Shell U.K. Limited

BRENT TOPSIDES DECOMMISSIONING
TECHNICAL DOCUMENT


A supporting document to the Brent Field Decommissioning Programmes

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THE OWNERS OF THE BRENT FIELD

This Technical Document has been prepared by Shell U.K. Limited (Shell) the Operator of the Brent Field, on behalf of itself and Esso Exploration and Production UK Limited (Esso), who are the owners in equal shares of the Brent Field. Throughout this document therefore, the terms ‘owners’, ‘we’, ‘us’, and ‘our’ refer to ‘Shell and Esso’.

Under the Petroleum Act 1998 and the three Section 29 Notices that have been served on the owners (for the Brent Delta topside, the other platforms and the Brent pipelines), Shell U.K. Limited and Esso Exploration and Production UK Limited have joint and several liability for the decommissioning of the Brent Field. A letter in the Brent Field Decommissioning Programme confirms that Esso fully supports and endorses the proposed Decommissioning Programmes.
2 BRENT FIELD DECOMMISSIONING DOCUMENTATION

The Brent Field comprises four platforms, twenty-eight pipelines and four subsea structures with a total mass of approximately 1.8 million tonnes. In various ways all the platforms are linked to each other or to third party assets, and in our initial planning we carefully considered the chronological sequence of decommissioning and the implications for other producing platforms and systems. We started planning this complex decommissioning programme in 2006, and as a result of the extensive period of study, evaluation and assessment there is a substantial body of work which:

- Describes the facilities and their environmental settings
- Provides information on the technical and engineering aspects of a range of decommissioning options, and the ways in which those options could be undertaken
- Examines the advantages and disadvantages of technically feasible decommissioning options

In agreement with the Department for Business, Energy and Industrial Strategy (BEIS)\(^1\), we have chosen to present essential detailed descriptive and factual information, and where necessary full Comparative Assessments (CA), in six separate Technical Documents (TD) which support and inform the Brent Field Decommissioning Programmes (DP) \(^1\). The DP itself therefore focuses on describing the:

- Process we followed to identify technically feasible options.
- Safety, technical, environmental, economic and societal implications of different options.
- Important differences between options.
- Recommended options for each of the facilities.
- Proposed programme of work for decommissioning the Brent Field.
- Continuing responsibilities that we will have for any assets or material remaining in the Brent Field.
- Monitoring programme that we would undertake to assess the condition and environmental impacts of any assets or material left in the Brent Field.
- Any necessary maintenance programme we would undertake on any assets or material left in the Brent Field.

Figure 1 shows the suite of documentation for the DP. The TDs are designed to be read after the DP, supplementing it and providing detail to the facts, assessments and conclusions presented in the DP. The full title of every reference is given when first cited, and thereafter by the document’s number in brackets \([\ ]\) as listed in Section 12.

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\(^1\) In July 2016 DECC was replaced by Department for Business, Energy and Industrial Strategy (BEIS) and any further reference to DECC should be taken as BEIS.
Figure 1  Brent Field Decommissioning Programmes and Supporting Documentation.
EXECUTIVE SUMMARY

This Technical Document presents detailed information on the decommissioning of the topsides on the Brent Alpha, Brent Bravo and Brent Charlie platforms, which weigh approximately 15,000 tonnes, 24,000 tonnes and 30,000 tonnes respectively. A separate Decommissioning Programme for the 24,000 tonne Brent Delta topside was approved in July 2015.

The topsides comprise the modules, facilities and equipment for oil and gas drilling, production and processing, and for the accommodation, safety and welfare of the platforms’ personnel. They are not candidates for derogation under OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations [2] and since we have not found any alternative uses for them, either in the Brent Field or elsewhere they will be completely removed and returned to shore for recycling and disposal.

We have contracted Excalibur Marine Contractors A.S., part of the AllSeas Group (AllSeas), to remove the Alpha, Bravo and Delta topsides as single units using the new Single Lift Vessel (SLV) Pioneering Spirit. Able UK Limited (Able) will receive, dismantle, recycle and dispose of them at their Able Seaton Port (ASP) facility on Teesside, in the northeast of England. The Brent Charlie topside will be subject to a separate tendering exercise.

Before removal, each topside will be prepared by fitting additional steel strengthening so that it can be safely lifted and carried by the SLV. Hydrocarbon fluids will be drained and purged, and other fluid contaminants will be drained or removed. 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. To support these activities and enable us to accurately record the materials being brought ashore, we have prepared detailed inventories of all the materials on and in the topsides.

The Pioneering Spirit will transport each topside to a site about 5.5 nautical miles from the mouth of the River Tees, where it will be transferred onto a large cargo barge for the short journey to the ASP facility. The topside will be slid from the barge onto a specially-prepared and strengthened quay. It will take 12-24 months to dismantle each topside and segregate all the materials into specific waste streams for reuse, recycling, treatment or disposal as appropriate. We estimate that at least 97% by weight of each topside will be recycled.

Dismantling and disposal will be carried out by Able, but we will be very closely involved in the planning, management and audit of all the operations. The management, storage, handling, transportation, processing, treatment and ultimate disposal of all waste streams arising from the Brent Decommissioning Project (BDP) will be undertaken in accordance with all applicable legislation and with Shell U.K. Ltd procedures and guidelines. Appropriate bridging documents will be put in place with AllSeas and Able to ensure that all matters relating to health and safety, and the potential environmental and societal impacts of the entire operation, are identified, managed and mitigated. All waste material retrieved to shore as a result of the decommissioning of the Brent Field will be processed, treated or disposed of by licensed contractors at licensed sites with all the necessary permits and consents.
4 INTRODUCTION

This Technical Document presents detailed information on the decommissioning of the topsides on the Brent Alpha, Brent Bravo and Brent Charlie platforms. The decommissioning of the fourth topside, Brent Delta, is described in a separate Brent Delta Topsides Decommissioning Programme [3] which was submitted to DECC in February 2015 and approved in July 2015.

Each topside comprises the equipment and systems for drilling wells and producing oil and gas, and all the accommodation facilities for platform personnel. As stated in OSPAR 98/3 [2] and the DECC Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998 [4], topsides are not candidates for derogation and must be completely removed and returned to shore for recycling and disposal.

We have contracted AllSeas to remove the Alpha, Bravo and Delta topsides as single units using the SLV Pioneering Spirit. Able will receive and dismantle the topsides at the ASP facility on Teesside, and then, as appropriate, reuse, recycle, treat or otherwise dispose of all the topsides material. The Brent Charlie topside will be subject to a separate tendering exercise.

OSPAR 98/3 defines topsides as ‘those parts of an entire offshore installation which are not part of the substructure and includes modular support frames and decks where their removal would not endanger the structural stability of the substructure’ [2]. There is a very clear distinction on all four platforms between the topsides and the supporting structures. All the Brent topsides include a lower deck (called the Plate Girder Deck Structure (PGDS) on Alpha and Bravo, and the Cellar Deck on Charlie) which would be removed as an integral part of the topside in any single lift.

This Brent Topsides TD:

- Describes the function, structure and present condition of the Alpha, Bravo and Charlie topsides.
- Presents our best estimates of the inventories of materials that will be on and in these topsides at decommissioning.
- Describes the planned programme of work that will be performed to separate the topsides from their supporting structures and take them to shore using the SLV Pioneering Spirit.
- Describes the programme of work that will be performed onshore to dismantle the topsides at the ASP facility and handle, store, recycle, re-use, treat or dispose of all the topside material.
5 RE-USE OF TOPSIDES

We have completed high level studies to investigate the possibility of re-using the Brent platforms and their topsides, and this work is summarised in the DP [1]. We have not identified any uses for any of the Brent platforms in their current locations or at other sites. As part of these studies we have concluded that it would not be technically feasible or commercially viable to use any of the Brent platforms for carbon capture and storage (CCS).

We have also examined the possibility of using the topsides offshore for treating, disposing or otherwise managing materials that may be present in the oil storage cells of the three concrete Gravity Base Structures (GBS) or in the drilling legs\(^2\) and minicell annuli\(^3\) of the Brent Bravo and Brent Delta GBSs. If such activities were feasible, they would affect the timing of topsides decommissioning and removal. Our studies have shown that neither the topsides facilities nor the existing platform-based wells are suitable for managing these materials. The results of these studies are described in the Brent GBS Contents Decommissioning Technical Document [5].

We have concluded that there are no alternative uses for any of the Brent topsides and no role for them in the decommissioning of any of the GBS contents and that, accordingly, the topsides should be decommissioned.

\(^2\) The Brent Bravo and Brent Delta GBSs each have two legs designated “drilling legs”, which house the conductors linking the topsides to the wellbores.

\(^3\) The minicell is a separate concrete cylinder 60 m high and 7 m in diameter at the base of the utility legs on the Bravo and Delta GBSs, containing process and utility pipework. The space between the wall of the minicell and the wall of the leg is called the “annulus”.
6  DESCRIPTIONS OF THE BRENT PLATFORM TOPSIDES

6.1  Overview

This section presents descriptions of the topside on the three Brent platforms covered in this TD, a summary of its functions, and a description of its present condition and status. The topside facilities have been upgraded or modified over the course of nearly 40 years of production. The biggest change, which began in 1995, was the Long-term Field Development (LTFD), in which the Field was switched from mainly oil production to gas production. The effects and implications of the LTFD are summarised in Section 6.3.

Table 1 presents a summary of factual information for all four Brent topsides. The activities and operations that will be carried out to prepare the topsides for decommissioning are described in Section 7, and the resulting topsides inventories are presented in Section 8.

Detailed descriptions of the corresponding supporting structures can be found in the Brent Alpha Jacket Decommissioning Technical Document[6] and Brent Bravo, Charlie and Delta GBS Decommissioning Technical Document[7].

6.2  Overview of Modules, Components and Process Systems on a Topside

All four support structures in the Brent Field – the steel jacket Brent Alpha and the three concrete GBSs Brent Bravo, Brent Charlie and Brent Delta (Figure 2) - carry a large multi-purpose topside. Figure 3 to Figure 5 are computer-generated diagrams showing the main decks of each topside and the proposed location of the cut lines which will separate the topside, as a single unit, from the support structure. Typically, the topside on each Brent platform comprises the following modules and systems:

- **Accommodation and helideck.** Comprises the accommodation, laundry, catering, and recreation facilities for the crew. Helicopter landing and fuelling facilities are located on the roof of this module.

- **Drilling derrick and support.** Comprises equipment for the drilling and maintenance of oil and gas wells including the drilling rig, an electrical generation package, and facilities for the bulk storage, handling, preparation and pumping of drilling fluids.

- **Utilities.** Comprises firewater systems, safety systems, water purifying equipment, hot water boilers, electrical switchboards, workshops, and facilities for chemical storage and pumping, potable water bulk storage and pumping, and diesel fuel storage and pumping.

- **Oil and Gas production process modules.** Contain all the vessels and equipment for separating the well fluid into its three main components of oil, gas and produced water, and for transferring these individual streams to the export pipelines, other areas of the platform or the oil storage cells for permitted disposal to sea as produced water.

- **Water injection module.** Contains the equipment for filtering and treating raw seawater so that it can be pumped down-hole to enhance production by augmenting the natural pressure of the reservoir. There has been no water injection in the Brent Field since the mid to late 1990s, so these modules are no longer in use.

- **Power generation modules.** Contain gas turbine electrical generators, transformers, switchboards and associated equipment. The turbines are fuelled by gas from the production process and have sufficient capacity to provide all of the platform’s electrical power. Additional generators of much lower capacity are capable of providing power to the platform when the main oil, gas and water injection systems are not in operation. Emergency generators are also available to provide basic life support power if all the other generators are unavailable.
• **Wellhead modules.** Contain the equipment and control valves that regulate the flow of oil and gas from each well. The individual flow lines are combined in a manifold system which supplies the oil and gas processing equipment. The modules also contain the water injection wellhead equipment which, when in use, received high pressure treated water from the water injection module and pumped it into the reservoir through dedicated water injection wells.

• **Flare tower/boom.** The tower supports the flare, which was designed to vent and burn any surplus hydrocarbon gas that might pose a safety risk to platform personnel and/or process systems.

