document. However, DNV GL have reviewed the results of this survey and presented the following statement:

DNV GL believe that the 2015 Brent Field survey data indicates that the Brent Field is, in general, recovering over time (which is to be expected given biodegradation processes and bioturbation). As such, DNV GL consider that the environmental impact assessment (and thus the CA scores), which are based on the 2007 Brent Field survey data, do not require amendment or updating to reflect the 2015 Brent field survey data.

Information on the spatial and temporal changes and trends in the physical, chemical and biological characteristics of the seabed adjacent to each of the five Brent sites is presented in more detail in the ES [16] and in the *Brent Field Drill Cuttings Decommissioning Technical Document* [27].

7.2 Environmental Sensitivities

The decommissioning of the Brent topsides will be undertaken within several 'environmental settings' – the offshore environment of the Brent Field, the tow route to Teesside, the nearshore transfer site off the River Tees and the ASP facility at Teesside.

The Brent Field: The environmental setting of the Brent Field is summarised below in Table 7 and Table 8. A full description of the physical, biological and socio-economic environments in the Brent Field is presented in the ES [16].

The character of the benthos, and in particular the changes that have occurred as a result of the permitted discharge of cleaned oily cuttings and the recovery that has begun since those discharges ceased in 1996, are well documented by a series of seabed surveys, the most recent of which was in 2015. All the offshore activities for the decommissioning of the topsides will occur within the 500m safety zones around the three installations, areas which have been covered by all the benthic surveys.

Table 7 Summary of the Physical, Biological and Socio-economic Environments in the Brent Field.

Aspect	Summary Data			
Water column	Water depth	140.2 to 142.1m	Tidal range	1.83m
100 year return wave	Amplitude	26.2m	Period	15.5 seconds
Maximum current speeds	Surface	0.86m.s ⁻¹	Seabed	0.46m.s ⁻¹
Water temperature	Maximum	13°C	Minimum	6°C
Seabed sediments	Muddy sand, with holes and mounds created by burrowing fauna especially Norway lobster <i>Nephrops</i> .			
Benthos	Characterised as 'North British Coastal zone' and 'offshore Northern North Sea', dominated by polychaetes, crustaceans, bivalves and echinoderms.			
Fish	Demersal and pelagic species, predominantly cod, haddock, whiting and herring. Platform located within spawning areas for herring, whiting, lemon sole, Norway pout, sandeels, sprat and <i>Nephrops</i> .			
Shellfish	Norway lobster <i>Nephrops</i> .			
Marine mammals	Low densities of cetaceans; most commonly occurring species are harbour porpoise and white-beaked dolphin. White-sided dolphin, Risso's dolphin, bottlenose dolphin, fin whale and minke whale have also been recorded.			
Seabirds	Important area for seabirds, particularly in summer, especially guillemot, fulmar, kittiwake and razorbill. Other species include puffin, herring gull, little auk, arctic tern, gannet, great skua, arctic skua, sooty shearwater, cormorant and common tern.			
Conservation interests	Marine mammals are designated species. There are numerous colonies of coral <i>Lophelia pertusa</i> on all four installations. The nearest offshore SAC ¹⁰ is Braemar Pockmark, 225km away.			
Commercial fishing	The relative value of commercial fisheries in ICES ¹¹ rectangle 51F1, in the Brent Field area, is 'Moderate' to 'Low'. Fishing effort in 51F1 is 'Low' and dominated by demersal gear types.			
Shipping	Within 50km there are 14 recognised shipping lanes, used by 8,430 vessels each year. Shipping density in the Brent Field ranges from 'low' to 'very low'.			
Nearest oil and gas activities	Stafford Field, 9.6km to the northeast.			
Commercial activity	With the exception of oil and gas activity, and commercial fishing, there is no other commercial activity at the site.			
MOD activity	None.			
Wrecks	Nearest marked wrecks are 9km away from Brent Alpha and Brent Bravo.			

¹⁰ SAC, Special Area of Conservation.

¹¹ ICES, International Council for the Exploration of the Sea.

Table 8 Environmental Sensitivities in the Brent Field.

Environmental Receptor	Main Features
Conservation Interests	There are no known Annex I habitats in the Brent Field area. Of the four Annex II species only the harbour porpoise has been sighted in the Brent Field area, with low abundance in February, from April to September and in December.
Seabed	The only significant seabed features are the Brent platforms, associated pipelines and drill cuttings piles. Surveys at Brent Alpha, Bravo and Charlie indicate elevated concentrations of total hydrocarbons and of heavy metals in the seabed sediments at all three sites. At distances of >500m from each installation, the concentrations of hydrocarbons had fallen to <50mg/kg, and the concentrations of heavy metals had fallen to concentrations similar to those at the (distant) reference stations. Benthic communities in the Brent Field area are similar to those found throughout a large surrounding area of the northern North Sea.
Fish	The Brent Field is located in spawning grounds for cod (January to April), haddock (February to May), Norway pout (January to April), saithe (January to April), sandeel (November to February) and whiting (February to June), and within nursery grounds for anglerfish, blue whiting, European hake, haddock, herring, ling, mackerel, Norway pout, sandeel, spurdog and whiting (throughout the year).
Fisheries	The relative value of commercial fisheries in ICES rectangle 51F1, in the Brent Field area, is 'Moderate' to 'Low'. Fishing effort in 51F1 is 'Low' and dominated by demersal gear types.
Marine Mammals	Marine mammal species occurring in the Brent Field area are harbour porpoise, killer whale, minke whale, sperm whale, white-beaked dolphin and white-sided dolphin. The majority of sightings have occurred during spring and summer.
Birds	Seabird vulnerability to oil pollution in the Brent Field area (Block 211/29 and adjacent blocks) is 'High' in January, March and July, and between September and November. The overall vulnerability in the area is 'Low'.
Other Users of the Sea	Shipping density in the Brent Field ranges from low to very low.
Atmosphere	Local atmospheric conditions are influenced by the day-to-day operations of the Brent Alpha, Bravo and Charlie platforms and associated vessels.

Transportation route to shore and transfer site: We have contracted Able UK Limited to dismantle and dispose of three topsides (Alpha, Bravo and Delta), and this work will be undertaken at the ASP facility on Teesside. The characteristics of the offshore route from the Brent Field to the River Tees, and the nearshore transfer site off The Headland at Hartlepool, are described in the ES [16] and summarised in Table 9. The proposed transit route passes twelve offshore conservation areas and directly through one conservation area, the NE of Farnes Deep Marine Conservation Zone (MCZ). The transfer site is outside but close to areas of potential Annex 1 sandbank and reef habitats (Figure 21). Numerous conservation areas are present within a 40km radius of the centre of the proposed transfer site.

Figure 21 Location of the Transfer Site off the River Tees

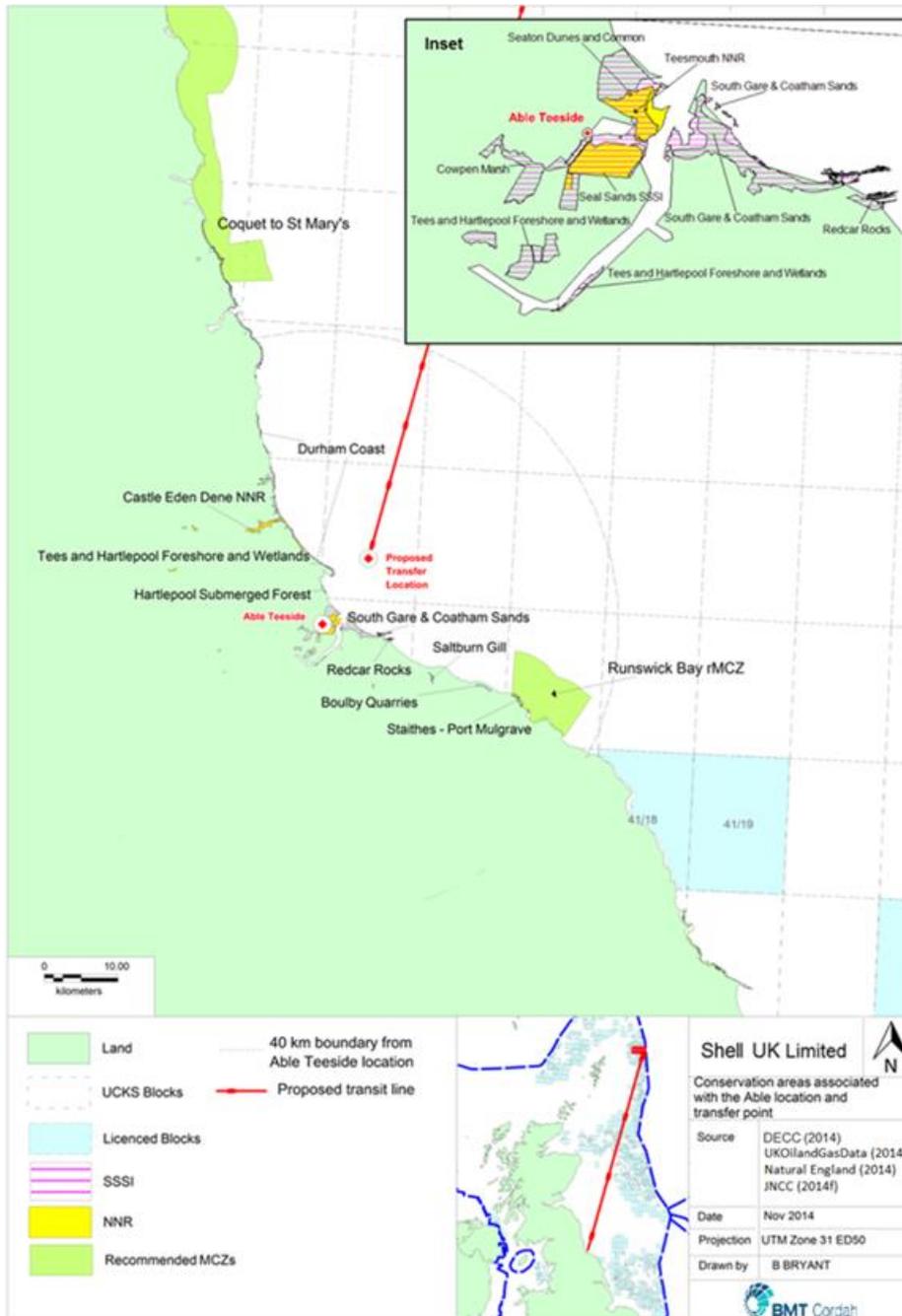


Table 9 Environmental Sensitivities along the Tow Route and at the Transfer Site.