• **Drainage systems.** The drains on a platform are usually divided into those serving hazardous areas, non-hazardous areas and living quarters. Drains are used to manage permitted discharges to sea through the use of oil/water separators and/or centrifugal pumps.

**Figure 2** Drawing of the Four Brent Field Platforms showing the Support Structures and their Topsides.

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### 6.3 Redevelopment of the Brent Topsides

In 1995, decreasing reservoir pressures in the Brent Bravo, Charlie and Delta Fields prompted us to undertake the LFTD project to convert the oil-processing trains on each of the GBS topsides to oil and gas-processing trains. All the process trains were replaced and on the GBS topsides the majority of the new system was contained within a new structure – the Replacement Process Module (RPM) – which was designed to handle large volumes of gas.
6.4 Brent Alpha

The Brent Alpha jacket was transported offshore on a barge and then finally floated into position without its topside [6]. Once the jacket had been fixed to the seabed by piling, the topside was lifted into place in two parts using a Heavy Lift Vessel (HLV). Additional modules were then added to this structure.

Although Brent Alpha was not redeveloped during the LTFD project, some of its processing facilities were made redundant and/or removed in 2002 when the platform was reconfigured as a satellite of Brent Bravo.

Brent Alpha ceased production in November 2014, and it is currently powered by electricity via a cable from Brent Bravo. Emergency power for lighting can be provided by a diesel generator and back-up batteries on Brent Alpha. Drilling power is supplied by four dedicated diesel generators on Brent Alpha, and these can provide additional power to supplement the emergency generator if the power supply from Brent Bravo fails. The general configuration of the Brent Alpha topside is shown in Figure 3.

As described fully in the Brent Field Pipelines Decommissioning Technical Document [8] the removal of the Brent Alpha topside is dependent on the successful completion of the Brent Bypass Project which will re-route the northern and western leg gas pipelines⁴ so that they no longer cross over the Brent Alpha topside.

Figure 3 Three Main Levels of the Brent Alpha Topside.

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⁴ The Northern Leg Gas Pipeline is the 20" line C0603/PL164 and the Western Leg Gas Pipeline is the 18" line N0601/PL017.
6.5 Brent Bravo

Brent Bravo is a Condeep-design concrete GBS with three legs. All the Brent Bravo topside modules were installed during its fabrication in a fjord near Stavanger, before the GBS was towed offshore and ballasted down at its final location [7].

Brent Bravo ceased production in November 2014 and it is presently powered by turbines using gas from Brent Charlie. The general configuration of the Brent Bravo topside is shown in Figure 4. In terms of design, size, mass, inventory and facilities, the Bravo topside is very similar to the Delta topside which is described in the Delta Topside DP [3].

Figure 4 Three Main Levels of the Brent Bravo Topside.

6.6 Brent Charlie

Brent Charlie is a SeaTank-design GBS with four legs (Figure 5). All its topside modules were installed during its fabrication at a nearshore deep-water site, before the GBS was towed offshore and ballasted down at its final location [7].

The topside is located on a lattice girder Cellar Deck which is supported on four 15.7 metre (m) high steel transition pieces on the top of the concrete legs. When the topside is removed, it will be separated at the bottom of the transition pieces at a height of about 7 m above sea level (Lowest Astronomical Tide (LAT)), leaving the transition piece attached to the topside (Section 9.4.3).

Brent Charlie is still in production and is powered by a combination of its own gas and gas from the Penguins Field received through the 4 inch pipeline PL 2228/N1141. It receives oil from the Penguins Field through the 16 inch pipeline PL 1902/N0513, and exports this to Cormorant Alpha through the 30 inch pipeline PL 0001/N0501. It is currently estimated that Brent Charlie will cease production by the end of 2018. The general configuration of the Brent Charlie topside is shown in Figure 5.

As described in the Pipelines TD [8], the Penguins subsea tie-back will be disconnected from Brent Charlie. The future of the Penguins Field will be subject to separate approvals from OGA/BEIS.
Figure 5 Three Main Levels of the Brent Charlie Topside.

6.7 Summary Data on Topsides

Table 1 Summary Data on the Brent Platform Topsides.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Alpha</th>
<th>Bravo</th>
<th>Charlie</th>
<th>Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total mass (tonnes)</td>
<td>15,068</td>
<td>23,636</td>
<td>30,423</td>
<td>24,200</td>
</tr>
<tr>
<td>Number of decks</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Footprint (m x m)</td>
<td>81 x 37</td>
<td>73 x 46</td>
<td>80 x 49</td>
<td>72 x 47</td>
</tr>
<tr>
<td>Height from cut line$^5$ to helideck (m)</td>
<td>38</td>
<td>39</td>
<td>47$^6$</td>
<td>41</td>
</tr>
</tbody>
</table>

5 The positions of the cut lines are presented in Section 9.4.3.

6 Charlie is higher because most of the 15.7m long steel transition pieces will be removed with the topside.
7 PREPARATION OF TOPSIDES FOR REMOVAL

7.1 Introduction

This section describes the preparatory work that has or will be undertaken on the topsides before they are removed. Brent Alpha and Brent Bravo ceased production on 1 November 2014 and their topsides are being prepared. A similar preparatory programme will be performed on Brent Charlie when it too ceases production.

Our decision to remove the topsides using an SLV, and thus to conduct the majority of dismantling onshore, will result in a significant reduction in both the safety risks for project personnel and the likelihood of accidental environmental impacts offshore. Because the topsides will be removed as single units, much less preparatory work is required offshore.

We will, however, complete carefully planned and managed programmes of work to remove the bulk of mobile contaminants from equipment, pipework and vessels, and make the topsides safe for transportation. The main aim of this work will be to ensure that in the period leading up to removal (when the topside may be minimally-manned or unmanned) and during topside removal, the remaining contaminants will pose little or no risk to personnel, the environment or the installation. Hazardous materials and chemicals are mainly located in the well engineering package and the production process systems. Any chemicals in the accommodation areas, such as domestic cleaning products, will be present in only small volumes. This section therefore focuses mainly on the preparation of the topside production process modules.

7.2 Preparation for Cessation of Production

Following the Cessation of Production (CoP), the stocks of chemicals on the platforms will be reduced to essential minimum amounts. The focus will be on reducing the inventories of chemicals used in production such as Hydrogen Sulphide (H₂S) scavenger, corrosion inhibitors, anti-foam chemicals, oxygen scavengers, monoethylene glycol (MEG), triethylene glycol (TEG) and biocides.

In our present plan, Alpha and Bravo will be powered by fuel gas from Charlie until the Far North Liquids and Gas System (FLAGS) pipeline is disconnected in 2019; both platforms will then be powered by diesel generators. When the platforms stop using fuel gas, it is likely that the platform blowdown system and flare system will be used to burn-off the remaining hydrocarbon inventory in the topside processing system, in an operation that will be identical to that carried out during a normal planned shut-down. Depending on the exact timing and sequence of topside decommissioning, any gas still present in the out-of-service Brent intra-field pipelines will be flared. The decommissioning of the Brent Field pipelines system, including the emptying of these lines, is described in detail in the Pipelines TD [8]. The platforms will then be ready for the decommissioning cleaning operations.

7.3 Decommissioning Cleaning Operations

The topside systems will be cleaned so that any contaminants still present while the platform is minimally-manned or during topside separation will pose no risk to personnel or the environment. The resulting waste will be disposed of using approved processes. The important objectives of the decommissioning cleaning programmes will be to:

1. Minimise the risk that personnel may be exposed to hazardous substances, e.g. by minimising the requirement to work in confined spaces
2. Minimise the number of lifting operations on the platform
3. Ensure that there will be no loss of containment from the topside before removal or during transportation to the ASP facility
4. Ensure that wastes and contaminants removed from the topsides offshore are in a condition suitable for acceptance by onshore waste contractors
5. Maximise the amount of cleaning, decontamination and dismantling that can be performed onshore
Before shutdown, the systems will have been drained, or purged and vented (through the cold flare system), to ensure that no pockets of hydrocarbon liquid or gas are present. These procedures may be repeated until the systems are within limits for the safe breaking of containment (that is, cutting a pipe or breaking into a vessel). As a safety measure, additional vents may be created at selected locations in the topside process systems to ensure they are not recharged from any trapped inventories. All drained systems will be left open to the atmosphere to permit free-venting and prevent the build-up of gases. We know that material may accumulate in ‘dead legs’ (such as the bends of pipes) but we do not expect large quantities to be present, and by virtue of their location such residual materials are not likely to escape during lifting or transportation. Such locations will be included in the detailed survey of the topside once it is received onshore. If a system cannot be fully drained for operational reasons (e.g., the final diesel inventory which is required to fuel essential generators), the locations and quantities of fluids will be clearly recorded. Accordingly, inventories will be minimised to ensure that risks during transportation are reduced to a level that is As Low As Reasonably Practicable (ALARP).

Where practical, tanks and vessels will be sampled and the results of any analyses will be recorded in the materials inventory, which will be issued to Able so that they are aware of the materials that will be present on the topside when it is received onshore. The majority of lubricating (‘lube’) oils will be removed and shipped to shore for disposal but oils within sealed systems will be left because (i) they are present in only small quantities and, (ii) their removal would involve breaking open systems which could damage the equipment and result in it being scrapped instead of reused. Because the volumes involved are small and the systems will remain closed, there is a very small risk that such oils will be spilled.

The acceptable level of cleanliness will depend on the particular system, and guidance on cleanliness will be produced for each system. Appropriate levels of cleanliness will be further defined during the detailed engineering phase, before the start of any work, and recorded as part of our safety and environmental screening activities.

Once the cleaning programme has been completed, the topside process system will be purged with nitrogen, and the gas vented through the flare system, to ensure no pockets of hydrocarbon gas are present. As a safety measure, additional vents may be created at selected locations in the topside process system.

7.4 Positive Isolation and Depressurisation of Hydrocarbons

We will implement ‘positive isolation’ to prevent any remaining hydrocarbons from migrating between different systems or areas of the platform. This means that at important or critical locations, pipework and systems will be severed and blanked-off to create a physical air gap between components. Additional controlled drain points and vent points will also be installed so that we will be able to bleed-off and monitor any accumulations of gas or fluid. All vessels will be closed-off, thus isolating all inlets and outlets, and the doors of modules will be opened. The topsides process systems will then be monitored to ensure that personnel can work safely and that risks to the environment are reduced to levels that are ALARP.

7.5 Disposal of Waste

Every drain point will be sealed and connected by a flexible hose and a valve to a collecting tray. Appropriate sections of the platform’s drains system will be closed, and monitored daily until no fluids are discharged when the valves are opened. Any liquids collected in the trays will be transferred to tote tanks (transportable containers) and shipped to shore for disposal.
7.6 Disposal of Remaining Chemicals and Lube Oils

Any chemicals remaining after the pre-CoP run-down period will be collected in tote tanks and shipped to shore for disposal, along with any remaining lube oils in tanks and machine pipework. The main sources of lube oils will be the turbine generators and large components such as pumps, motors and gearboxes.

7.7 Final Removal of Oil

Brent Alpha is essentially a wellheads platform with no processing or storage capacity; all its produced fluids were exported to Brent Bravo through the 12/14 inch oil pipeline PL1955/N0310. Production ceased in November 2014, and fluids from well lubrication were exported to Brent Bravo. The small amounts of fluids from well plugging will be back-loaded and taken to shore for treatment.

Brent Bravo also ceased production in November 2014. Bulk de-oiling of the cells will be undertaken to export fluids to Brent Charlie through the 24 inch oil line PL045/N030. The Brent Bravo cells do not contain any attic oil but some interphase material may be present.

The final oil export run on Brent Charlie will take place before the final decommissioning of the related infrastructure. The Brent Charlie cells probably contain some attic oil and interphase material, but we do not know the exact volumes of these materials in either the storage cells or the peripheral (ballast) cells.