Environmental Receptor	Main Features
Conservation Interests	<p>The transit route passes twelve offshore conservation areas and directly through one conservation area, the NE of Farnes Deep MCZ. This MCZ protects a large area with a variety of seabed sediments and a wide range of associated species. The MCZ is not cited to be of particular importance to marine mammals. The route passes across seabed sediments exhibiting a wide range of associated seabed species including ocean Quahog, seapens and burrowing fauna. The transfer site is outside but close to areas of potential Annex 1 sandbank and reef habitats. Numerous conservation areas are present within a 40km radius of the centre of the proposed transfer site. The transfer site is approximately 10km from both the Teesmouth and Cleveland Coast Special Protection Area (SPA) and Ramsar site, and the Teesmouth National Nature Reserve (NNR). Along the coast to the north are the Durham Coast Site of Scientific Interest (SSSI), Hart Warren SSSI, Castle Eden Dene NNR, Tees and Hartlepool Foreshore and Wetlands SSSI and Hartlepool Submerged Forest SSSI. On the coast to the south are Redcar Rocks SSSI, Staithes–Port Mulgrave SSSI and Runswick Bay MCZ. There are several other designated sites located within the Tees estuary. The Annex II species harbour porpoise has been sighted in the area throughout the year along with both grey and common seals.</p>
Seabed	<p>Sublittoral sand (classified as A5.2 in the European Nature Information System) dominates the sediments in the nearshore waters along the route to the transfer site. Sediments from the transfer site to the ASP facility range from Atlantic and Mediterranean moderate energy circalittoral rock (A4.2) to Atlantic and Mediterranean low energy infralittoral rock (A3.3).</p>
Fish	<p>The transfer site is in ICES rectangle 38E8 which is within spawning grounds for lemon sole (April-September) and <i>Nephrops</i> (January-December), and nursery grounds for whiting, cod, herring, plaice and spurdog.</p>
Fisheries	<p>The transit route passes through several fishing grounds and the area around the transfer site is of 'Low' to 'High' relative value for fishing. Fishing effort is 'Low' to 'Moderate' and is dominated by demersal and shellfish fisheries.</p>
Marine Mammals	<p>Harbour porpoises, white-beaked dolphins and white-sided dolphins have been sighted in the area throughout the year. The Teesmouth NNR is the site of the only regular breeding colony of common seals on England's north-east coast. Seal densities near the transfer site are expected to be higher during the pupping and breeding season (June to July for common seals and October to December for grey seals).</p>
Birds	<p>The Teesmouth and Cleveland Coast SPA and Ramsar site is approximately 10km from the transfer site and is designated to protect breeding, passage and wintering populations of birds including the Annex I species little tern and Sandwich tern. Over 1% of the biogeographic population of various migratory species use the site.</p>

Table 9 Environmental Sensitivities along the Tow Route and at the Transfer Site, Continued.

Environmental Receptor	Main Features
Other Users of the Sea	<p>The transit route passes through areas of existing dense activity associated with both offshore oil and gas and renewable energy. This comprises both surface structures (wind farms, platforms, drilling units) and subsurface structures (pipelines, umbilicals, manifolds, wells). The closest surface infrastructure to the proposed transfer site is the Teesside wind farm, located approximately 2km to the south-east. The route from the nearshore transfer site to the ASP facility will cross over the Ekofisk 2/4J to Teesside pipeline, but the transfer site itself has been selected to avoid this line.</p> <p>Shipping density along the transit route ranges from very low to high, and shipping traffic along the route is expected to comprise mainly oil and gas support vessels. Shipping density is considered to be high within the nearshore waters close to the transfer site and the ASP facility. The transfer site has been selected to avoid the main shipping approach lanes for the Tees and Hartlepool Marina.</p>
Atmosphere	<p>Atmospheric conditions along the transfer route are expected to be influenced by oil and gas platform operations and shipping. Nearshore atmospheric conditions are expected to be influenced by high levels of shipping activity and industrial activity around Teesside.</p>

Onshore dismantling, treatment and disposal sites: The characteristics of the short tow route into the River Tees, and the ASP facility and its environs, are described in the ES [16] and summarised in Table 10. A detailed description of the onshore facilities at the ASP facility is given in the ES and the Brent Toppides TD [7]. The ASP facility is located on the north side of the Tees estuary, adjacent to the Teesmouth NNR, where Annex II common seals and grey seals haul out at low tide. This is the only area on England's north-east coast where common seals regularly breed.

Table 10 Environmental Sensitivities in and around the ASP Facility at Teesside.

Environmental Receptor	Main Features
Conservation Interests	<p>The ASP facility is located on the north side of the Tees estuary adjacent to the Teesmouth NNR, an important seal haul-out and breeding site. The Teesmouth NNR is divided into two areas (i) the northerly area which overlaps the Seaton Dunes and Common SSSI (including the North Gare dunes and grazing marsh areas) and a small portion of the Seal Sands SSSI, and (ii) the southerly area which overlaps the Seal Sands SSSI. Cowpen Marsh and a small portion of the Tees and Hartlepool Foreshore and Wetlands SSSI lie to the west of the NNR. These sites are part of the Teesmouth and Cleveland Coast SPA and Ramsar site which provides internationally important habitats for migratory and wetland bird populations; the intertidal and sub-tidal areas of the SPA are designated as the Teesmouth and Cleveland Coast European Marine Site (EMS). The estuary area also includes the South Gare and Coatham Sands SSSI.</p>
Seabed	<p>The ASP facility is located on the sheltered Seaton Channel off the River Tees estuary. It covers 126 acres and includes a 25 acre deep-water basin/dry dock. The heavily industrialised estuary area around the ASP facility is surrounded by a variety of habitats including sandy, muddy and rocky foreshore, dunes, saltmarsh, freshwater marsh, seawalls, and extensive areas of intertidal mudflats.</p>

Table 10 Environmental Sensitivities in and around the ASP Facility at Teesside, Continued.

Environmental Receptor	Main Features
Marine Mammals	Annex II common and grey seals haul out on the sand banks at the Teesmouth NNR at low tide. This area has the only regular breeding colony of common seals on England's north-east coast.
Birds	The Teesmouth and Cleveland Coast SPA designation includes protection for the Annex I species little tern and Sandwich tern. In summer (April to August) little terns breed on the beaches along the Teesmouth and Cleveland Coast. Sandwich terns are abundant in the SPA on passage. During winter (October to March) the coastal habitats provide feeding and roosting opportunities for over 20,000 water birds. The SPA is used regularly by more than 1% of the biogeographic population of certain migratory species such as knot, redshank and ringed plover. The SPA is also home to nationally important populations of cormorant, shelduck, teal, shoveler, ringed plover and sanderling.
Onshore Communities	Much of the area around the ASP facility is industrial; the site is adjacent to Hartlepool Nuclear Power Station and close to the Huntsman Dioxide chemical plant, sewage works, industrial estates and oil storage depots. The site includes the Teesside Environmental Reclamation and Recycling Centre (TERRC) and is within 0.2km of the Seaton Meadows hazardous waste landfill site. The nearest residential area is 1.7km away at Seaton Carew, south west of Hartlepool.
Other Users of the Sea	The River Tees estuary is a busy area for commercial shipping and is also used for recreational sailing and boating.
Atmosphere	The ASP facility is situated within an area of heavy industry, with large amounts of CO ₂ (>10,000t/year) emitted from the surrounding sites including the Huntsman Dioxide chemical plant and the Seaton oil storage depot. There are no reports that high levels of dioxins, nitrogen oxides or particulates (PM10) are emitted, and both the ASP facility and surrounding sites have generally good levels of compliance with air quality permits. The nearest significant source of air pollution is the A1085 dual carriageway on the south side of the Tees estuary.

7.3 Summary of Method used to Assess Environmental Impacts

To complete the EIA and prepare the ES, DNV GL:

1. Described the possible programmes of work that would be undertaken to complete each of the short-listed options. This was done with reference to reports, studies and data supplied by the Brent Decommissioning Project (BDP) and through numerous interviews and meetings with each of the lead engineers on the BDP.
2. Described the 'environmental settings', all the locations and sites offshore, nearshore and onshore, where project-related activities or operations may be carried out. This was done with reference to site-specific offshore data gathered by the BDP, project-specific baseline descriptions provided in other studies, and published data.

3. Identified the types, number and possible severity of all potential impacts from the BDP in these settings. This was done by means of a scoping report the *'Brent Decommissioning Environmental Assessment Scoping Report'* prepared by DNV [28]. The scoping report was prepared following the international guidance given in the EU document *'European Commission (EC) Guidance in EIA Scoping'* [29] and the EU *'Guidance Checklist of Criteria for Evaluating the Significance of Environmental Effects'* [30]. It was published in June 2011, and stakeholders were invited to comment on its findings. Subsequently the scoping report was used to inform the detailed EIA that was reported in the Brent Field Decommissioning ES [16].
4. Calculated the total energy use and the total gaseous emissions of the proposed programmes of work. To prepare these estimates DNV GL used the widely-accepted method, reference data and factors in the Institute of Petroleum's (IoP) *'Guidelines for the calculation of estimates of energy use and gaseous emissions in the removal and disposal of offshore structures'* [31].
5. Identified those potential impacts that were considered significant, and assessed their effects in greater detail. This was achieved by scrutinising the results of the scoping report, and the comments and concerns expressed by stakeholders either in our programme of stakeholder engagement or as a result of the scoping report. Particularly significant or important issues were examined in greater depth, often by means of specialist third-party studies, reports or modelling.
6. Assessed the potential cumulative effects of the both proposed Brent Decommissioning Programmes. This was done by examining the phasing of the offshore and onshore work, the numbers and magnitudes of impacts, and the ways in which these impacts might overlap or interact spatially and temporally. Specialist studies and modelling by third-party experts were again used as necessary.

7.4 Assessment of Impacts and Presentation of Results

Following the EU guidance [30], potential impacts were assessed in terms of 12 criteria (Table 11).

Table 11 Criteria Selected to Examine Potential Environmental Effects.

Local Onshore: Effects of operations on local nearshore and onshore communities	Accidents: Effects of possible accidental events on the marine environment
Resource Use: Effects of the use of resources, such as fuel and raw materials	Employment: Assessment of possible employment effects from the option
Hazardous Substances: Effects of the presence, handling, treatment of hazardous substances	Legacy: Long-term physical and chemical impacts from both operations and end-points
Waste: Effects of the handling and treatment of other wastes	Fisheries: The effects of offshore <i>operations</i> on fisheries. Long-term effects assessed in <i>legacy</i>
Physical: Physical effects of offshore operations on the marine environment	Free Passage: Effects of <i>operations</i> on navigation; long-term effects assessed in <i>legacy</i>
Marine: Ecological effects of operations on the marine environment, including underwater noise	Energy and Emissions: Estimate of energy use and gaseous emissions from the complete option.

(Derived from [30])

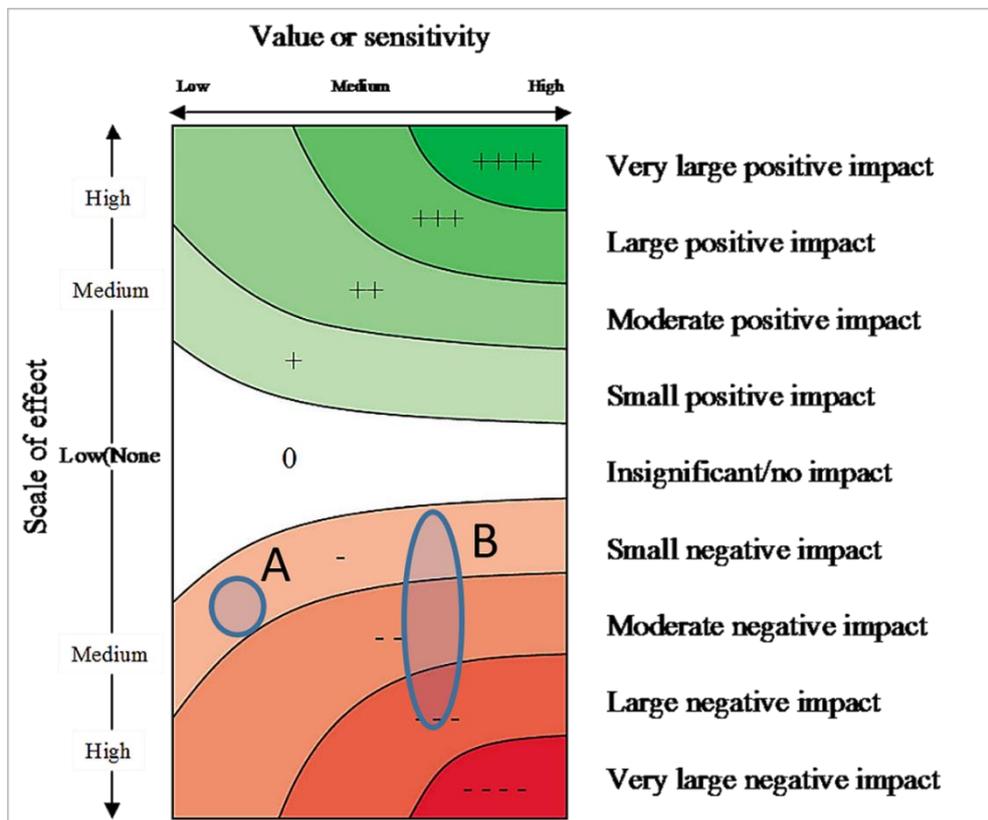
For each potential impact, DNV GL assessed the likely scale of effect, taking into consideration standard mitigation measures commonly applied by the offshore industry and the project- and site-specific mitigation measures that are identified in the ES.

The likely overall **severity** of the effect was determined by considering the **sensitivity** of the receptor or the environment and the **scale or magnitude** of the potential impact. For every facility, the severity of the overall effect of the option on each receptor is shown on a single diagram, as shown in Figure 22.

In these diagrams, the four curved bands shaded green indicate positive impacts of increasing (positive) effect, and the four curved bands shaded red indicate negative impacts of increasing effect. The white zone indicates where the combination of sensitivity and severity would result in no impact or an insignificant impact. The labels on the right of the diagram indicate the severities of each band. The position of the circular or elliptical area **within a band** or **straddling a band** indicates the degree of certainty or uncertainty in the assessment. For example, Point A has a small negative impact and a relatively small degree of uncertainty, as indicated by the small circle. The value or sensitivity (horizontal axis) is well defined, and the assessment of effect (vertical axis) has been determined with confidence. By contrast, Point B represents a relatively larger degree of uncertainty, because although the value or sensitivity is well defined, there is a high uncertainty about the scale of effect, and this translates into an impact ranging from 'small negative' to 'large negative'. DNV GL noted that detailed planning of activities, substantial knowledge, and robust methodologies and procedures can contribute to a reduction in the uncertainty of the assessment.

As a result of applying this methodology, the same scale of effect may give a different impact depending on the value or sensitivity of the receptor or environment. DNV GL consider this a sound basis for assessing and presenting environmental impacts. They noted that a 'moderate negative' or 'large negative' impact does not necessarily mean that the impact is unacceptable, but that further consideration should be given to it.

Figure 22 An Example of the Diagrams used to Portray the Severity of an Impact



7.5 Estimation of Energy Use and Emissions

Decommissioning options will use energy and emit gases as a result of several different types of activity, including the use of vessels offshore, the transportation of material at sea and on land, and the dismantling, treatment, recycling or disposal of material onshore.

All these activities are 'direct' sources of energy use. To properly account for any energy 'savings' that may be made when material is removed and taken to shore for recycling, options in which no such removal is undertaken must be 'debited' with the energy and emissions that would be associated with the new manufacture of replacement materials [31].

The total net energy use and the total masses of gaseous emissions for all short-listed options were estimated by following the loP guidelines [31]. DNV GL took the loP factors for the amounts of energy used and gases emitted during the combustion of different fuels and during the recycling or new manufacture of different types of materials, and applied these to our estimates of the durations of operations, the sizes of the vessel spreads for each option, and inventories of the masses of materials in structures and of the material that would be removed or left in the sea under different options.

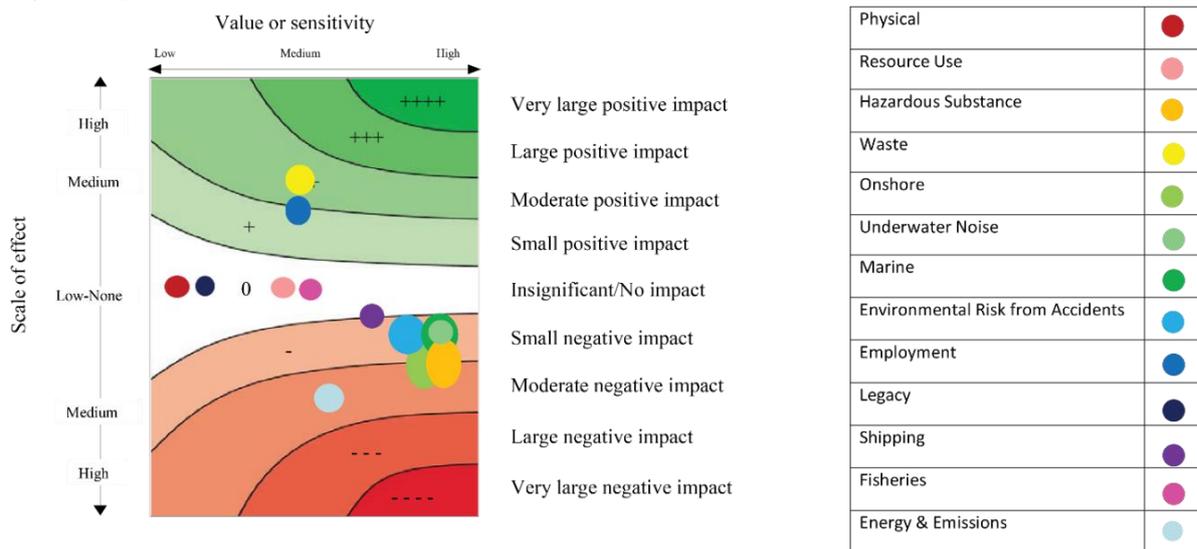
7.6 Potentially Significant Impacts in ES

7.6.1 Introduction

Figure 23 presents DNV GL’s summary of the results of the environmental impact assessment of the programme of work that would be carried out to remove all four of the topsides completely as single lifts by SLV, and dismantle, recycle or dispose of them onshore at the ASP facility.

The most significant negative impacts from this activity were (i) the use of energy and the gaseous emissions offshore, which was assessed as ‘moderate negative’, and (ii) onshore impacts noise and the handling of hazardous wastes, both of which were assessed as ‘small-moderate negative’ [16]. There were ‘small-moderate positive’ impacts from the offshore employment associated with this programme and from the treatment and recycling of waste materials.

Figure 23 Environmental Impacts from Decommissioning of all Four Brent Topsides by SLV



7.6.2 Impacts of Offshore Operations

All the proposed offshore operations in the Brent Field would occur within the 500m safety zones around the installations and consequently will not result in any impacts to fishermen or other users of the sea.

The transportation of topsides on the SLV will be a normal marine operation that will not impact other users of the sea. Each operation to transfer a topside to the cargo barge will take one or two days at the designated nearshore transfer location off Teesside, and will be suitably notified to mariners and fishermen and is not expected to have any effect on other users of the sea.

Barring a major and very unlikely accident during lifting or transportation, the main potential impact offshore would be the underwater noise from the SLV. The presence of the SLV and attendant vessels will increase the level of underwater noise in the area of the installation. Modelling showed that this would be localised and transient, and unlikely to reach a level that would cause more than short-term disturbance to a few individual marine mammals. This noise will be very similar to that already experienced at the site, and is likely to vary depending on the levels of activity. Noises will not begin suddenly, but are likely to increase steadily as vessels enter the 500m safety zone. Modelling has shown that although the noise frequency from the vessel spread will be within the hearing range of several species of marine mammals, the received noise levels at distances of more than about 900m are not likely to be high enough to cause 'disturbance behaviour' in marine mammals, and certainly not high enough to cause a temporary threshold shift in their hearing ability. The noise will not cause any harm to fish or other marine species.

7.6.3 Impacts of Onshore Operations

The bulk of the material that will be removed to shore will be received, dismantled, treated and disposed of through the ASP facility on Teesside. The separate *Brent Removals and Dismantlement Impact Assessment (ESHIA)* (Environmental, Social and Health Impact Assessment) by AECOM for the activities at this existing, active, licensed site [32] has shown that there will be no significant impacts to the communities living close to the dismantlement site. All the sources of impact have been identified and understood and there are, or will be, specific measures in place to minimise or eliminate each type of potential impact.