Brent Delta ceased production in 2014. All the oil from topsides cleaning was routed into one of the GBS cells for temporary storage before the final export run to Brent Charlie in June 2015. In 2016 we started a programme of work on Brent Delta to tap into every cell and move the trapped attic oil and interphase materials into a single holding cell. This programme will be restarted after the topside has been removed, and once all this material has been gathered into the holding cell it will be removed and taken to shore for recycling. On Bravo and Charlie we plan to recover this material using the existing pipework. If this is not possible, e.g. because of the poor condition of the pipework, the subsea removal method used on Brent Delta will be repeated as necessary on Bravo and/or Charlie.

7.8 Preparation for Lifting

All three topsides will have to be strengthened to bear the forces to which they will be subjected when lifted by the SLV. Additional steel plates may be welded onto some modules to reinforce or further secure them. The main activity will be the attachment of specially-designed lifting points at several carefully selected locations on the underside of the PGDS and Cellar Deck. Such a programme of work has already been completed on Delta, with the addition of approximately 120 tonnes of “cruciforms” (Figure 6 and Figure 7), and 80 tonnes of module deck strengthening. Some fixtures and fittings will have to be removed to allow the lifting beams to be positioned. The whole structure will be checked for loose or damaged items and components, and these will be repaired or removed.
For the removal of the Delta topside, we have designed and installed ‘shear restraints’ inside the legs (Figure 8 and Figure 9). These strong steel structures, each weighing approximately 36 tonnes, have been bolted in place in the leg at the height of the cut line, and will serve to ensure that the topside remains firmly in place after the cuts have been made. It is likely that similar restraints will be fitted to Bravo.
Figure 8  Shear Restraint being Assembled Dry Onshore.

Figure 9  Shear Restraint Fitted Inside a Leg on Brent Delta.
7.9 Removal of Conductors and Pipework

On Bravo, the topside is linked to the caisson by pipework in the utility leg and by conductors in the two drilling legs, and on Charlie it is linked by pipework in all four legs and by the external conductors located between legs C3 and C4. On Brent Alpha the topside is linked to the jacket by pipework running down the legs and by 28 conductors held in place by the conductor guide frames.

If derogation were granted for the GBSs, and our recommendations to leave all three GBSs with their legs upright and in place were accepted [7], it would be our intention to leave the majority of the conductors in place inside the legs. Likewise, if derogation were granted for the Brent Alpha jacket, it would be our intention to leave the lower parts of the conductors in place from the seabed up to the top of the footings at approximately −84.5 m LAT [6]. We have determined, however, that the most efficient method for removing all or part of the conductors on Brent Alpha is to lift them with an HLV after the removal of the topside. Consequently, for the removal of the topsides, the conductors on Brent Alpha, Bravo and Charlie will be cut at approximately +6 m LAT, +16 m LAT and +6 m LAT respectively, slightly below the height of the cuts that will be made to separate the topsides from their support structures.

To enable the topsides to be lifted, suspension flanges and dip tubes will be removed and the existing wellheads prepared for removal by cutting off all the side outlet valves. The various annuli (between conductor, surface casing and inner casings) will be hot-tapped and flushed with seawater. The wellheads will cut from the top of each conductor by a diamond wire cutting (DWC) machine and lifted away using one of the platform’s cranes.

The lengths of conductor remaining above the cut point for the removal of the topside will be marked into section approximately 30 feet long. Each section will then be drilled and pinned at top and bottom, to provide lifting aids and to hold the internal sections of casing in place, and then cut using a diamond wire. The sections of conductor plus casings will be lifted through the wellbays and, after capping and suitable preparation, taken to shore for recycling.

On the GBSs, this will allow a scaffold work-platform to be installed inside the top of each leg for the deployment of the DWC machine that will cut the legs. On the Brent Alpha steel jacket, a DWC will be deployed externally (Figure 10) to cut the vertical diagonal bracing members, the six main legs and the two additional legs.

---

7 Following CoP and the completion of the programme to plug and make safe the wells, the 30” diameter steel conductors will each contain two “casings” (hollow steel tubes) with diameters of 13 3/8” and 20”. The space between casings, or between the 20” casing and the conductor, is called the annulus.

8 Hot-tapping is the procedure used to drill into a pipe or vessel that contains pressurised fluid.
We understand the issues associated with securing the steelwork inside the legs, should there be a need in the future to partially remove the legs by underwater cutting. All items within the drilling and utility legs on the GBSs are currently secure, and in our ongoing preparations for the removal of topsides we will complete various checks and sweeps that will provide assurance that the internal pipework and steelwork will be left secure after the topside lifts.
We appreciate that if parts of the GBS legs had to be removed some years in the future, the potential cut line (at about -69m LAT for the utility leg) could be obstructed by corroded pipes and steelwork. Before DWC cutting operations could begin, such obstructions would have to be cleared by an ROV deployed through a large opening in the side of the leg. The study Brent GBS Leg Removal: Feasibility Assessment of Specific Issues [9], by Dr techn. Olav Olsen (DTOO), the original designers of the Condeep GBSs, has concluded that a nominal 2m x 2m opening would not be likely to affect the structural integrity of the concrete leg. Current engineering activities will leave the leg internals secure. Any cutting operations in the medium- to long-term future would be preceded by subsea intervention to ensure that the cut zones were clear and secure.

7.10 Testing and Verification

Throughout each step of this programme, the completion of each activity will be confirmed and recorded. The important steps are the initial isolation and blowdown, cleaning for decommissioning, and, finally the positive isolation of important systems.

7.11 Present Status of Brent Topsides

Table 2 presents a summary of the condition or status of the three Brent topsides at 1st February 2017.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Brent Alpha</th>
<th>Brent Bravo</th>
<th>Brent Charlie</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceased production</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Wells P &amp; L</td>
<td>26 of 26</td>
<td>37 of 37</td>
<td>12 of 38</td>
</tr>
<tr>
<td>Wells P&amp;A</td>
<td>3 of 26</td>
<td>36 of 37</td>
<td>NS</td>
</tr>
<tr>
<td>Production chemicals run down</td>
<td>S</td>
<td>S</td>
<td>NS</td>
</tr>
<tr>
<td>Process systems drain, purge or vent</td>
<td>S</td>
<td>S</td>
<td>NS</td>
</tr>
<tr>
<td>Process system depressurised</td>
<td>S</td>
<td>S</td>
<td>NS</td>
</tr>
<tr>
<td>Bulk oil exported</td>
<td>NA</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Hydrocarbons free</td>
<td>S</td>
<td>S</td>
<td>N</td>
</tr>
<tr>
<td>Attic oil removed</td>
<td>NA</td>
<td>NA</td>
<td>NS</td>
</tr>
<tr>
<td>Conductors cut</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Underdeck strengthened</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Pre-removal cleaning</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Key
P & L = Plug and Lubricate; the process of circulating the drilling fluids out of the well and casing.
P&A = Plug and Abandon; the process of setting the concrete barrier plugs to seal-off the well and make it safe.
8 INVENTORIES OF TOPSIDES AFTER PREPARATION

8.1 Introduction

This section presents information on the materials that will be on or in the topsides when they are ready to be removed. With the planned single lift removal method, it is important from safety, legislative and environmental reasons that we have a detailed inventory of the materials being taken to shore for processing.

Although construction materials such as steel, metals, plastic, wood and insulation constitute the majority of the mass of each topside, many different types of materials have been used in the construction and operation of the Brent platforms and some of these will be classified as hazardous or will have hazardous qualities. It will be necessary to ensure that material from the topside is being dealt with by organisations suitably licensed to carry, treat and dispose of it.

When considering a topside and its materials, it can be useful to assign material to one of three categories, namely: architectural materials, equipment, and hazardous material. The following sections present information on these categories.

8.2 Architectural Materials

Architectural materials primarily comprise steel structures and the frames that form the floors, cladding and walls between different parts of the topside. The majority of this material will be recycled.

8.3 Equipment

Equipment refers to all the machinery, systems and fixed or mobile items used in the operation of the platform. This includes compressors, generators, pumps, tanks, pipework, valves, heat-exchangers, filters, drains and sumps. The majority of this equipment will be recycled or reused.

8.4 Hazardous Materials

The topsides contain potentially hazardous materials, which are frequently embedded or contained within specific components or other types of material. The main hazardous materials present on some or all of the topsides are briefly described in the following sections.

8.4.1 Asbestos

Asbestos is a fire-resistant material widely used on offshore platforms for insulation, lagging and gaskets. Its presence is of concern from a safety point of view during dismantling, transportation and disposal activities.

8.4.2 Heavy Metals in Batteries

There are many batteries on the Brent platforms, including large centralised supplies and small-scale supplies such as the back-up Un-interruptible Power Supplies (UPS) necessary for safety-critical systems. The batteries may contain several heavy metals (including cadmium and lead) and potentially environmentally harmful chemicals.

8.4.3 Paint

Paint coatings are applied externally and internally, mostly for protection against corrosion. The types and quantities of paints will determine how various materials are managed during dismantling and disposal, the risks those materials pose and the extent to which they can be recycled. The main reported paints are zinc primers and epoxies, but other potentially hazardous paints are also present including lead chromate paints, isocyanate paints and anti-fouling paints containing tributyltin.
8.4.4 Naturally Occurring Radioactive Material and Other Radioactive Sources

In many oil and gas operations, produced water from the reservoir carries radioactive constituents and accompanying major ions from the oil-bearing formations to the wellhead and into the processing facilities. This material is called Naturally Occurring Radioactive Material (NORM), and it often precipitates inside pipes or valves as an insoluble scale referred to as Low Specific Activity (LSA) Scale. There can be significant health, safety and environmental concerns associated with NORM, and its handling, transportation and disposal are the subject of stringent national legislation.

We engaged the specialist consultancy Aberdeen Radiological Protection Services (ARPS) to review and update data on the inventory of NORM [including LSA scale] on each of the Brent platforms. NORM is present as LSA scale on the internal surfaces of some plant and equipment which has been exposed to produced water, and in sand and sludge deposits in separators, hydrocyclones and other tanks and vessels. Table 3 presents our estimates of the mass of NORM on the Brent platform topsides (in the form of sludge and LSA scale) and the activity levels of the main radionuclides Pb 210, Ra 226 and Ra 228.

8.4.5 Mercury in Fluorescent Tubes

There are many fluorescent lighting tubes on the Brent topsides and these pose a hazard due to their mercury content. Fluorescent powders in the tubes exhibit some hazardous properties and during use tend to absorb some of the mercury in the gas space.

8.4.6 Mercury in Other Locations

Mercury from formation fluids can be deposited into oil and gas process pipelines and vessels. Mercury can be relatively easy to manage if it is present as a surface film, but more difficult if it is combined within the fabric of the steel itself. Our sampling data from the Brent topsides does not indicate the presence of mercury. From a health and safety point of view it is best to keep the process systems intact until the topside is delivered to shore, and then perform carefully planned and controlled surveys and intrusive sampling to determine if mercury is present within the steel. Any mercury or mercury-contaminated components will be handled, removed, transported and disposed of appropriately during onshore inspection and dismantling.

8.4.7 Diesel

Diesel fuel is used for routine operations and to power back-up emergency electricity supplies and firefighting systems, and will continue to be used until the topsides are removed. As the date for each topside lift approaches, the volume of diesel on the platform will be carefully reduced so that only the minimum amounts necessary for safe operation are present at the time of lifting. Before dismantling begins onshore, the diesel tanks will be flushed and purged.

8.4.8 Chemicals in Cables

Polyvinylchloride (PVC) electrical cables contain plastisizers (phthalates) and stabilisers such as lead, cadmium and organotins. The presence of these chemicals will be taken into consideration during dismantling and waste management.

8.4.9 Heavy Metals in Smoke Detectors

Smoke detectors contain small amounts of heavy metals such as lead, zinc, tin and copper, and smaller amounts of more exotic metals in the components themselves. These are standard materials covered by the Waste Electrical Equipment Directive. Ionisation smoke detectors use a small radioactive source and require specialist handling.

8.4.10 PCBs in Transformers

Polychlorininated biphenyls (PCBs) were once routinely used in large transformers for insulation and cooling. Although they are no longer used offshore and have been replaced, there may be residues of PCBs in some transformers. PCBs are resistant to biodegradation and therefore persistent in the environment, and under electrical and thermal stress they can break down to form the more toxic dioxins that are also persistent.
8.4.11 Halons

Several halogenated organic compounds, including Chlorofluorocarbons (CFC) and Hydrofluorocarbons (HFC), were used in fire extinguishing systems and as refrigerants, and some of the original isomers used posed a significant threat to the ozone layer. The more hazardous isomers have been replaced by other halons that pose less of a hazard to the ozone layer. All the halons once used in the Brent platforms’ fire systems have been removed and replaced with water-based foams or fine water spray.

8.4.12 Helicopter Fuel

Helicopter (heli) fuel is stored in tanks close to the helideck and will continue to be used almost until the topsides are removed. Shortly before each planned lift, heli-fuel will be run down to volumes that are as low as practical and the equipment will be isolated. Before dismantling begins onshore, all tanks and pipelines will be flushed and purged.

8.4.13 Lubricating Oil

The Brent platforms have many pumps, motors and other rotating machines that use lubricating oils. Small components and items of equipment may have self-contained lubricating systems within the item, and such sealed systems will be left intact and dealt with onshore. In large components, however, the lubricating system may comprise reservoirs, oil pumps and in some cases lube oil coolers connected to the item or machinery. These systems will be drained as far as possible before the lift.

8.4.14 Topsides Chemicals

Many chemicals are used in oil and gas recovery and processing, including methanol, TEG, corrosion inhibitor, anti-scale chemicals, oxygen scavenger (ammonium bisulphite), demulsifier, anti-foam, H₂S scavenger, biocide, foam used in the fire-fighting systems, and diatomaceous earth used in water injection filter pre-coat systems. Most of these so-called ‘bulk’ chemicals are delivered to the platforms in 2.7 m³ Intermediate Bulk Containers (IBC). These chemicals will all be run down at CoP and only minimal volumes will be present on the topside when it is lifted-off, these small amounts will be disposed of properly onshore.

8.4.15 Hydrocarbon Residues

There may be residues of solid, liquid and gaseous hydrocarbons in the piping at CoP, before final cleaning and venting. These may vary from traces of hydrocarbon gases, to films of oil and solid deposits of waxes and other less volatile hydrocarbons. The decommissioning cleaning operations are designed to minimise the volumes of such hydrocarbons.
8.5 Topside Inventory

Table 3 presents a summary of the types and masses of material that we plan will be present on the Brent topsides when they are removed by the SLV. The mass of the topsides at the time of removal will depend on how much material is removed in preparation for the lift and how much under-deck strengthening is added, and may be greater than the total mass of the materials itemised in Table 3. On Brent Delta, for example, approximately 120 tonnes of steel have been welded to the underside of the PGDS to strengthen the lifting points.

The topsides inventories were initially compiled in a desktop study of original plans, drawings and weight reports. They have subsequently been updated from the most recent weight reports to account for modifications and the movement of materials to and from the platforms. In these tables, the following assumptions have been made regarding the removal of some materials before the topsides are lifted:

- The production process trains will be drained of all liquids
- Bulk and drummed chemicals will be removed
- Fuel oil and grease lubricants will be removed as far as possible
- Diesel and heli-fuel tanks will be run down to the minimum levels required for safe operation
- All Fluorinated gas (F-Gas) and CFC gas will be removed
- Hazardous and Non-hazardous drains tanks will be drained and vented; some tanks may be removed
- All muds, chemicals and bulk material used for drilling will be removed from the platform on completion of the P&A programmes
- Mobile Non-Destructive Testing (NDT) sources will be removed
## Table 3  Summary Inventory of main Materials on the Brent Platform Topsides.

<table>
<thead>
<tr>
<th>Material</th>
<th>Unit</th>
<th>Alpha</th>
<th>Bravo</th>
<th>Charlie</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>tonnes</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>Plastic pipes</td>
</tr>
<tr>
<td>Ac 228</td>
<td>MBq</td>
<td>n/q</td>
<td>n/q</td>
<td>n/q</td>
<td>In smoke detectors</td>
</tr>
<tr>
<td>Alloy steel</td>
<td>tonnes</td>
<td>216</td>
<td>285</td>
<td>329</td>
<td>Pipework, pumps</td>
</tr>
<tr>
<td>Aluminium</td>
<td>tonnes</td>
<td>419</td>
<td>15</td>
<td>15</td>
<td>Anodes, engines</td>
</tr>
<tr>
<td>Aluminium bronze</td>
<td>tonnes</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Pumps</td>
</tr>
<tr>
<td>Americium 241</td>
<td>MBq</td>
<td>5</td>
<td>16</td>
<td>20</td>
<td>Smoke detectors</td>
</tr>
<tr>
<td>Anodes (total)</td>
<td>tonnes</td>
<td>419</td>
<td></td>
<td></td>
<td>See Al and Zn</td>
</tr>
<tr>
<td>Asbestos blue</td>
<td>tonnes</td>
<td>n/q</td>
<td>n/q</td>
<td>n/q</td>
<td>Not yet quantified</td>
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<tr>
<td>Asbestos white/brown</td>
<td>tonnes</td>
<td>n/q</td>
<td>n/q</td>
<td>n/q</td>
<td>Not yet quantified</td>
</tr>
<tr>
<td>Asbestos (total)</td>
<td>tonnes</td>
<td>4</td>
<td>9</td>
<td>9</td>
<td>Insulation, gaskets</td>
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<tr>
<td>Batteries</td>
<td>tonnes</td>
<td>28</td>
<td>16</td>
<td>36</td>
<td>Various battery sets</td>
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<tr>
<td>Brass</td>
<td>tonnes</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Pumps, piping</td>
</tr>
<tr>
<td>Bronze</td>
<td>tonnes</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Pumps, piping</td>
</tr>
<tr>
<td>Buna</td>
<td>tonnes</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>O-ring seals</td>
</tr>
<tr>
<td>Butyl rubber</td>
<td>tonnes</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>O-ring seals</td>
</tr>
<tr>
<td>Carbon steel</td>
<td>tonnes</td>
<td>11,921</td>
<td>19,572</td>
<td>25,448</td>
<td>Structural steel, equipment</td>
</tr>
<tr>
<td>Cement (powder)</td>
<td>tonnes</td>
<td>2</td>
<td>n/q</td>
<td>n/q</td>
<td>Residual bulk material</td>
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<tr>
<td>Ceramics</td>
<td>tonnes</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>White ware</td>
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<tr>
<td>Chartist/fire protection</td>
<td>tonnes</td>
<td>27</td>
<td>103</td>
<td>122</td>
<td>Penetrations</td>
</tr>
<tr>
<td>Chromium</td>
<td>tonnes</td>
<td>n/q</td>
<td>n/q</td>
<td>n/q</td>
<td>Alloy steel only</td>
</tr>
<tr>
<td>Copper</td>
<td>tonnes</td>
<td>107</td>
<td>222</td>
<td>281</td>
<td>Pipes, cables, transformers</td>
</tr>
<tr>
<td>Copper nickel alloys</td>
<td>tonnes</td>
<td>67</td>
<td>174</td>
<td>229</td>
<td>Pipe-valves, pumps</td>
</tr>
<tr>
<td>Cork</td>
<td>tonnes</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>Lifebuoys</td>
</tr>
<tr>
<td>Cotton</td>
<td>tonnes</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>Bedding</td>
</tr>
<tr>
<td>Diesel</td>
<td>m³</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>Reduced to minimum</td>
</tr>
<tr>
<td>Drill cutting residues</td>
<td>tonnes</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>Behind shale shakers</td>
</tr>
<tr>
<td>EPDM</td>
<td>tonnes</td>
<td>23</td>
<td>5</td>
<td>23</td>
<td>Cables</td>
</tr>
<tr>
<td>Ethylene/polypropylene</td>
<td>tonnes</td>
<td>72</td>
<td>46</td>
<td>120</td>
<td>Cables</td>
</tr>
<tr>
<td>Fire foam</td>
<td>m³</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>Firefighting systems</td>
</tr>
<tr>
<td>Fluorescent tubes</td>
<td>nos.</td>
<td>1,396</td>
<td>2,984</td>
<td>3,116</td>
<td>Lighting</td>
</tr>
<tr>
<td>Formica</td>
<td>tonnes</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>Living areas</td>
</tr>
<tr>
<td>Glass</td>
<td>tonnes</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>Living areas</td>
</tr>
<tr>
<td>GRP</td>
<td>tonnes</td>
<td>7</td>
<td>21</td>
<td>16</td>
<td>Replaced floor grids</td>
</tr>
<tr>
<td>Graphite/charcoal</td>
<td>tonnes</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>Water filters</td>
</tr>
<tr>
<td>Gun metal</td>
<td>tonnes</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Pumps, valves</td>
</tr>
<tr>
<td>Halon (CFC)</td>
<td>kg</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Has been removed</td>
</tr>
<tr>
<td>Heli-fuel</td>
<td>m³</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>Reduced to minimum</td>
</tr>
</tbody>
</table>
Table 3, continued  

Summary Inventory of main Materials on the Brent Platform Topsides.

<table>
<thead>
<tr>
<th>Material</th>
<th>Unit</th>
<th>Alpha</th>
<th>Bravo</th>
<th>Charlie</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inconel/nimonics</td>
<td>tonnes</td>
<td>6</td>
<td>13</td>
<td>13</td>
<td>Generators</td>
</tr>
<tr>
<td>Insulation</td>
<td>tonnes</td>
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9 REMOVAL OF TOPSIDES BY SLV

9.1 Introduction

SLVs are purpose-built craft capable of removing the entire topsides of large platforms in one lift. To date, only one such vessel has been built, the AllSeas vessel Pioneering Spirit. We have commissioned AllSeas to remove the Brent Alpha, Bravo and Delta topsides and transport them to the ASP facility on Teesside for dismantling, with the materials then being appropriately reused, recycled, treated or disposed of. The removal of the Brent Charlie topside will be subject to a separate tendering exercise at a later date.

Removal of complete topsides by SLV is a novel technology that offers considerable reduction in offshore safety risk. A detailed analysis of the hazards and safety risks of the entire removal programme, including leg cutting, lifting, transportation, barge-loading and skidding to shore, will be completed for each topside. The actual cutting and lifting operations will be detailed in the Dismantlement Safety Cases as required by the Health and Safety Executive (HSE); the Brent Delta Dismantlement Safety Case was approved in April 2016.

9.2 Description of SLV Pioneering Spirit and Cargo Barge

The Pioneering Spirit (Figure 11) is a very large twin-hulled vessel, designed for heavy lifting and for the deployment and retrieval of pipelines. It was launched in 2014 and has now been commissioned and performed its first lift in 2016 (Section 9.3). By means of the ‘slot’ (the 122 m x 59 m gap between the two hulls) and the Topside Lifting System (TLS) which can bridge this gap, the Pioneering Spirit is capable of lifting topsides weighing up to 48,000 tonnes. A system for lifting large jackets weighing up to 25,000 tonnes (the Jacket Lift System [JLS]) will be designed and added at a later date.

Figure 11 Photograph of the Pioneering Spirit during Initial Sea Trials in September 2014.
There is insufficient water depth at the ASP facility for the Pioneering Spirit to moor alongside the quay. The Brent topsides will therefore have to be transferred to shore using a specially-constructed cargo barge, the Iron Lady, which is 200 m long and 51.6 m wide (Figure 12). Tugs will be used to tow the barge and manoeuvre it around the Pioneering Spirit and the ASP facility quay.

Figure 12 The Cargo Barge Iron Lady in the Slot between the two hulls of the Pioneering Spirit.

9.3 Assurance and Risk Assessments

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 Front-end Engineering and Development (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 Shell Trading and Shipping Company (STASCO), 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 platform modifications of Safety Critical Elements (SCE) that affect the Dismantlement Safety Case, subject to approval by the 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 finalised the installation of 12 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 platform\(^9\) (Figure 13). Together, these two lifts provide further assurance that any unforeseen problems in design, systems or operating procedure have been identified and resolved. The remaining 4 lifting beams are currently being installed, before the Brent Delta topside lift which is planned to take place in summer 2017.

\textbf{Figure 13}  \textit{Pioneering Spirit} lifting the Yme topside, August 2016.