The most likely source of potential impact during topsides decommissioning will be the long phase of onshore dismantling. At the ASP facility, the programme of hot and cold cutting, the 'cut and pull' operations to separate the sections of topsides, the lifting, handling and transportation of increasingly smaller sections of the topsides will generate noise, dust, and odour, and additional light and road traffic, in and around the site. Small spills of hydrocarbons and other fluids may occur. Consequently, the main impacts of the topsides decommissioning are onshore, to the local community and infrastructure. Decommissioning the topsides onshore was estimated to have a 'small-moderate negative' impact on local receptors owing to a combination of potential noise, dust, traffic and visual impacts upon local residents and birds, that could occur over a significant period of time as a result of the large volumes of topsides materials that will come to shore. When considered together, however, and bearing in mind the sensitive nature and proximity of the Special Protection Area (SPA), and the significant length of time the decommissioning activities will take, the overall potential impact is higher. The impacts are manageable, however, and the necessary controls will be in place to ensure that the impacts are minimised. With regard to the handling and management of hazardous materials, the ES found that the handling and treatment of hazardous wastes from the decommissioning of the topsides are estimated to have a 'small-moderate negative' impact. The assessment reflects the current uncertainty about the exact volumes of mercury, asbestos and NORM wastes, and the potential presence of pyrophoric scale (although to date Shell has no evidence that pyrophoric scale is present in the topsides). In practice, however, the impact of the planned management of hazardous waste may be less than this, even 'insignificant'. The ASP facility will be fully licensed to receive decommissioning wastes and all work will be conducted under the necessary permits and consents. We will ensure a Duty of Care assurance programme is in place, to monitor the management of the ASP facility and ensure that all appropriate controls are in place and complied with. The ASP facility will be audited by a third-party to ensure compliance with its stated management systems.

7.6.4 Legacy Impacts

We plan to recycle at least 97% by weight of the material returned to shore and consequently it is likely that only a relatively small amount of non-recyclable material, predominantly hazardous waste and inert solids, will have to be disposed of to landfill. Most of this will be disposed of in the existing Able-operated landfill adjacent to the ASP facility over a period of 3-4 years as the topsides are dismantled individually. It is not expected that these operations will have any impact on landfill sites.

7.6.5 Cumulative Impacts

There will be no cumulative impacts offshore from the proposed programme of work to remove the topsides. As shown in the draft schedule (Figure 20), the Bravo, Alpha and Charlie topsides will be removed in different years. Consequently, any local and transient effects from underwater noise or gaseous emission will not overlap.

There will be no significant cumulative impacts at the onshore dismantling site. The topsides will be received at different times, and will then progress at their own pace through individual programmes of dismantling by cut and pull, and then small-scale dismantling into different waste streams. Although the ASP facility is large enough to accommodate all four Brent topsides, it is not likely that any more than two Brent topsides would be being dismantled at the ASP facility at any one time.

7.6.6 Energy and Emissions

The proposed programme of work for all four topsides would have a net energy use (i.e. including any savings that may be achieved by recycling material) of approximately 1.2 million gigajoules (GJ) (Table 12). It would take about 320,000 GJ to recover the topsides to shore and dismantle them, and about 0.8 million GJ to recycle them. The greatest use of energy, and the greatest single source of gaseous emissions, will be the recycling of all the different waste streams. DNV GL estimate that the whole programme for all four topsides would result in the emission of about 63,000 tonnes of CO₂.

Table 12 Energy and Emissions associated with SLV Removal and Onshore Disposal of all Four Brent Topsides.

Operations	Energy (GJ)	Emissions to Atmosphere (tonnes)		
		CO ₂	NO _x	SO ₂
Direct				
Marine operations	254,958	19,423	527	284
Onshore dismantling	43,511	3,200	71	3
Onshore transport	21,340	1,570	35	1
<i>Sum</i>	<i>319,809</i>	<i>24,193</i>	<i>633</i>	<i>288</i>
Recycling				
Material recycling	837,199	38,852	135	407
Materials not recycled	42,125	No Data	No Data	No Data
Total	1,199,133	63,045	768	695

7.7 Mitigation Measures for Topsides Programme of Work

7.7.1 Assurance

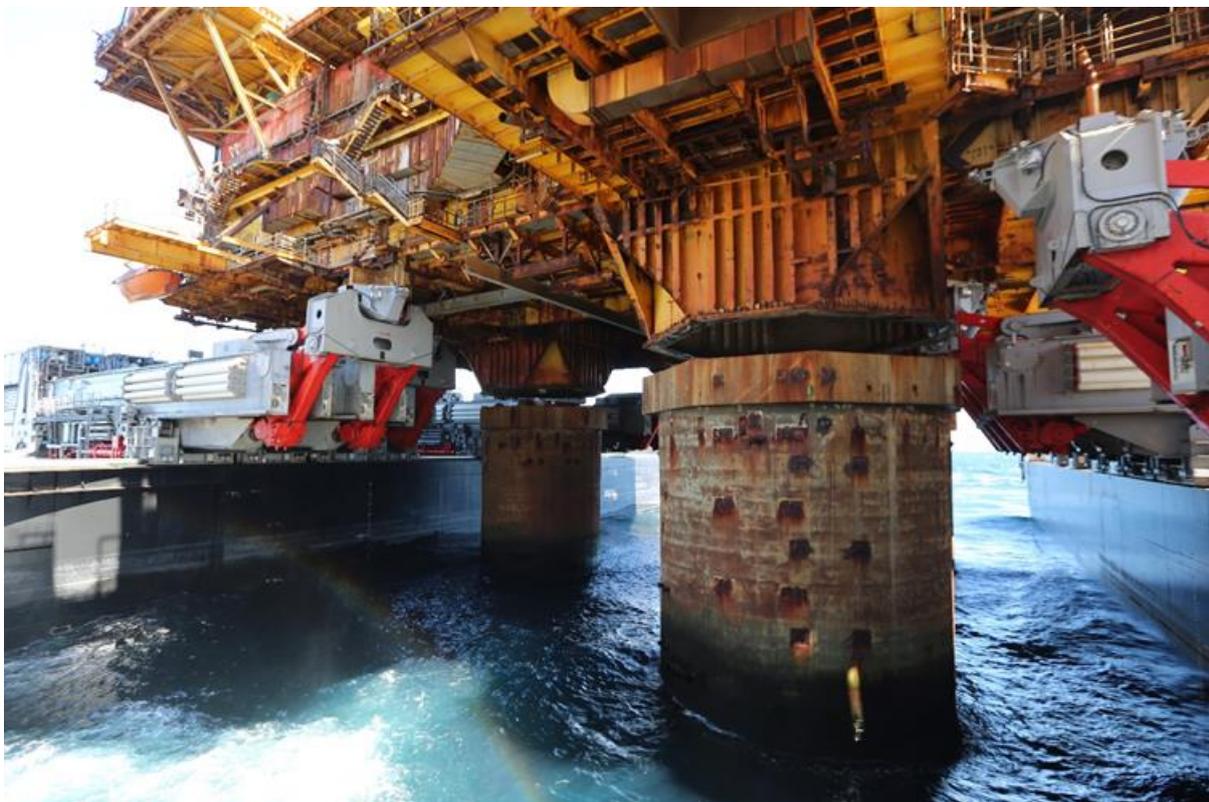
Although the Intellectual Property rights associated with the design, construction and operation of the SLV belong to Allseas, we have carried out extensive technical reviews of the SLV methodology during specific phases of the project including; a General SLV Concept Review (Pre-Qualification for Tender) in 2009, a *Pioneering Spirit* SLV-specific review during the FEED in 2012, and a Pre-Contract Award review (as part of a Development Release procedure) in 2013. Throughout this process the BDP has been fully engaged with STASCO (Shell Trading and Shipping Company), the appointed Marine Warranty Surveyor DNV GL, an Independent Verification Body (Bureau Veritas), and our own Technical Authorities. DNV GL will review and accept all relevant calculations, specifications, procedures and marine spread for the programmes of work for removal, transportation and load-in, such that a Certificate of Approval can be provided to assure our insurers that the marine activities are ready to proceed safely. Bureau Veritas will provide an independent verification of modifications of Safety Critical Elements (SCE) that affect the Dismantlement Safety Case, subject to approval by the Health and Safety Executive (HSE).

The technical requirements for which compliance will be demonstrated include:

- Lloyd's Register Class requirements for Dynamic Positioning (DyP) Class 3 Standard and appropriate redundancy concept for DyP system
- Robustness against single point failures of systems for ballasting, power management, dynamic positioning and lifting
- Application of two-compartment damage stability standard
- Strengthening of topsides such that the support structure is robust against the worst combination of loads corresponding to failure of a single lifting point

Considerable effort has been made to reduce the likelihood that a Brent topside would topple during removal, transportation or back-loading. By the end of 2016, Allseas had fitted twelve of the lifting beams, performed a trial lift using a test-lift platform weighing 5,000 tonnes, and successfully lifted the 13,500 tonne topside from the Yme platform¹². The remaining beams were then fitted, and in April 2017 the 23,700 tonne Brent Delta topside was successfully lifted (Figure 24) and delivered to the ASP Facility.

Figure 24 Brent Delta Topside Lifted Clear of GBS Legs, April 2017



We worked closely with the appropriate Regulators and local Marine or Harbour authorities to ensure that all the contingency plans were in place before the removal of the Brent Delta topside. Emergency response plans were in place for the removal and transportation activities including a Brent Field System Oil Pollution Emergency Plan (OPEP) incorporating a contract for specialist response services through Oil Spill Response Limited (OSRL). Once a topside is secured on the SLV any spill of hydrocarbons will be managed through the vessel's Shipboard Oil Pollution Emergency Plan (SOPEP). A bridging document will be in place between Shell and Allseas to confirm all the responsibilities and response arrangements.

¹² Yme is a platform in the Norwegian sector of the North Sea.

With Allseas, Able, the warranty surveyor and the Harbour Master, we will perform a detailed Marine Hazard Identification (HAZID) exercise for the transfer, tow-in and load-in of the topsides. This will be informed by knowledge that has been gained from the successful removal and load-in of the Brent Delta topside in April-May 2017, and transfers and load-ins that have been performed in and around Teesside over the last few years. We will submit Dismantlement Safety Cases for the Alpha and Charlie topsides. These will be similar to the Safety Cases approved for Delta in 2016 and Bravo in 2017, and will describe the management of the remaining offshore Major Accident Hazards (MAH), and the associated BEIS environmental permits.

The potential environmental impacts of the entire topsides removal and disposal programme – including offshore separation, lifting, transportation, barge transfer, skidding, onshore dismantling and disposal – have been identified and assessed in the ES [16]. In addition to the project-wide ES, we engaged AECOM Limited to prepare the Brent Removals and Dismantlement ESHIA [32] of the potential environmental, social and health impacts of the operations at the nearshore transfer site, and at all the Able facilities used for dismantling, storing, handling, treating and disposing of all material from the topsides. This provides the information necessary for us to satisfy ourselves that we are ready to bring material ashore, and that we understand the risks and have suitable mitigation measures in place.

The successful lift of the Brent Delta topsides in May 2017 gives additional experience of, and confidence in, the whole lift process using the SLV *Pioneering Spirit*, transfer to the barge *Iron Lady*, and skidding onto the quayside at the ASP facility on Teesside.

If a part of a topside were lost to sea, there is a procedure that must be followed for dropped objects associated with oil and gas infrastructure. BEIS must always be notified by a PON2 notification, through which other agencies are also notified. Depending on the location of the dropped object, other statutory notifications and/or procedures will apply to ensure compliance with other legislation e.g. a Marine Licence under the Marine and Coastal Access Act 2009.

7.7.2 Summary of Mitigation Measures

- The programme of work to remove and dismantle the Brent topsides will be conducted under all necessary permits
- Appropriate Notices to Mariners will be issued to alert other users of the sea to the proposed operations in the Brent Field, along the tow route and at the nearshore transfer site
- Explosives will not be used to remove the structures
- Before removal, a comprehensive programme of depressurisation, draining and flushing will be performed to remove the bulk of hydrocarbons and other fluids and gases from the topsides systems, so as to minimise the risk that residual fluids will escape to sea
- On completion of offshore operations to remove the topside, other users of the sea will be advised of the changed status or condition of the installation
- On each GBS, one of the legs will be fitted with an AtoN to alert shipping
- At Brent Alpha, if the upper jacket is not removed immediately after the removal of the topside, an AtoN will be designed and fitted to the top of the jacket, or a buoy positioned at the site, to alert shipping
- If there is any delay in the fitting of AtoNs on any structure, a guard vessel will be deployed to alert other users of the sea
- The dismantling of the topsides, and the treatment and disposal of all resultant waste streams, will take place at the ASP facility on Teesside, which is fully licensed for the dismantling of offshore structures and the management of these wastes

- The topsides will be dismantled in accordance with the Code of Practice for full and partial demolition [15]
- Able UK will apply a range of mitigation measures to minimise the potential impacts of onshore dismantling. These will include carefully planned work practices and programmes, limits to night work, dust-control measures, and measures to plan and monitor additional road traffic and the movement of large loads

7.8 Management of Environmental Impacts

Table 13 summarises the main potential environmental impacts of the proposed decommissioning programme for each of the Brent topsides and how they will be managed.

Table 13 Management of Environmental Impacts.

Main Impacts	Management
Planned Operations and Activities	
Separation and Removal of Topside by SLV	
<ul style="list-style-type: none"> • Underwater noise: The underwater noise originating from the presence and movements of the vessel ‘spread’ around the Brent platforms might result in a ‘small negative’ impact to marine mammals. These noises could cause temporary disturbance to individual cetaceans within 1 to 2km of the platform, which would cease as soon as the vessels moved away. Since the removal operations will take only a few days, and cetacean numbers are likely to be low in the Brent Field, only a few individual animals are likely to be disturbed in this way. Since the cutting operations themselves will be in air, it is not thought likely that any noise from the DWC transmitted into the sea via the legs would add significantly to the source noise levels originating from the vessels • Energy consumption and atmospheric emissions: The fuel consumed and the atmospheric emissions generated during each topside removal might constitute ‘small negative’ impacts 	<ul style="list-style-type: none"> • Vessels will be well maintained to ensure efficiency and to minimise underwater noise • Removing each topside in a single lift will reduce the time required for in-field vessels and transits, with subsequent reductions in energy use, emissions and underwater noise • All vessels will use low-sulphur marine diesel
Transportation to Nearshore Transfer Site	
<ul style="list-style-type: none"> • Underwater noise: The transit of the SLV will create underwater noise that may result in a ‘small negative’ impact due to disturbance to marine mammals within about 1km of the route. Individual cetaceans, and nearer the coast, seals, may exhibit avoidance behaviour, but this will cease once the vessel passes • Energy consumption and atmospheric emissions: The fuel consumed and the atmospheric emissions generated during each topside transit to the transfer site might constitute ‘small negative’ impacts 	<ul style="list-style-type: none"> • The SLV will be well maintained to ensure efficiency and to minimise underwater noise • All vessels will use low-sulphur marine diesel

Table 13 Management of Environmental Impacts, Continued.

Main Impacts	Management
Planned Operations and Activities	
Back-loading to Barge and Tow to ASP Facility	
<ul style="list-style-type: none"> • Underwater noise: The presence of the SLV and the tugs at the transfer site will create underwater noise that may result in a 'small negative' impact due to disturbance to marine mammals within about 1 to 2km of the site. Individual cetaceans and seals may exhibit avoidance behaviour, but this will cease once the transfer has been completed and the vessels have moved away • Risk of injury to seals: When the SLV is on station at the transfer site, it is predicted that the use of thrusters might result in a 'small negative' impact as a result of injury to individual seals • Energy consumption and atmospheric emissions: The fuel consumed and the atmospheric emissions generated during operations at the transfer site and during the short tow to the ASP facility might constitute a 'small negative' impact 	<ul style="list-style-type: none"> • Vessels will be well maintained to ensure efficiency and to minimise underwater noise • Following a detailed risk assessment and discussion with stakeholders, Shell will consider the use of marine mammal observers and seal scarers during the 48-hour period of near-shore operations when the SLV is stationary and held in position using dynamic positioning thrusters • All vessels will use low-sulphur marine diesel
Dismantling Topside in ASP Facility	
<ul style="list-style-type: none"> • Onshore disturbance from noise, dust and traffic and visual impacts: It is estimated that the combined effects of additional noise, dust, traffic and visual impacts from the dismantling of each topside would result in a 'small negative' impact to the local community. The effects are expected to be small because the dismantling site at Quay 6 is more than 1km from the nearest residential receptor and more than 0.5km from the Teemouth and Cleveland Coast SPA and Seal Sands. Some impact is predicted, however, due to the sustained nature of operations at the facility over the course of 1 year • Employment: Since the onshore component of the decommissioning programme will support approximately 250 man-years of work, this effect on employment is categorised as a 'positive' impact 	<ul style="list-style-type: none"> • The ASP facility will be fully licensed to receive decommissioning wastes and all work will be conducted under the necessary permits and consents • Under normal operations all dismantling work will be undertaken during daylight hours and there are unlikely to be any 24-hour operations • A thick bed of sand will be used during the 'cut and pull' operations to reduce the potential noise effects of the dismantling of large sections of the topsides • Dust will be managed and controlled through the use of water sprays, sweeping vehicles, speed limits on site and where necessary cleaning of traffic wheels leaving the site • Shell will ensure a Duty of Care assurance programme is in place to monitor the management of the ASP facility and ensure all appropriate controls are in place and complied with • The ASP facility will be audited by a third party to ensure compliance with its stated management systems

Table 13 Management of Environmental Impacts, Continued.

Main Impacts	Management
Planned Operations and Activities	
Handling, Storage and Recycling of Topside Material	
<ul style="list-style-type: none"> • Hazardous wastes: Moving, handling and storing hazardous waste may give rise to impacts that are categorised as ‘small negative’ • Energy consumption and atmospheric emissions: The total consumption of energy, approximately 186,500GJ (Alpha); 305,900GJ (Bravo); and 398,000GJ (Charlie) and the generation of atmospheric emissions, 9,800t CO₂ (Alpha); 16,000t CO₂ (Bravo); and 20,900t CO₂ (Charlie) as a result of removing and recycling each topside are categorised as ‘small negative’ impacts • Recycling of steel: The planned recycling of approximately 11,900t (Alpha), 19,600t (Bravo) and 25,500t (Charlie) of carbon steel from the topsides is assessed as being a ‘positive’ impact 	<ul style="list-style-type: none"> • The ASP facility will be fully licensed to receive decommissioning wastes and all work will be conducted under the necessary permits and consents in line with regulatory requirements • A waste map and management plan will be implemented by Able and approved by Shell to ensure adequate management and disposal of hazardous wastes • Shell will ensure a Duty of Care audit programme is in place to monitor the management of the site and to ensure all appropriate controls are in place and complied with; this will include waste management and monitoring • The ASP facility will be audited by a third party to ensure compliance with its stated management systems • Pre-dismantling surveys will be undertaken at the ASP facility to assess the types and quantities of hazardous waste including mercury, asbestos, pyrophoric scale and NORM. When the surveys have been completed, specific plans will be updated and implemented to manage all hazardous wastes in line with legislative requirements and good practice • Some topsides pipework may be impregnated with mercury as a result of prolonged exposure to production fluids. If such pipework is found during onshore pre-dismantling surveys a mercury management plan will be implemented by Able to ensure safe management and disposal • NORM waste ‘Cleaning Acceptance Certificates’ and where appropriate ‘Decontamination Certificates’ will be completed to record the final condition of the topside and ensure that dismantling activities can be carried out safely • Procedures at the ASP facility will include metering and monitoring for NORM contamination every time containment is broken (e.g. cutting of pipework) • NORM will be managed in line with OGP Guidelines for the management of NORM in the oil and gas industry [33] • Able has been contracted by Shell to achieve a target level of 97% recycling of retrieved topsides material

Table 13 Management of Environmental Impact, Continued.