\section*{9.4 Description of Topside Removal Process}

\subsection*{9.4.1 Introduction}

This description of the removal operation is based on the programme for Brent Delta, because this is the most advanced and fully-developed of the topside programmes. It is likely that the programmes for Brent Alpha, Brent Bravo and Brent Charlie will be very similar to this, but they may be modified in light of the experience we gain in lifting Brent Delta and the experience AllSeas gain in lifting topsides and facilities for other operators.

The topside removal process comprises nine steps or operations that result in the placement of a topsides on Quay 6 of the ASP Facility on Teesside.

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\(^9\) Yme is a platform in the Norwegian sector of the North Sea.
9.4.2 Step 1 Preparatory Phase

The topside will be prepared for lifting by removing obstructions, and reinforcing some of the structural components so that they can withstand the forces that they will experience during lifting and transportation. For the preparations currently under way on the Brent Delta topside this phase comprises four programmes of work – under-deck preparation, lift point preparation, module preparation and the fitting of the shear restraints – and it is likely that broadly similar programmes of work will be required for the Alpha, Bravo and Charlie topsides.

All pipework and hoses that might contain liquids that could be spilled into the environment will be capped, and loose objects that may pose a risk to personnel, the vessel or the substructure will be removed or secured. We will conduct a review with AllSeas to (i) ensure that in the planned programme of work there will be no interactions between any part of the topside and equipment or structures on the Pioneering Spirit during removal and, (ii) confirm that the topsides are sound enough to be lifted and transported. Structural analyses have determined that the Delta flare tower and drilling derrick can be left in place and taken to shore with the topside. AllSeas will carry out further analyses for the other topsides.

9.4.3 Cutting the Legs

Brent Alpha

To separate the topside from the Brent Alpha jacket, the legs and vertical diagonal members will be cut at approximately +7 m LAT, about 0.5 m to 1 m above the horizontal framing at +6.5 m LAT (Figure 14). At this height on the jacket a total of 18 cuts will be required and it is likely that the cuts on the main legs will be castellated (stepped) to ensure that the topside remains stable and in place after all the cuts have been made.

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

On the Condeep GBS Brent Bravo the topside is fixed to the tops of the legs by 5.5 m long steel transition pieces located at +19.8 m LAT, just above the ring beam at the top of the concrete legs (Figure 15). To separate the topside, a DWC machine will be deployed inside the legs to cut through the grout and the bolts that secure the transition pieces to the ring beams (Figure 16). To make the cuts, holes will be drilled at intervals around the wall of the leg so that the wire of the DWC can be passed out and round a section of the leg wall (Figure 17). As each section of wall is cut, steel spacers (‘shims’) will be placed in the cut to keep the gap open and prevent the DWC from jamming. All of this work will be carried out from the scaffold work-platform inside the top of each leg but personnel will need to use rope access on the outside faces of the legs to pass the diamond wire back through the holes to create the wire loop. After the cuts have been made, the topside will be held safely in place by a combination of friction and the shear restraining supports bolted inside the legs.

Figure 15  Location of the Cut Line at the Top of the Concrete Leg.

![Figure 15](image1)

Figure 16  Cross-section through the Top of a Leg and Ring Beam.

![Figure 16](image2)
Figure 17  Using a Diamond Wire Cutting Machine on Concrete.

The topside will be separated from the GBS by cutting through the steel transition piece where it joins the concrete leg, at a height of approximately +7 m LAT (Figure 18). Steel restraining supports will be added after the cuts have been made to ensure that the topside remains stable and in place until it is removed.

Figure 18  Typical Location of Cut Line on Brent Charlie Leg.
9.4.4 Step 2 Vessel Moves into Position at the Platform

The topsides will remain stable and in place on top of the legs and jacket after the cuts have been made, and throughout the period when the topsides are likely to be unmanned. On completion of the preparatory phase we will monitor the state of the topsides until the lifting programme begins, to ensure that they remain in a condition suitable for lifting.

Removal operations must take place during a suitable ‘weather window’ which is clearly defined by maximum limits for sea state and wind speed. Before finally committing to the operation, a detailed forecast will be obtained to determine if the weather conditions will be suitable. AllSeas will confirm that there is a suitable weather window for lifting operations and transit to shore, and that there are appropriate ‘safe haven’ options for the SLV if weather deteriorates or operations are delayed.

On arrival in the Field, the Pioneering Spirit will be positioned just outside the 500 m safety zone. After completing pre-operational checks on the DyP, ballast and lift systems, the vessel will be granted formal approval from Shell and the Marine Warranty Surveyor to enter the 500m safety zone and begin operations.

Once the vessel is close to the platform, it will be very accurately positioned so that the GBS legs fit into the vessel’s slot (Figure 19); the clearance between the vessel’s hull and the platform substructure is sufficient to allow for small lateral movements of the vessel. The beams of the TLS (Figure 20) will be fully retracted at this time, to provide the maximum clearance between the SLV and the substructure when manoeuvring.

Positioning will be achieved using a combination of the Pioneering Spirit’s advanced DyP system, a global reference system and a local reference system that will be fitted on the platform’s substructure during the preparatory phase.

Figure 19 SLV Pioneering Spirit Aligning with a GBS.
9.4.5 Step 3 Position the Yokes at the Pre-determined Strong Points

The SLV will be stationed beneath the topside (Figure 21), and the 16 large beams of the TLS (paired into eight forklift units) will be positioned under the prepared lift points on the underside of the PGDS (Figure 22).

Figure 20 TLS Beams Extending from both Hulls of the *Pioneering Spirit* with the Cargo Barge in the Slot.

Figure 21 SLV in Position under the Topside.
Each forklift unit is fitted with a yoke (lifting pad) that will fit onto one of the prepared topside lifting points on the underside of the PGDS or Cellar Deck (Figure 23). All eight forklift units will be used, and this will spread the load across the lift points and minimise the amount of local strengthening required on the under-deck. The forklift units will be positioned under the lift points using the TLS reference system, and the active motion compensation system will be used to ensure that the yokes and the TLS beams do not collide with the substructure of the platform. The units will be positioned so that the distance between the lifting beam and the underside of the platform is as large as possible, to minimise the risk of an impact.

Two pairs of lifting beams (or forklift units) will be connected in turn. Once each pair connects with the lifting point by means of ‘stabbing pins’, the upward pressure against the topside under-deck will be increased until sufficient friction is gained to switch the active motion and heave compensation systems of the two units to the passive motion control system.

The next lifting beam will then be positioned under the corresponding lift point, and the process repeated. The forklift units will thus be progressively installed in pairs until all the yokes are positioned correctly.
9.4.6 Step 4 Pre-tensioning

When all the yokes have been connected to the lifting points and all the forklift units have been transferred to passive motion control, the vessel will be progressively deballasted to transfer the weight of the topside onto the yokes and TLS system (Figure 24). When approximately 80% of the total load has been taken by the TLS (subject to detailed structural analysis) the vessel will be ready to make the final lift.

Figure 24 Deballasting the Pioneering Spirit.

9.4.7 Step 5 Lifting the Topside

Figure 25 Lifting a GBS Topside using the SLV Pioneering Spirit.
In the final lift, all the lifting levers will simultaneously be pushed to the upper position to lift the topside clear of the legs in an operation that will take approximately 20 seconds (Figure 25). At the same time, using the ‘quick-drop ballast system’, the vessel will be quickly deballasted to compensate for the final 20% of the topside load. This final lift is designed to raise the topside clear of the legs very quickly and create a gap between the topside and the top of the legs that is sufficient to prevent contact between the legs and the topside as the vessel rises and falls in the swell. Once the final lift has been initiated, it will not be possible to reverse the sequence of events. After the final lift, the SLV will be further deballasted to maximize the clearance between the underside of the TLS beams and the tops of the legs whilst it manoeuvres away from the GBS. Immediately after the removal of the topside, the ‘seafastening’ operations on the SLV will be completed by locking the lifting yokes and arms into position and closing the connection beam between the two bow sections of the vessel (Figure 26).

Figure 26 Preparing for Transportation.

9.4.8 Fitting Navigation Aids and Condition of the Support Structures after Removal of Topside

For the GBSs: After the topsides have been removed, the GBSs will be left with their legs protruding 19.8 m above LAT (Bravo, Figure 27) or approximately 7 m above LAT (Charlie, Figure 28). Once clear of the GBS legs, the SLV will be repositioned so that its cranes can fit concrete caps onto the open end of each leg. The caps will weigh approximately 300 tonnes and one of them will be pre-fitted with Aids to Navigation (AtoN) designed to operate remotely and to be able to be maintained and changed-out by helicopter without any need for personnel to be put onto the leg. On Charlie, a new 20m long steel extension will be fitted to one of the legs to raise the AtoN well above the sea. If the caps or the AtoN cannot be fitted at this time, we will discuss appropriate action with BEIS. In such circumstances, a likely temporary solution would be to station a guard vessel close to the GBS to alert shipping; the guard vessel would stay on site until the AtoN could be installed and switched on.

The decommissioning of the Brent GBSs themselves is described in detail in the GBS TD [7]. The existing Consents to Locate (Ctx) will remain in force and the existing 500 m radius safety zones around the GBSs will remain in place as long as any part of the structures remains above sea level. We will discuss with BEIS how the long-term presence of any underwater remains can best be marked and reported to other users of the sea. As described in the GBS TD [7], it is our intention to apply to BEIS for the 500m safety zone around each GBS to remain in force even after the structures have disappeared from view.
For the Brent Alpha jacket: After the topside has been removed, the Brent Alpha jacket will be left with the top of the jacket protruding approximately 7 m to 7.5 m above LAT [the PGDS will have been removed as an integral part of the topside] (Figure 29). If derogation were granted for the Brent Alpha jacket, it is likely that the upper part of the jacket would be removed at a convenient time after the topside had been lifted away. Appropriate measures to alert mariners and safeguard the structure during this time will be discussed and agreed with BEIS, and are likely to comprise either the fitting of a specially designed AtoN to the top of one of the platform legs or the permanent stationing of a guard vessel close to the jacket. The decommissioning of the Brent Alpha jacket itself is described in detail in the Jacket TD [6]. The existing CtL will remain in force and the existing 500 m radius safety zone around the jacket will remain in place as long as any part of the jacket remains above sea level. We will discuss with BEIS how the long-term presence of any underwater remains can best be marked and reported to other users of the sea. As described in the Alpha Jacket TD [6], it is our intention to apply to BEIS for the 500m safety zone around the jacket footings to remain in force after the upper jacket has been removed.

Figure 27 Condition of the Brent Bravo GBS after Removal of the Topsides.

Figure 28 Condition of the Brent Charlie GBS after Removal of the Topsides.

Figure 29 Condition of the Brent Alpha Jacket after Removal of the Topside.
9.4.9 Step 6 Transportation

The Pioneering Spirit will then proceed under her own power to Teesside, approximately 388 nautical miles (nm) (719 kilometres [km]) away; this voyage will take less than one week. Operational procedures, based on acceptable accelerations and subsequent loads in the structure, will determine the vessel’s maximum speed in different sea conditions.

Each topside will be considered ‘cargo’ in this phase of the project, and it will contain some hazardous materials that are subject to permitting requirements. These materials will therefore be itemised in the vessel’s cargo manifest, and all necessary permits and consents will have been obtained for carrying and moving them. The removal and transportation of LSA scale, for example, will be in accordance with the Radioactive Substances Act (RSA) 1993 [10]. All sealed radioactive sources (for example in instruments and gauges), will be transported in accordance with the International Maritime Dangerous Goods (IMDG) Code 2011 which is mandatory under the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78).

We are working closely with the appropriate Regulators and local Marine or Harbour authorities to ensure that all the contingency plans will be in place before the removal of the first topside, Brent Delta, which is planned for summer 2017. Emergency response plans will be in place for the removal and transportation activities, including a Brent Field System Oil Pollution Emergency Plan (OPEP) which incorporates 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). We will put a bridging document in place with AllSeas to confirm all the responsibilities and response arrangements.

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 topside. This will be informed by knowledge that has been gained from the transfers and load-ins that have been performed in and around Teesside over the last few years, including the removal of the Brent Delta topside. We have also performed an Environmental Societal and Health Impact Assessment (ESHIA), bearing in mind the inventory of materials that will be present on the topside when it is ready to be removed. The Delta Dismantlement Safety Case, detailing the management of the remaining offshore Major Accident Hazards (MAH), was approved in April 2016.

9.4.10 Step 7 Transfer to the Cargo Barge

The topsides will be transferred to the cargo barge Iron Lady at a designated nearshore transfer site, which is a circular area of 2.78 km diameter centred on 54°44.0' N, 01°06.0' W. The centre of this area is approximately 5.5 nm from the mouth of the River Tees and approximately 3 nm from the nearest coastline (The Headland at Hartlepool), and has a water depth of approximately 35 m (Figure 30). Transfer operations will have to be conducted during very specific weather and metocean conditions.

The hull connection beam will be opened and the mechanical lock of the TLS beams will be undone. The barge will then be manoeuvred into the slot using pre-rigged mooring wires from the SLV. The SLV will be gradually ballasted-down until the whole weight of the topside is taken by the pre-fitted supports and grillages on the barge. Ballasting and deballasting on the Pioneering Spirit and the barge will be carefully controlled and coordinated to ensure that both vessels stay horizontal and level. Load monitors on the TLS beams will confirm when the load has been successfully transferred. The TLS forklift units will then be fully retracted to allow the barge to be towed out of the slot.
Figure 30  Location of the Proposed Transfer Site off the River Tees.
9.4.11 Step 9 Load-in

The dismantling and processing of the Brent Alpha and Bravo topsides, and the Brent Alpha jacket, will take place at the ASP facility on the Tees Estuary. This facility has a very large dry dock and a designated quay for the loading and off-loading of large structures (Section 10). The barge will be towed to Quay 6 of the ASP facility where it will be moored with its stern to the quayside. It may temporarily be moored alongside the quay for final preparation or while waiting for a suitable weather window.

For the load-in, the barge will be moored to the quay (Figure 31) and carefully ballasted-down onto a prepared grounding bed, to ensure that the topside can be skidded across to the quay onto prepared supports (‘stillages’) on the quay (Figure 32).

Figure 31 Mooring Arrangement for Load-in of the Brent Delta Topside to Quay 6 of the ASP Facility, Plan View.

![Mooring Arrangement](image1.png)

Figure 32 Skidding Arrangement for Load-in of the Brent Delta Topside to Quay 6 of the ASP Facility.

![Skidding Arrangement](image2.png)
10 ONSHORE DISMANTLING AND DISPOSAL OPERATIONS

10.1 Introduction

This section describes the methods that our dismantling and disposal contractor Able will use and the procedures they will adopt to dismantle, handle, treat, recycle and dispose of the topsides. The Brent Charlie topside will probably be dealt with in a very similar way to achieve the same objectives, but will be subject to a separate tendering exercise.

Onshore dismantling will be performed in accordance with the British Standard BS 6178:2011 Code of Practice for Full and Partial Demolition [11]. The scope of the onshore disposal contract that we have placed with Able comprises:

1. Provision of newly-constructed quayside facilities and newly-constructed lay-down areas to receive the structures from our removals contractor.

2. Provision of facilities, equipment and personnel to safely dismantle the structures.

3. Re-use and recycling of materials, with a target to recycle 97% of the mass of material that is taken to the shore.

4. Disposal of all non-hazardous and hazardous waste streams in accordance with statutory requirements.

10.2 Management of Disposal and Recycling

The removal of the topsides as single units by the SLV will enable all the detailed surveys, inspections, cleaning and dismantling that would have been required offshore, for a modular dismantling programme to be carried out more safely and more efficiently onshore.

The dismantling and disposal will be managed by our dismantling and disposal contractor Able, a well-established international dismantling and recycling contractor. Able were selected after an extensive competitive tendering exercise involving several UK and Norwegian yards; the assessment included (but was not limited to) their historic performance, demolition engineering capabilities and current management systems and procedures. Able have dismantled and recycled offshore modules for various operators on the United Kingdom Continental Shelf (UKCS), including Shell and BP (in 2008 they dismantled the topsides and jacket of BP’s NW Hutton) and they have dismantled American and French naval vessels. The site is licensed and subject to regular checks by the appropriate government agencies.

We will be very closely involved in the planning, management and audit of all the operations at the ASP facility, as described in Section 11. The management, storage, handling, transportation, processing, treatment and ultimate disposal of all waste streams arising from the BDP will be undertaken in accordance with all applicable legislation and our procedures and guidelines.

All waste materials recovered during the decommissioning of the Brent Field and its facilities will be processed, treated and disposed of by licensed contractors at licensed sites with all the necessary permits and consents. The contractors will be chosen through an extensive selection process in which environmental and safety considerations will be paramount, and the social impacts of onshore activities will be assessed. The Best Practicable Environmental Option (BPEO) will be used throughout the project and the principles of the waste management hierarchy will be observed, in that, where possible, material will be reused or recycled.

When the onshore processing, treatment and disposal of the Brent Field facilities has been completed, data will be available on the quantities of material that have been recycled and disposed of, and the methods and sites used to dispose of all non-hazardous and hazardous waste streams. A summary of this information will be included in our Decommissioning Close-out Report.
10.3 Description of the Onshore Dismantling Site

The dismantling work will be carried out at Quay 6 of the ASP facility which is located on the Seaton Channel off the River Tees Turning Circle, Hartlepool, England (Figure 33). The ASP facility covers 51 hectares (ha) (126 acres) including a 10 ha (24.7 acres) deep-water basin/dry dock and 306 m of quay frontage (Figure 34), which hosts the specialised Teesside Environmental Reclamation and Recycling Centre (TERRC). The facility has a wide range of plant and equipment including multi-wheeled heavy lift transport, forklift trucks, cranes, portable man lifts and lifting equipment. It has been in operation since 1996 and has completed numerous decommissioning projects. The ASP facility can process up to 300,000 tonnes of offshore structures each year and its services and supporting infrastructure can sustain a workforce of more than 2,000 personnel.

Figure 33 The ASP Facility on the Tees Estuary.

The ASP facility can handle all the different types of materials and waste streams that will be present on the Brent topsides when they are received on the quayside. The various licenses at the ASP facility are currently being renewed, and the site will be fully licensed for all the activities that may be involved in handling, dismantling, treating and disposing of the Brent topsides and the Brent Alpha jacket.
10.4 Environmental Setting of the Onshore Dismantling Site

The town of Hartlepool is located within Cleveland on the northeast coast of England and is part of the Tees Valley economic area (sub-region); the Borough of Hartlepool covers an area of approximately 9,400 ha.

The ASP facility is located on the north side of the Tees estuary adjacent to the Teesmouth National Nature Reserve (NNR), an important seal haul-out and breeding site which hosts the only regular breeding colony of common seals on England’s north-east coast. The Teesmouth NNR overlaps two Sites of Special Scientific Interest (SSSI), the Seaton Dunes and Common SSSI (including the North Gare dunes and grazing marsh areas) and the Seal Sands SSSI. Cowpen Marsh and a small portion of the Tees and Hartlepool Foreshore and Wetlands SSSI lies to the west of the NNR, and form part of the Teesmouth and Cleveland Coast Special Protection Area (SPA) and Ramsar site, which provides internationally important habitats for migratory and wetland birds. The intertidal and sub-tidal areas of the SPA are designated as the Teesmouth and Cleveland Coast European Marine Site (EMS). The ASP facility is adjacent to the Hartlepool Nuclear Power Station (EDF Energy) and the Huntsman Tioxide Chemical Plant. Seaton Meadows Landfill Facility is located in the low-lying coastal plain approximately 1.5 km from the Tees Estuary and 500 m from the ASP.

The nearest major residential population is Seaton Carew, Hartlepool, 1 km to the north.

Table 4 gives a summary of the designated sites within a 2km radius of the ASP facility, and Figure 35 shows the location of the ASP facility in relation to nearby sites of conservation significance.
The environmental sensitivities of the ASP facility and surrounding area are described in DNV GL’s Brent Field Decommissioning Environmental Statement (ES) [12] and AECOM’s site-specific Brent Removals and Dismantlement Impact Assessment (ESHIA) [13]. This includes a description of the conservation designation and status of sites adjacent to the nearshore transfer site, the tow route to the River Tees and the ASP facility. The potential environmental impacts of receiving, dismantling, treating and disposing of all the topsides materials are identified and assessed in the ES and ESHIA, along with a description of the site- and project-specific controls and mitigation measures that will be put in place to eliminate or minimise any impacts.

Table 4  Summary of Internationally and Nationally Designated Sites near the ASP Facility.

<table>
<thead>
<tr>
<th>Status</th>
<th>Distance from ASP</th>
<th>Designated Site</th>
<th>Habitats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internationally</td>
<td>Adjacent to north, east and west</td>
<td>Teesmouth and Cleveland Coast SPA</td>
<td>Tidal river, estuary, mud flat, sand flat, lagoon, salt marsh, sand beaches, inland water bodies</td>
</tr>
<tr>
<td>designated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internationally</td>
<td>Adjacent to north, east and west</td>
<td>Teesmouth and Cleveland Coast Ramsar site</td>
<td>Tidal river, estuary, mud flat, sand flat, lagoon, salt marsh, sand beaches, inland water bodies</td>
</tr>
<tr>
<td>designated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nationally designed</td>
<td>30m north</td>
<td>Seaton Dunes and Common SSSI</td>
<td>Sand, mud, rocky foreshore, dunes, dune slack, dune grassland, salt marsh, freshwater grazing marsh, dykes, pools and seawalls</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nationally designed</td>
<td>Within the SSSI</td>
<td>Seal Sands SSSI</td>
<td>Intertidal mud flats</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nationally designed</td>
<td>150m southwest</td>
<td>Tees and Hartlepool Foreshore and Wetlands SSSI</td>
<td>Wetland, estuarine and maritime</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nationally designed</td>
<td>40m east</td>
<td>South Gare and Coatham Sands SSSI</td>
<td>Intertidal mud and sand, sand dunes, saltmarshes and freshwater marsh</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nationally designed</td>
<td>1.7km southwest</td>
<td>Cowpen Marsh SSSI</td>
<td>Grazing marsh</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nationally designed</td>
<td>50m west</td>
<td>Teesmouth NNR</td>
<td>Sand dunes, intertidal sand, grazing marsh and mud flats</td>
</tr>
</tbody>
</table>
10.5 Description of Dismantling Process and Schedule

10.5.1 Introduction

It is planned that the first topside to arrive at the onshore dismantling facility will be Brent Delta in the summer of 2017, and we expect that it will take 12-24 months to dismantle this topside after load-in [3]. According to our current schedule, the Brent Bravo topside will be brought ashore in 2020, Brent Alpha in 2021, and Brent Charlie probably not before 2025.

Our aims are to dismantle the topsides in the safest possible manner and, in line with the waste hierarchy and our policy on waste, to recover as much equipment and material as practicable for re-use in its existing form, and then recover as much as possible of the balance for recycling. The objective of our waste policy is ‘to provide the policy and control for the management of waste for Shell to ensure that Shell-generated waste is disposed of in compliance with legal regulations and [Shell] Group Policy and standards.’

The work in this phase will include:

- Dismantling the topsides
- Removing hazardous waste
- Removing non-hazardous waste
- Removing reusable equipment
- Removing reusable steel sections e.g. plate, girders and pipe work
- Processing non-ferrous material to be sold for recycling
- Processing remaining ferrous material to be sold for recycling
10.5.2 Preparation and Surveys before Dismantling

When the topside has been safely positioned on the stillages, staircases will be erected to allow safe access and lighting will be installed as necessary. A team will then walk through the entire topside logging and cordon off any hazardous areas or items. External and internal visual surveys will be completed to determine if the topside has suffered any structural damage during transportation.