Main Impacts	Management
Planned Operations and Activities	
Unplanned or Accidental Events	
<p>A HAZID was carried out covering the removal of the Brent Delta topside by the SLV <i>Pioneering Spirit</i>, the transportation of the topside to a site outside the mouth of the Tees, and the transfer of the topsides to a barge. The short tow from the transfer site to the ASP facility and the load-in was subject to a second HAZID performed in 2015. These HAZIDs are generally applicable to the remaining three Brent topsides, but topside-specific HAZIDs will be completed before each lift.</p> <p>The first Delta HAZID was attended by representatives from all relevant companies and disciplines including Allseas, Shell and DNV GL together with project engineering and technical safety, environment and marine departments. The HAZID covered the following stages of the topside removal and transportation process:</p> <ol style="list-style-type: none"> 1. Manoeuvring and preparations at the offshore lift site. 2. Topside Lift System preparations and lift. 3. Remaining lifts and completion. 4. Transportation on the SLV. 5. Barge transfer preparations, manoeuvring of barge and transfer of platform topside. <p>The objective of the HAZID was to assess high level controls and interface issues. An activity-specific guideword process was used to help review these issues. Allseas will perform detailed risk assessments of the procedures to be used.</p> <p>Several actions were generated from the HAZID but the overall conclusion was that suitable arrangements are being put in place to provide a safe lifting and transportation process, although work is still ongoing to define the details of procedures and to provide independent assurance of the safety of the procedures and adequacy of the engineering controls to be applied. A 'small negative' impact from accidental events was determined due to a combination of the following:</p>	
Accidental Event	Mitigation
<ul style="list-style-type: none"> • Risk of a dropped object: During offshore cutting and lifting, there is a low probability that a part of the topside, or a component or part of the SLV would be dropped and land on the seabed 	<ul style="list-style-type: none"> • Any item accidentally lost to sea during the removal of the topsides will be reported to BEIS via a PON2 notification and recovered where possible
<ul style="list-style-type: none"> • Risk of topside toppling: During lifting and transportation offshore there is an extremely low probability that the topside would topple into the sea. If the topside toppled during lifting there is a possibility that it could damage some of the GBS cells and expose the cell contents but this is considered to be an extremely unlikely event • The risk of toppling during transit (i.e. once secured on the SLV) is even less likely. On the United Kingdom Continental Shelf (UKCS), accidents involving large dropped objects are very rare 	<ul style="list-style-type: none"> • By the time the topsides are lifted there will be no live hydrocarbon pipelines at any of the Brent platforms which could be impacted by a dropped object or toppled topside • Shell and Allseas will ensure that all safety testing is completed and warranties are in place before the topside lift begins • All the vessels engaged in the lifting operation itself will be stationed within the platform's 500m safety zone

Table 13 Management of Environmental Impacts, Continued.

Main Impacts	Management
Planned Operations and Activities	
Accidental Event	Mitigation
<ul style="list-style-type: none"> • Risk of oil spill: During the whole operation to lift, transport and transfer the topside to the ASP facility there is a low probability that vessel collisions (with other vessels or with the substructure) may result in a spill of diesel fuel to sea. Modelling previously performed to support the Brent Field oil spill plan has been used to inform the assessment of the effects of a spill in the Brent Field. A spill of 2,695m³ of diesel (a larger volume than is normally held in one fuel tank) could cross the median line within 3 hours but would be likely to disperse and evaporate within 9 hours and would not reach the UK or Norwegian coastlines [34]. Along the transit route and at the transfer site it is also possible that an accident could damage a fuel tank on a supporting vessel. We modelled the risk from a spill of 200m³ of diesel at the transfer site and this showed that there was a <1% probability of diesel fuel reaching the shore • The SLV will also be carrying heavy fuel oil (HFO) for use in international waters. Except in the event of a catastrophic total loss of the SLV, it is considered extremely unlikely that any HFO would be spilled to sea 	<ul style="list-style-type: none"> • The fuel tanks on the SLV are surrounded by 3m of water ballast tanks (below and on the sides), and there are void tanks above. Therefore, the SLV would have to be travelling at considerable speed for there to be sufficient energy for an impact from a vessel to the side of the SLV to penetrate both bulkheads. The manoeuvres of all vessels, both at the Brent platform sites and at the nearshore transfer site, will be very carefully controlled and will be at low speeds. It is therefore not credible that the fuel tanks of the SLV could be punctured by an accidental event other than a catastrophic event leading to the loss of the vessel itself • Once each topside is removed, it is planned that the legs of the GBSs will be capped and AtoNs installed on one leg of each GBS and on the top of the Brent Alpha jacket. If for whatever reason this cannot be done before the SLV leaves the Field we will discuss appropriate action with BEIS. In such circumstances a likely temporary solution would be to station a guard vessel close to the platform to warn shipping. Notices to mariners will be issued and the UK Hydrographic Office (UKHO) and Maritime and Coastguard Agency (MCA) informed of the changed status of the platform. The new status of the Brent structure will be entered into the FishSAFE programme of electronic warning • The <i>Brent Field System and Associated Pipelines Offshore Oil Pollution Emergency Plan (OPEP)</i> [34] will be in place during lifting operations and Shell have a contract for specialist response services through OSRL should a spill occur. Once the topside is secured to the SLV any spill of hydrocarbons will be managed through the vessel's SOPEP. Shell will have a bridging document in place with Allseas to confirm all responsibilities and response arrangements • Shell and Allseas will ensure that all safety testing is completed and warranties are in place before the topside lift and transportation begins

Table 13 Management of Environmental Impacts, Continued.

Main Impacts	Management
Planned Operations and Activities	
Accidental Event	Mitigation
	<ul style="list-style-type: none"> • The Brent Field standby vessel will be in place throughout lifting operations and is equipped with dispersant for the field as detailed in the OPEP • The topsides will have been drained and vented before decommissioning; all open systems will be empty of free-flowing hydrocarbons and all chemical tanks will have been emptied, minimising the potential spill risk • Lifting, transit, barge transfer operations and tow-in will be performed during good weather and sea states

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8 STAKEHOLDER ENGAGEMENT

8.1 Introduction

Throughout the development of the Brent Decommissioning Programmes we have carried out a programme of engagement with both formal and informal consultees and stakeholders. The aims of this programme were to:

- Provide all interested parties with news and information about the BDP, the issues that we were addressing and the information that we were obtaining
- Create a means by which stakeholders could tell us of their concerns and views on any aspect of the BDP
- Provide mechanisms for stakeholders to learn about, and discuss, the views and concerns of other stakeholders
- Allow us to appreciate and understand our stakeholders' concerns, and take these into account when assessing the advantages and disadvantages of different options, and identifying recommended options

This section summarises our programme of stakeholder engagement and its important findings that informed our decision-making process. A full description of our stakeholder engagement programme, our stakeholders, and the concerns and issues they raised is given in our *Brent Decommissioning Stakeholder Engagement Report* [35].

8.2 Identifying Stakeholders

The Oil and Gas UK (OGUK) *Guidelines on Stakeholder Engagement during Decommissioning Activities* [36] define a stakeholder as '*someone with a specific and defined interest in your activities; either because they could be impacted by the decisions you make and what you do, and/or because they can have impact or influence on what you do*'.

We developed a stakeholder database by referring to previous decommissioning projects, identifying organisations interested in current operations in the North Sea and following DECC's Guidance Notes [5] and the OGUK Stakeholder Guidelines [36]. Our database now contains information on over 180 organisations, involving more than 400 individuals in the UK and Europe. These cover a wide cross section of stakeholder groups including regulators, statutory¹³ and other identified 'formal' consultees as listed by DECC in the Guidelines [5], trade unions, Non-Governmental Organisations (NGOs), business groups, local councils and community groups, and academics/researchers.

8.3 Stakeholder Engagement

We developed processes and tools for conducting a long-term programme of engagement with our stakeholders, and this comprised five main elements:

- A public website (www.shell.co.uk/brentdecomm)
- A regular e-newsletter, available from the website
- Stakeholder dialogue meetings

¹³ The statutory consultees are: The National Federation of Fishermen's Organisations, The Scottish Fishermen's Federation, the Northern Ireland Fish Producers Organisation Ltd and Global Marine Systems Limited.

- One-to-one meetings with individual stakeholders or stakeholder organisations
- Presentations at conferences and meetings

Two other important activities within the BDP supported the programme of stakeholder engagement:

- The work of the IRG in reviewing our technical studies
- The publication of DNV GL's Scoping Report [28]

8.4 Stakeholder Dialogue Events

8.4.1 Organisation, Facilitation, Participation

Since the beginning of 2007 we have held seven pairs of dialogue events (in Aberdeen and London) to which all the stakeholders were invited. The events were held at 9 to 12 month intervals and about 50 stakeholders attended each combined event.

The events were independently run and facilitated by The Environment Council (TEC) a UK-registered charity that specialised in multi-stakeholder engagement processes, and then by Resources for Change (R4C). They were held under a 'non-attribution' rule to encourage the free exchange of views, issues and concerns, and to provide an opportunity for stakeholders to discuss topics in depth.

At the request of stakeholders, each event focussed on specific aspects of the decommissioning scope. This allowed participants to examine the various technical, environmental, safety, economic and social issues in detail, enabling them to acquire a greater level of understanding and an appreciation of the project's challenges and trade-offs. Accordingly, appropriate technical specialists from the BDP attended the events as necessary, supporting the Director of the BDP who attended every event. Representatives of the IRG attended all the events and, in the later meetings, gave short presentations on their activities, views and conclusions.

8.4.2 Disseminating Information, Recording Views and Concerns

Before each event we sent stakeholders a comprehensive set of pre-reading materials on the topics to be discussed, to enable them to participate as fully as possible on the day. At each meeting, new stakeholders were offered an introductory briefing. Following each pair of events, the independent facilitators produced a transcript of the proceedings and a full set of responses to the issues and questions raised by stakeholders; we sent this directly to all stakeholders and published it on the BDP website.

We met regularly with TEC and R4C to ensure that our engagement activities were meeting stakeholders' expectations. Stakeholder feedback was sought after every event, and consolidated and analysed by the facilitators, and published on the BDP website.

8.5 The Brent Decommissioning Website

In addition to the full reporting of the dialogue events and the publication of our presentation material and the pre-read information, the BDP website presents:

- The project's statement on 'Stakeholder Dialogue – Our Commitment'
- Project background, status, technical information and frequently asked project questions
- A full record of all the issues raised by stakeholders and our responses to those issues
- The IRG's pages. These pages allow the IRG to publish their views on any aspect of the BDP and its work, and their content is fully under the control of the IRG. The Terms of Reference for the IRG's activities is also published
- Contracting and procurement information
- A 'Contact Us' facility to allow all stakeholders and members of the public to email the Brent stakeholder engagement team directly with queries, comments or views

8.6 Brent Newsletter

At the request of stakeholders, we have regularly published a Brent decommissioning newsletter which provides an update on the status of the BDP and additional technical information on various aspects of the project. Nineteen editions of the newsletter have been produced since 2009, and these were sent electronically to every stakeholder and published on the website.

8.7 Conferences and Speeches

Since 2007, Brent decommissioning staff have attended many public and industry events on decommissioning, and presented updates on the BDP at more than 50 conferences and industry events. These have included the annual NPF (Norske Petroleumsforening) Decommissioning Conference in Oslo, the joint OGUK/Decom North Sea conferences held in Dunblane and more recently in St Andrews, various supply chain events, and specialized technical events and seminars. All of this engagement has facilitated greater exchange of information and learning within the industry, supply chain and other stakeholders.

8.8 Consultation with Statutory Consultees and Public Notification

In accordance with the DECC Guidance Notes, we undertook a programme of formal statutory consultation on the Consultation draft DP Document and its supporting documentation from February to April 2017.

Public notifications were published in local and national newspapers to provide the opportunity for representations to be made regarding the programmes. The Consultation draft DP Document and its supporting documentation, including the ES, were available for a period of 60 days through the Brent Decommissioning website www.shell.co.uk/brentdecomm. All the referenced supporting material (technical studies and reports) were also available upon request. The Consultation draft DP Document and the ES were available on the BEIS website (<https://www.gov.uk/guidance/oil-and-gas-decommissioning-of-offshore-installations-and-pipelines>).

Letters or emails were sent to every stakeholder and all parties who registered their interest during the dialogue sessions, to inform them about the period of statutory consultation.

8.9 Comments from Public Consultation

8.9.1 Introduction

The Consultation draft DP was submitted for Public Consultation on 7 February 2017, and the Consultation closed on 10 April 2017. During this period, we received a number of responses from individuals and organisations, covering both general topics and specific issues concerning the decommissioning of the topsides.

All the comments regarding the decommissioning of the topsides have been incorporated in this Topsides DP. Comments covering employment opportunities and supporting under-graduate research are not included in this DP.

We did not receive any comments from three of the four statutory consultees, namely the National Federation of Fishermen's Organisations, Northern Ireland Fish Producers' Organisation and Global Marine Systems Limited. For reference, the Brent Delta Topside DP presents generic and specific comments and questions from stakeholders regarding the decommissioning of that topside by the SLV *Pioneering Spirit*.

8.9.2 Issues and Concerns Raised by Stakeholders

During the programme of stakeholder engagement, before the submission of the Consultation draft of the Field DP, the main issues and concerns raised by stakeholders about topsides decommissioning were:

- The method or procedures that will be used to remove the topsides
- The investment that Shell might make in onshore dismantling or recycling sites
- The employment or local benefit that would be generated by the onshore dismantling and recycling activities

- Competition with other activities at such sites e.g. manufacture or deployment of offshore wind turbines
- Accidental discharges or releases of hydrocarbons to sea
- Accidental loss of large components to sea
- Impacts to local communities at onshore dismantling or recycling sites caused by noise, dust and odour
- Impacts to onshore infrastructure
- The need to manage waste disposal properly and according to best practice

8.9.3 Questions on the Proposed Programme of Work Raised by Stakeholders during Public Consultation

Concerning the broad topic of topsides decommissioning and the disposal of materials onshore, the questions and issues from stakeholders during the period of Public Consultation were:

- Can you please advise single lift capacity of Allseas' *Pioneering Spirit* in metric tonnes

Our response to this question is:

Allseas *Pioneering Spirit* lift capacities are 48,000 tonnes for a topside and 25,000 tonnes for a jacket. The Brent facilities that the vessel has been contracted for fall well within these weights.

To find out more about the vessel, and to view animations and videos of single lift, please visit the Allseas website here: <https://allseas.com/equipment/pioneering-spirit/>

- Has the experience and knowledge from the Indefatigable Field been taken into account in this project?

Our response to this question is:

Since 2006, the Brent Decommissioning team has engaged with the regulator, industry bodies, other operators and the supply chain to learn from and share project lessons and experience as is lawfully possible. This includes previous decommissioning experiences from Indefatigable, the Brent Spar and Brent Flare.

In addition, Shell has made a commitment to share key learning from Brent Decommissioning, as an ongoing process, with regular presentations and dialogue with interested parties.

- I have a concern about the Brent infrastructure being taken to an English yard for decommissioning and not a Scottish Yard.

Our response to this comment is:

We appreciate and understand the many differing views around the decommissioning industry. The decision to decommission the Brent Field, and remove infrastructure for recycling and disposal in Teesside, was taken following a full competitive tendering process with bids received from UK and European companies ahead of awarding the contract to Able UK.

We would point out that over the 40+ year lifecycle of the Brent Field numerous Scottish businesses have been intricately involved with varying aspects, activities and operations. In addition, and as the Field has entered its decommissioning phase, the majority of business has, in fact, been awarded to Scottish businesses. In June 2016 this figure was calculated to be approximately 90%.

All Operators are expected to deliver safe and efficient decommissioning programmes (under the Petroleum Act 1998) and the Oil and Gas Authority monitors delivery of this. We aim to do this for the Brent Field.

- Can you please provide the European Waste Catalogue codes for each Topsides material?

Can you confirm that the consignment note for transportation of hazardous waste will be signed offshore, before the transport to shore starts? And who will sign this consignment note on behalf of Shell and the Transportation Company?

Where will the *Pioneering Spirit* discharge the topsides to the cargo barge? If this is in Norway, how will the temporary export of waste be handled?

Why is the weight of the asbestos 'not yet quantified' (in Table 6)?

Is a type 3 asbestos survey available, and if not, when will this be made available? This shall be done before the platform leaves the location.

What type of 'paint' is meant? Has the paint been tested on Lead (Pb) or Chrome (Cr)?

Our response to these questions is:

The first platform to be decommissioned is the Brent Delta. After consultation with the SEPA and the Environment Agency (EA), it has been agreed that the (topside) waste will be categorised as 94% metal and carbon as per inventory. As such the categories requested by the Environment Agency were as follows:

Metals (94%)

17 04 07 Mixed metals

17 04 09 Metal waste contaminated with dangerous substances

Remaining 6% (comprising mixed construction/demolition wastes) were as follows:

Cables

17 04 10 Cables containing oil and other dangerous substances

17 04 11 Cables other than 17 04 10

Con/Dem wastes

17 02 01 Wood

17 02 02 Glass

17 02 03 Plastic

17 06 01 Asbestos (In Situ and Gaskets)

17 06 04 Insulation materials other than those mentioned in 17 06 01 and 17 06 03

17 09 03 and 17 09 04 Mixed construction and demolition wastes (hazardous and non-hazardous)

Electrical waste

16 06 02 Batteries – NiCad Dry and Wet

16 06 01 Batteries – Lead Acid

16 02 09 Transformers and capacitors containing PCBs

16 02 13 and 16 02 14 Discarded electronic equipment (hazardous and non-hazardous components)

20 01 21 Fluorescent Tubes

The remaining platforms will be reviewed with the Regulator nearer the time of their topsides preparations, prior to removal.

As clarified with the Environment Agency, the Hazardous Waste Regulations were applicable once the platform entered the harbour area. Therefore, a hazardous waste consignment note was required from Able's yard onwards. The waste consignment note was signed on behalf of Shell and this was then passed to Allseas to complete as the carrier of the waste and then finally on to Able as the Consignee of the waste.

The Brent Delta topsides is currently in the Able Seaton Port facility in Hartlepool. In due course, it is intended that the Brent Alpha and Brent Bravo topsides will be transported there too. (Charlie topside is yet to be decided). The topsides will be transferred to the cargo barge at a designated nearshore transfer site in UK territorial waters.

Each platform is being surveyed for asbestos as part of its topsides engineering preparation scopes. This provides an up to date detailed inventory prior to topside removals. This survey will be verified once the topside has been successfully loaded onshore and prior to the commencement of any dismantling.

In 2014 a comprehensive lead paint survey was carried out on all Brent platforms to detect areas that would need additional health controls if fabric maintenance or construction work, such as blasting or welding was carried out. Paint samples were analysed for the lead mg/kg concentration and the areas sampled broken down into one of three categories, 'Lead found and controls to be implemented', 'Lead found but no lead control measures required' and finally 'No lead found'. The results of these surveys including the areas tested and results have been shared with Able.

9 MANAGEMENT OF THE PROGRAMME

9.1 Strategy

The strategy for this project is to maximise the use of our in-house resources and existing contracts for the preparatory work, and to award lump sum contracts to pre-qualified prime contractors for the main decommissioning activities of topsides removal and disposal.

9.2 Project Management

The project will be managed in accordance with applicable regulatory requirements and to Shell's Global Project Management standards. The project will be led by a Shell Project Director with sub-project managers, project engineers and support functions including, but not limited to, Health, Safety and Environment, Quality, and Project Services. The project will be divided into a series of sub-projects and tendered to the open market as appropriate. Synergies will be sought with other Shell project activities (and in principle other decommissioning activities) where they make economic and business sense.

The approved DP will be subject to strict change management, with any significant change to scope being agreed with BEIS prior to implementation.

9.3 Preparatory Work

We will work closely with our contracting partners to prepare the topsides and other facilities for decommissioning. This work will include topside and pipeline flushing, equipment isolation, engineering-down and making safe for handover to decommissioning contractors.

9.4 Notifying Other Users of the Sea

At least 6 weeks before any vessel-based offshore decommissioning work begins we will notify the UK Hydrographic Office so that appropriate Notices to Mariners can be distributed. At the same time an advisory notice about the planned programme of work will be placed on the Sea Fish Industry Authority's Kingfisher Bulletin.

9.5 Post-topside Removal Debris Clearance and Verification

The planned programmes to remove the topsides by SLV will not result in the deposition of any debris on the seabed at any of the three sites. If an unforeseen incident results in the deposition of any item on the seabed this will be reported to BEIS via a PON2 and we will consult with BEIS about an appropriate course of action to ensure that it does not give rise to any safety risk, commercial impact to other users of the sea or environmental impact. The existing debris on the tops of the GBS cells and on the seabed around the GBSs and the Alpha jacket will be removed in one or more 'campaigns' which will be performed across the whole Brent Field once all the platforms and pipelines have been decommissioned.

After removal of the topsides the GBSs and the Alpha jacket will be entered into the FishSAFE programme of electronic warning, the UKHO and MCA will be notified, and a Notice to Mariners will be issued so that other users of the sea can amend their charts. The AtoNs that will be fitted will have been approved by the UKHO and the UK Coastguard. The existing 500m radius safety zone around the platforms will remain in place. The final condition of the GBSs and the Alpha jacket will depend on the decommissioning proposals presented in the Brent Field DP.