Before any work begins onshore, our dismantling and disposal contractor Able will carry out a series of inspections, surveys and risk assessments including:

- Demolition and refurbishment asbestos survey
- Hazardous waste survey
- Non-hazardous waste survey
- Hazardous waste inventory
- Photographic survey
- Stored energy report
- Gas survey
- NORM survey

The objective of these surveys and inspections will be to ensure it is safe for the work to begin, identify and quantify any hazardous substances, and identify areas requiring any special safety precautions. Any recommendations arising from the surveys and inspections will be implemented and agreed before work begins. Our own personnel will be involved during the hand-over of the topsides to Able and will help them to identify and manage hazards.

Before any work can be carried out on tanks or other enclosed spaces, it will be necessary to establish that the atmosphere is safe to work in and that mechanical access can be safely obtained. The air will be sampled to determine its H₂S content and the concentrations of any potentially explosive hydrocarbon gases. If the samples prove to be totally negative, it will be considered safe to begin work in the tank. If the samples indicate the presence of a potentially explosive mixture of gases, the tank will be purged using purging gases supplied through an existing or newly-created access point. A suitable exit point will be selected and temporarily piped to ensure that the gas is vented at a height of at least 2 m above the personnel working level. After purging, further air samples will be taken to ensure that the tank is safe to enter; purging will be repeated until no dangerous gases are detected.

Pipework attached to any tank, vessel or container will then be cut to create a physical break in the line. Tanks and vessels will be opened to the atmosphere.

After any hazardous substances have been removed from an area, a dedicated team will carry out a programme of ‘soft stripping’ to remove architectural items, soft furnishings and other non-structural equipment. Where possible, items for reuse will also be removed at this time, before demolition begins.

10.5.3 Access to Topsides Onshore

Access to the topsides will be planned during the surveys and inspections, and it is anticipated that access will be achieved using one or more of the following methods:

- Existing access doors, walkways, platforms and staircases (following full inspection regarding condition and stability of the structure)
- Hydraulic platform
- Mobile Elevated Work Platform (MEWP)
- Conventional scaffolding or Haki scaffolding tower (a stair tower attached to the structure)
The principles of ALARP and Best Available Technology Not Entailing Excessive Cost (BATNEEC) will be implemented at all times during the project, so that the residual risk is as low as reasonably practicable.

10.5.4 Removal of Components and Material

Following the surveys and inspections, the main objective will be to remove all hazardous waste material from the topside to allow dismantling to begin. Able's approach to the management of the different types or categories of wastes is summarised below.

Asbestos. Independent personnel, accredited by the United Kingdom Accreditation Service (UKAS), will carry out a destructive asbestos survey and log the results. Following this onshore survey, all asbestos will be removed by specialist contractors wearing appropriate protective clothing and respiratory equipment. This will be completed as part of the 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. All of this work will be carried out in line with the Integrated Management System including safe operating procedures for asbestos removal.

Liquids. All liquids will be removed from the topside and recycled where possible or disposed of at a suitably-licensed facility. All pipework will be checked to ensure that it has been drained and does not contain any residual material.

NORM. Independent, radiation-accredited personnel will carry out a survey for any radioactive sources, and log and mark them. If samples confirm the presence of radioactive contaminated materials these items will be removed and processed. All smoke detectors and other radioactive sources will be removed under controlled conditions and placed in the decontamination facility.

Oil. Any petroleum hydrocarbons discovered within the pipework, equipment, vessels or tanks will be drained into suitable receptacles and sent to a licenced facility for recycling or disposal. Small sealed items of equipment containing oil will be transferred to the hazardous waste store, to be processed under safe working conditions.

Waste disposal. All waste material will be disposed of to a suitably-licensed facility. Ferrous metals, reusable material and general waste (in skips) will be segregated and stored in separate piles adjacent to the demolition site, and will be removed at a later date.

10.5.5 Cleaning of Removed Items/Components

There are several buildings and facilities on the ASP site where removed items or components can be properly stored, and where they can be cleaned or refurbished under controlled conditions before being removed from the site. The facility has numerous methods of cleaning, including pressure washing, sand blasting, hand brushing and needle guns.

10.5.6 Storage and Handling of Materials

Modules or structures that are stored for reuse but subsequently identified as waste will not be dismantled unless suitable temporary containment measures for the decontamination of the structure have been agreed with the Environment Agency (EA). All decontamination of modules and structures which could cause pollution that cannot be mitigated by local containment procedures will take place within the Dirty Module Dismantling Pad. This is a specific area at ASP which is served by drains and interceptors to collect surface run-off and any accidentally spilled liquid contaminants.

Waste materials generated from module dismantling will be removed from the TERRC site and stored in temporary containers on the Dirty Module Dismantling Pad or in the Hazardous Waste Store until they are removed.

The module storage area at the ASP facility is 5 hectares of concrete hard-standing which is fully lined and surrounded with a drainage ditch system connected to an oil interceptor. Any liquid wastes or rainwater run-off from the topside will be collected in the cut-off drain and passed through the oil interceptor before exiting into the main site drainage.
10.5.7 Opportunities for Re-use of Components, Items and Material

Where possible, any items that are suitable for reuse will be removed from the structure before demolition begins, and then cleaned, tested or otherwise made ready for reuse. Able will then organise reuse within the site or to third parties. Reusable equipment will be removed from the module or structure and stored within the Reclaimed Materials Storage Area pending sale. Any steel sections, plate or pipe that can be reused will also be stored in the Reclaimed Materials Storage Area, pending sale. Generally, any ferrous material that is to be reprocessed will be cut into sizes not exceeding 1.5 m x 0.6 m x 0.6 m and stockpiled in the Reclaimed Materials Storage Area.

10.5.8 Cutting Techniques

Several ‘hot’ and ‘cold’ cutting techniques will be used during the dismantling of the topsides, including:

- High reach shear: Once the large sections have been brought to ground level a 360° excavator fitted with a hydraulic cutting shear can be used very effectively to cut the materials into smaller manageable pieces. This means that only one person is present during the dismantling operations.
- Excavator: An excavator fitted with ripper blade.
- Plasma: A hot cutting system for stainless steel and cast iron.
- Diamond wire: A chain embedded with industrial diamonds for cutting steel.
- Abrasive wheel: A hand-held cutting tool.
- Arc air: A hand-held carbon or graphite electrode which melts the metal, which is then removed by a blast of air.
- Oxygen propane: In oxy-propane oxygen and propane are combined to form a hot flame. It is efficient, accurate, cost-effective and safe, and is the most commonly-used method for cutting metals.
- Powder cutting: An oxy-propane cutting system modified by the addition of metal particles to cut stainless steel.
- Reciprocating saws: A hand-held cutting tool with saw blades, for cutting wood, plastic, and small cables and pipes.
- Hand tools: Various hand-held tools for cutting small items such as cables and pipes.

10.5.9 Demolition Method

The essence of Able’s proposed programme of work is to quickly reduce the height of the 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 then connected by wire ropes to a large vehicle on the ground (e.g. an excavator). This will then slowly move away, forcing the section to part from the topside and fall in a controlled manner into a designated drop zone. A thick bed of sand will be laid around the topside to absorb the shock of these falling sections (Figure 36). Cut and pull is well-proven as the safest method for topside demolition and dismantling, particularly since it minimises the number of man-hours spent working at height. Once on the ground, removed sections of topside will be dismantled using a mixture of hot and cold cutting techniques, reducing the topside to small pieces that can be handled, stored and then transported to appropriate recycling sites.

Before any demolition work begins, personnel will inspect the structure to locate which items or areas are to be removed. This activity will also highlight situations where it is possible that the removal of an item(s) could result in the release or generation of stored (mechanical) energy and ensure that all personnel are aware of such locations.
When the section to be removed has been identified, a cutting sequence will be planned which will describe the locations of the separation gaps and the final cuts, and the types of cuts required. Demolition operatives who specialise in the hot cutting of metals – known as ‘top burners’ – will then prepare the internal areas of the structure by removing pipework, cable trays and non-structural steel work, and create ‘separation gaps’ horizontally and vertically along the external walls, leaving the load-bearing uprights intact.

‘Sit cuts’ or ‘hinge cuts’ will then be made in the steelwork to help stabilise the section. A ‘sit cut’ is designed to separate the steel structure in such a way that the cut section sits back down onto the secure, uncut section to maintain the stability of the two sections until they are pulled apart. A ‘separation gap’ is a break in the steel which can be physically inspected to positively confirm that the two sections are not connected. A ‘hinge cut’ is a cut in a structural beam in which one flange and part of the web are removed to form a hinge to control the direction in which the cut section falls.

Before the final cuts are made, the wire pulling ropes will be lifted into position by a crane and shackled to the upper section of the structure. Top Burners will then cut the retaining uprights at the desired levels, leaving only the highest level retaining beams intact. Once the exclusion zone has been put in place, the Top Burners will make the final cuts in the retaining beams and the cut section will be pulled to the ground. This procedure will be repeated following a planned sequence until the topside is dismantled.

An exclusion zone will be set up around the work area before any demolition begins. The exclusion zone will comprise the following two areas (Figure 36):

- The ‘drop zone’: The area of the exclusion zone where the section of topside is predicted to fall. This area will be covered by a layer of sand at least 1 m thick, to prevent any damage to the quay surface and to absorb and thus reduce vibration.

- The ‘exclusion zone’: The area into which any debris from the structure might spread, either as it falls or, in particular, on impact. The demolition engineer will calculate the size of this area.

A dust-suppression system may be set up in the exclusion zone to reduce any air-borne particles that may arise during demolition operations. This system is fully automated to eliminate all risk to personnel.

As demolition proceeds, additional supports may be placed under the topside to ensure that it remains stable and secure. Throughout the demolition process, the status of the topside and the need for extra supports will be determined by the Demolition Engineer.

Figure 36  Elevation of a Topside in the Dismantling Area.
11 MANAGEMENT OF THE HEALTH, SAFETY AND ENVIRONMENTAL IMPACTS OF Dismantling AND DISPOSAL

11.1 Introduction
This section describes how the programme of work will be managed by our dismantling and disposal contractor Able and its sub-contractors once a topside has been delivered onto the quayside at the ASP facility. Unless otherwise stated, the title or roles refer to personnel employed by Able, its partner companies or its sub-contractors.

All of the Brent topsides material will be taken to the UK where it will be processed, treated and disposed of by licensed contractors with all the necessary permits and consents. The principles of the waste management hierarchy will be observed throughout the dismantling and disposal of the Brent topsides. We will seek opportunities to reuse materials, components and equipment but where this is not possible the materials will be recycled; we aim to recycle at least 97% by weight of the topside material retrieved to shore. Although our dismantling and disposal contract is with Able, we have an ultimate duty of care to ensure that all this work is carried out in a safe and environmentally responsible way. The specific arrangements of the contract ensure that we will have a continuing involvement with the planning, management and execution of the dismantling programme. Our contractor Able will prepare a detailed plan for the execution of the whole dismantling programme, and they will report progress against this schedule once work begins.

11.2 The Health, Safety, Security, Environment and Social Performance Aims of the Brent Decommissioning Project

In terms of Health, Safety, Security, Environment and Social Performance (HSSE & SP) the aims of the BDP are:

- To decommission the Brent assets in a safe and environmentally responsible way. This means applying Goal Zero: No harm, no leaks and being a good neighbour (no community impact)
- Comply with the Health, Safety and Environment content of Shell’s Corporate Management System (CMS) including the Life Saving Rules, Golden Rules, and Construction Site Safety Standards

Consequently, the BDP fully endorses the following principles:

- Pursue the goal of no harm to people or the environment
- Be willing to challenge normally-accepted methodologies and practices
- Visibly report on our performance and learnings
- Play a leading role in promoting best practice in our industries and our people
- Manage change and safety matters as any other critical business activity
- Promote a positive safety culture in which all personnel share these commitments

The main objectives are to:

1. Identify all HSSE & SP hazards and reduce the risks to an ALARP level; sub-contractors will employ best-practice methods to identify, assess and control HSSE & SP hazards and will document the methods used and outcomes achieved.
2. Maintain a safe workplace during all phases of the project.
3. Ensure that the project subscribes to Shell’s Business Principles and Life Saving Rules.

To focus on safety, all of the onshore workforce will be involved in safety management activities. All personnel will carry an equal responsibility for safety.