For the decommissioning of the topsides, verification activities will concentrate on the management of onshore work and the disposal of waste streams through the ASP facility. Although our dismantling and disposal contract is with Able, we will have a continuing involvement with the planning, management and execution of the dismantling programme. After completion of the load-in at the ASP facility ownership of the structures will transfer to Able but we will continue to monitor Able's activities against the requirements of the dismantling contract to ensure successful completion of the dismantling and disposal phase of the work. This will include reviewing and approving necessary documents, monitoring execution activities and participating in significant joint meetings.

9.6 Post-decommissioning Monitoring and Evaluation

After removal of the topsides and installation of the AtoNs we will initiate a programme of monitoring and maintenance, to be discussed and agreed with BEIS, to ensure that the AtoNs are working properly. Until the remaining Brent facilities are decommissioned it is most likely that this will be achieved by visual monitoring from one of the other Brent platforms, the Brent Field standby vessel and other vessels operating in the Field. The AtoNs will be replaced at regular intervals.

9.7 Verification

At significant milestones in the planning and execution of the project, work will be subject to internal peer reviews by Shell and by Esso. Major technical decisions will also be subject to approval from Shell's internal 'technical authorities'.

9.8 Reporting Progress

We will report progress to BEIS throughout the offshore and onshore programmes of work. Given the prolonged nature of the Brent Field topsides decommissioning programme, the frequency and content of these reports may vary (see Section 9.10) but this will be discussed and agreed with BEIS.

9.9 Duty of Care for Waste Materials

In planning and managing the responsible disposal of our materials we will follow the 'waste hierarchy', which states that re-use is preferred to recycling, and recycling is preferred to disposal to landfill. In order of decreasing preference, the hierarchy of how material from the Brent Field will be disposed of is therefore as follows:

- Refurbishment for re-use as a unit
- Removal of equipment for re-use
- Segregation of pipes for re-use (recovered end sections)
- Segregation of steelwork and other materials for re-use
- Segregation of materials for recycling
- Segregation of materials (including hazardous materials) for disposal

Table 14 presents a summary of how the main waste streams will be dealt with. All hazardous materials will be appropriately handled and disposed of in accordance with the relevant legislation. We expect that the bulk of the recovered platform material will be recycled but some compound items that are difficult to separate into their component materials may have to be scrapped and sent to licensed landfill sites.

Once on the quayside, any large components scheduled for re-use or possible re-use will be stored in a designated area of the facility for refurbishment or preservation until final decisions have been made about their disposal or fate.

Other components that are not viable for re-use as single units will be stripped and any equipment and/or materials suitable for re-use will be stored and preserved in suitable warehouses or designated storage areas.

Other materials will be collected by type and stored in separate areas for shipment to smelters or other recycling facilities.

Materials not suitable for any of the above treatments (including hazardous materials such as asbestos, LSA-contaminated materials, and heavy metals) will be collected and then removed for disposal in landfill and/or other approved disposal facilities. All wastes will be dealt with in accordance with the appropriate legislation, including if applicable, the Transfrontier Shipment of Waste Regulations.

The project has set a target to recycle and re-use at least 97% by weight of the equipment and materials retrieved. We will comply with our legal duties with respect to the management, treatment and disposal of all waste equipment and materials retrieved during the decommissioning programmes.

Table 14 Summary of Methods for Managing Waste Streams.

Waste Stream	Removal and Disposal Method
Steel	Steel will be removed by dismantling or by hot (oxy-propane flame) or cold (hydraulic shears) cutting. Processed material will be stored adjacent to the processing area or loaded into dump trucks and delivered to the processed scrap storage area on the ASP facility. Scrap metals will be transported by road, rail or sea to suitably-licensed facilities for processing.
Hydrocarbons	Any petroleum hydrocarbons discovered within the pipework, equipment, vessels or tanks will be drained into suitable receptacles and sent to a licensed facility for recycling or disposal.
NORM/LSA Scale	During the dismantling operations, radiation monitoring will be undertaken on any module or structure that is known or suspected to contain NORM. If monitoring reveals the presence of LSA scale a detailed method statement for the removal of the component or pipe will be prepared. This may involve encapsulating any open ends and transferring the item to the Hazardous Waste Store at the ASP facility, pending off-site disposal or further processing. All NORM will be handled, stored and treated in accordance with RSA 1993.
Asbestos	Following a period of onshore survey, all asbestos will be removed by specialist contractors wearing appropriate protective clothing and respiratory equipment. This will be completed as part of a 'soft strip' programme that will be undertaken before dismantling of the topside begins. All asbestos will be disposed of in sealed containers at the adjacent licensed landfill site owned and operated by Able.
Other Hazardous Wastes	All such wastes will be disposed of under appropriate permit(s).

9.10 Close-out Report

The proposed programmes of work to decommission and dismantle the Brent Field topsides will take about a further seven years to complete (Figure 20). We envisage that we will issue several interim Close-out Reports during this time, for example after the removal of each topside, again when their respective onshore dismantling and waste management programmes have been completed.

9.11 Costs

An estimate of the overall cost of the combined proposed programmes of work has been provided separately to BEIS.

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11 ACRONYMS AND GLOSSARY

ABS	Acrylonitrile Butadiene Styrene	EA	Environment Agency
Ac	Actinium	EIA	Environmental Impact Assessment
ASP	Able Seaton Port	EMP	European Marine Site
AtoN	Aid to Navigation	EPDM	Ethylene propylene diene monomer (a type of rubber)
Attic oil	Crude oil that is physically or hydro-dynamically trapped just below the GBS cell dome.	ES	Environmental Statement
		ESHIA	Environmental, Social and Health Impact Assessment
BDP	Brent Decommissioning Project		
BEIS	Department for Business, Energy and Industrial Strategy	FEED	Front End Engineering and Development
Bq	Becquerel, the SI unit measuring the activity of radioactive material		
		FishSAFE	An electronic means of alerting vessels to the proximity of a structure in the sea. FishSAFE is a commercial fishing industry driven safety program. (www.fishsafe.eu)
CA	Comparative Assessment		
Caisson	The term used to describe the lower part of the GBS, containing the storage cells.		
CCS	Carbon Capture and Storage	GBS	Gravity Base Structure
Cell sediment	Fine particles of sand from the reservoir fluids that have settled to the bottom of the cells.	GJ	Gigajoule (10 ⁹ joules)
		Grout	A general term for the pumpable cement that can be introduced into pipes or complex and/or confined spaces.
CFC	Chlorofluorocarbon		
CO₂	Carbon Dioxide	GRP	Glass-reinforced Plastic
Conductor	A large diameter pipe that links the well bore hole to the topsides.		
CoP	Cessation of Production	HAZID	Hazard Identification
		HFO	Heavy Fuel Oil
DECC	Department of Energy and Climate Change	HLV	Heavy Lift Vessel
		HSE	Health and Safety Executive
Dowel	A vertical steel and concrete 'pin' on the base of the GBS that penetrates the seabed and prevents the structure sliding sideways.	HVAC	Heating, Ventilation, Air Conditioning
DP	Decommissioning Programme	ICES	International Council for the Exploration of the Sea
Drawdown	The system and process which maintains a difference in pressure between the fluids inside the cells and the sea. The cell fluids are kept at a lower pressure and the resultant compression force enhances the strength and integrity of the caisson.	Interphase	A term for the viscous emulsion of oil and water that has formed at the interface between crude oil and sea water in the GBS oil storage cells.
Drill cuttings	The fragments of rock generated during the process of drilling a well.	IoP	Institute of Petroleum
DWC	Diamond Wire Cutting	IRG	Independent Review Group
DyP	Dynamic Positioning		
		kg	kilogramme
		KIMO	Kommunenes Internasjonale Miljøorganisasjon (KIMO) UK Network

km	kilometre	Riser	A steel tube that links a pipeline on the seabed to the topside. They are fixed to the outside of steel jackets but may run inside the legs of GBSs.
LAT	Lowest Astronomical Tide	ROV	Remotely Operated Vehicle
LSA	Low Specific Activity (scale)	RSA	Radioactive Substances Act
LTFD	Long-term Field Development	RSPB	Royal Society for the Protection of Birds
m	metre	R4C	Resources for Change
MAH	Major Accident Hazards	SAC	Special Area of Conservation
MBq	Megabecquerel, 1 million becquerels	SCE	Safety Critical Elements
MCA	Maritime and Coastguard Agency	SEPA	Scottish Environment Protection Agency
MCZ	Marine Conservation Zone	Skirt	Short vertical walls of concrete and steel fixed to the bases of the GBS. They divide the under-surface into compartments that are filled with grout and help to fix the GBS to the seabed.
mg	milligramme (1,000 of a gramme)	SLV	Single Lift Vessel
MOD	Ministry of Defence	SOPEP	Shipboard Oil Pollution Emergency Plan
MSF	Module Support Frame	SPA	Special Protection Area
NGO	Non-governmental Organisation	SSSI	Site of Special Scientific Interest
Nm	Nautical mile	STASCO	Shell Trading and Shipping Company
NNR	National Nature Reserve	TD	Technical Document
NORM	Naturally Occurring Radioactive Material	te	metric tonne (1,000kg)
NOx	Nitrous Oxides	TEC	The Environment Council
NPF	Norske Petroleumsforening	TERRC	Teesside Environmental Reclamation and Recycling Centre
OBM	Oil-based Mud	TLS	Topside Lifting System
OGA	Oil and Gas Authority	Tri-cell	A tall, thin vertical space with a triangular cross-section, formed when three circular GBS storage cells meet.
OGUK	Oil and Gas UK Limited	trillion	one million million (10 ¹²)
OPEP	Oil Pollution Emergency Plan	TTS	Temporary Threshold Shift
OSPAR	Oslo Paris Commission	UKCS	United Kingdom Continental Shelf
OSRL	Oil Spill Response Limited	UKHO	United Kingdom Hydrographic Office
P&A	Plug and Abandon	WROV	Work-class Remotely Operated Vehicle
Pb	Lead	WWF	World Wildlife Fund UK
PCB	Polychlorinated Biphenyls		
PGDS	Plate Girder Deck Support		
Piles	Hollow steel tubes that fix a steel jacket to the seabed. The piles are inserted through pile guides and bonded to the guides by grout.		
PON	Petroleum Operations Notice		
ppm	parts per million		
PTFE	Polytetrafluoroethylene		
PVC	Polyvinylchloride		
Ra	Radium		