Able were selected partly on the basis of their HSSE & SP performance and record. The proximity of their own landfill site means that there will be no requirement to transport lorry-loads of waste through local communities.
11.3 Shell Involvement with Able

Shell will monitor Able’s activities against the requirements of the dismantling contract. This will include reviewing and approving important documents, monitoring execution activities, and participation in significant joint meetings. After completion of the load-in at the disposal yard, ownership of the structures will transfer to Able, but we will continue to monitor the work to ensure successful completion of the dismantling and disposal phase.

11.4 Interface with the Environment Agency

Able will engage with relevant local authorities and the EA to ensure that all the regulatory requirements are fully understood and complied with. As the decommissioning project progresses, Able will ensure that the appropriate permits, consents and licences for all activities will be in place with the relevant authorities. All permits, consents and licences will be managed within the overall project management structure.

11.5 Environmental Impacts of Separation, Transportation, Skidding and Dismantling

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 by DNV GL in the ES [12] as required by the DECC Guidance Note [4]. In addition to the project-wide ES, we engaged AECOM Limited to prepare a detailed ESHIA [13] 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 to shore, and that we understand the risks and have suitable mitigation measures in place.

11.6 Onshore Operations at the ASP Facility

Able recognises the importance of environmental protection, and is committed to operating its business responsibly and in compliance with all environmental regulations, legislation and approved codes of practice relating to their activities. These include:

- Environmental Protection Act 1995[14]
- Health and Safety at Work etc. Act 1974[15]
- Control of Substances Hazardous to Health Regulations 2002[16]
- Radioactive Substances Act 1993[10]
- Construction (Design and Management) Regulations 2007[18]

Able has an ISO 14001 Environmental Management System and integral Environmental Monitoring System [19] in place at its ASP facility. Able’s policy, which is communicated to all employees, suppliers and sub-contractors, is to carry out all reasonably practicable measures to meet, exceed or develop all necessary or desirable requirements, and to continually improve environmental performance by:

- Regularly assessing the environmental effects of its activities
- Training employees to achieve competence in environmental topics
- Minimising the production of waste
- Minimising material wastage
- Minimising energy wastage
- Promoting the use of recyclable and renewable materials
- Reducing and/or limiting the production of pollutants to water, land and air
• Controlling noise emissions from operations
• Minimising the risk to the general public and employees from its operations and activities
• Complying with all the requirements of permits and licences

11.7  Management and Control of Specific Health, Safety and Environmental Risks

11.7.1  Introduction
When managing the health of personnel working on the project, the following overriding standards will apply:

• Maintain compliance with the requirements of applicable legislation as an absolute minimum
• Co-operate and co-ordinate with other organisations or work groups active on site in a pro-active manner to share non-sensitive information
• All personnel working on behalf of the project will be included in a health surveillance scheme when required
• Health risk information will be included in work packs and work instructions as appropriate
• Health risk information will be shared openly between organisations working on the same installation where there is the potential of cross contamination

11.7.2  Working at Height
All activities which are to be carried out at height will be subject to a suitable risk assessment which is aligned with the requirements and classifications detailed in the *Working at Height Regulations 2005* [20] and the *Working at Height (Amendment) Regulations 2007* [21].

11.7.3  Working in Confined Spaces
All work in confined spaces will be carried out in accordance with the *Confined Spaces Regulations 1997* [22]. A confined space means any place, including any chamber, tank, vat, silo, pit, trench, pipe, sewer, flue, well or other similar space in which, by virtue of its enclosed nature, there arises a reasonably foreseeable specified risk. The most common hazards encountered in confined spaces are atmospheric hazards that affect air quality and present immediate hazards to health or life. Acceptable atmospheric conditions must be verified before entry, and the atmosphere must be monitored continuously while the space is occupied.

11.7.4  Lifting Operations
All lifting operations will be undertaken by competent persons and will be conducted following the requirements of the *Lifting Operations and Lifting Equipment Regulations 1998 (LOLER)* [23], and the relevant supporting Technical Guides applicable to the activities being undertaken and the equipment being used.

All major dismantling ‘drops’ will be engineered by the Demolition Engineer who will take particular care to ensure that the structure is stable at all times. The Engineer will provide detailed drawings that identify cuts and lifting sections. After each demolition operation, the Engineer will inspect the remaining structure and assess its stability and integrity to confirm that it is safe for personnel to work on, and these inspections will be recorded by the Demolition Manager.

11.7.5  Minimising Exposure to Noxious Gases
As a minimum, the eight principles of the COSHH Regulations [16] will apply to the control of all substances hazardous to health. The project will develop a strategy for the Management of Occupational Health.
11.7.6 Minimising Exposure to Fire, Explosion and Flammable Material

The ASP facility has been subject to a fire risk assessment approved by the local authority, and this is periodically reviewed according to the local authority’s guidance on such matters. A specific assessment will be conducted before any topside is delivered to the site. This will include guidance on the types of extinguishers to be available, and their numbers and locations, as well as input to any activity-specific risk assessments, emergency arrangements and rescue plans.

Escape routes will be clearly identified and will be updated so that they are current and relevant to the stage of dismantling; emergency mustering arrangements will be in place and regularly tested.

An approved site-specific Emergency Response Plan will be in place. This will include arrangements for all foreseeable emergency situations arising at the Able disposal site, and for any potential impacts from neighbouring sites and their emergency arrangements.

No naked flame hot work will be undertaken without the express approval of senior management, and then only under a specific permit to work and after suitable and sufficient risk assessment; where practicable, the preferred method for cutting is cold-cutting.

11.7.7 Minimising Exposure to NORM

Under the Ionising Radiations Regulations 1999 (IRR) [24], employers who work with materials that contain small, but from a radiation protection perspective, significant, amounts of NORM are required to take action to restrict radiation exposure to their employees and other persons who may be affected by their work with such materials.

Exposure to materials that contain NORM can sometimes arise directly from working with the raw materials themselves but more commonly occurs during their processing. The IRR apply where such processes could cause employees or other persons to receive an annual dose in excess of 1 millisieverts (mSv). Consequently, in the health and safety risk assessment required by the Management of Health and Safety at Work Regulations 1999[25], employers must determine whether such exposures are likely and, if they are, take the necessary steps to comply with the IRR.

The management of all radioactive sources and related activities will fall under the control of an appointed Radiation Protection Advisor (RPA), who will be supported in the day-to-day management of such activities by a project- or site-appointed Radiation Protection Supervisor (RPS). Local testing will be carried out before undertaking activities on any system or process which has contained hydrocarbons, sludge, or slurry which could, as a result of hydrocarbon production processes, be radioactive. This will apply at all work sites likely to have NORM. Where NORM contamination is found to be at an unacceptable level, the approved procedures for the handling and disposal of NORM will be used.

All personnel who are likely to undertake activities which will result in exposure to ionising radiation will be subject to medical monitoring. The amounts of ionising radiation received by personnel regularly exposed to such radiation will be measured by the use of personnel monitoring devices and exposure badges.

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. For 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 monitoring for NORM contamination every time containment is broken. NORM will be managed in line with the OGP Guidelines for the management of NORM in the oil and gas industry [26].

During the dismantling operations, periodic radiation monitoring will be undertaken on any module or structure that is known to contain NORM or is suspected of containing NORM, to check for the presence of residual LSA scale. 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, pending off-site disposal or further processing.
11.7.8 Minimising Exposure to Asbestos

Our contractor Able will appoint an Authorised Person for asbestos and an approved contractor for work on or removal of, asbestos and refractory ceramic fibres, including exposure-monitoring and clearance-testing. All work will be performed under approved Permit to Work regulations.

In a topside, asbestos is most likely to be found in insulation, lagging and some types of gaskets. Asbestos-Containing Material (ACM) becomes hazardous when the fibres are released, for example as a result of drilling, sawing, breaking, cutting or machining. Fibrous asbestos insulation may contain blue (crocidolite), brown (amosite) or white (chrysotile) asbestos. To confirm the type of asbestos, a survey of any suspect insulation will be undertaken in accordance with the Asbestos Survey Guide (HSG 264). Until such an analysis has been completed, it will be assumed that the suspect materials contain the most hazardous types of asbestos, crocidolite (blue) and amosite (brown).

Persons sampling insulation materials will wear appropriate Respiratory Protection Equipment (RPE) and Personal Protective Equipment (PPE). Asbestos will be sampled under controlled conditions, using a tool specifically designed to seal the surface of the insulation after it has been cored and clean the corer as it is removed from the sample area. Once the sample is removed, the sample site will be made safe by covering with tape or by filling it with an inert material to prevent the release of the fibres.

All work with asbestos or in areas suspected of containing asbestos will be performed in accordance with the Control of Asbestos Regulations 2012 [27]. Exposure to asbestos must be prevented or, where that is not reasonably practicable, it must be reduced to ALARP. Only competent and suitably-accredited specialist sub-contractor personnel will undertake work with asbestos. At all times the site will maintain a suitable number of persons competent in the control of asbestos. Steps to manage the risk of asbestos exposure to personnel include:

1. All personnel who are likely to undertake activities which will result in exposure to asbestos will be subject to appropriate medical surveillance.
2. All personnel who work with asbestos shall hold current Asbestos Medical Surveillance, and the medical examinations shall be carried out at intervals not exceeding 2 years.
3. All personnel likely to encounter Asbestos will complete an Asbestos Awareness Course.

Asbestos will be removed by specialist contractors wearing appropriate RPE and PPE. On completion of the removal activities, the working area will be assessed to determine if it is thoroughly clean and this will be managed by means of a site clearance certificate. All asbestos materials will be disposed of in sealed containers at a suitably-licensed landfill site.

11.7.9 Minimising Exposure to Mercury

When handling and dealing with mercury, the project will follow the HSE’s good-practice guide within Offshore COSHH Essentials (supported by Shell’s standard as a minimum). All personnel who are likely to undertake activities which will result in exposure to mercury will be subject to appropriate medical monitoring.

Certain items of steel may be contaminated with mercury, and some topside pipework may be impregnated with mercury as a result of prolonged exposure to production fluids. If mercury contamination is found, an initial survey will be carried out, including monitoring by air. Spaces or equipment contaminated with mercury will be marked and unauthorised access will be prohibited. Full characterisation of the chemical form in which mercury is present will be conducted by a UKAS-accredited laboratory prior to removal.
Specialist contractors will be engaged to remove any steel that is impregnated with mercury by cold-cutting it into 3 m x 3 m sections; personnel will wear RPE and PPE. Pipework contaminated with mercury will be carefully examined so that it can be disassembled at natural break-points such as flanges. If this is not possible, the contaminated section will be removed using water-doused abrasive cutting by personnel wearing appropriate RPE and PPE. Once in manageable sections, the ends of the contaminated pipe will be sealed and the pipework removed to the hazardous waste compound to await collection by an authorised waste carrier. Process residues will be collected in suitable containers and placed in the hazardous waste store.

Steel contaminated with mercury will be disposed of by a Specialist Waste Management Contractor. If recycling or reclamation is not possible, mercury-contaminated steel will be disposed of by burial at an approved, secure landfill. Before the waste material leaves the ASP facility, it will be analysed to characterise the mercury contamination.

11.7.10 Minimising Exposure to Paint Fumes

Exposure during the burning or heating of certain types of paint can be hazardous to human health, mainly as a consequence of the inhalation of vapours or fumes which can contain isocyanates and/or lead. All personnel who are likely to undertake activities which will result in exposure to respiratory sensitizers will be subject to medical monitoring.

The COSHH requirements will be complied with and appropriate RPE will be worn where exposure is likely. Personnel will be ‘face fit’ tested for the RPE being worn to ensure that the equipment will provide the necessary protection.

A programme for sampling the topside paint coatings will be agreed between Able and the EA, and will be completed before dismantling begins. Samples of paint will be manually scraped from the metal surfaces, and analysed for lead and PCB content by an approved UKAS-accredited laboratory. The purpose of the sampling programme will be to characterise the paint coatings from a safety and environmental point of view and thus determine the appropriate route for the disposal of the painted steel.

All personnel engaged in the hot-cutting of materials coated with paint containing hazardous substances will wear approved RPE. Paint debris will be stored in suitable sealed steel containers awaiting disposal. Painted metals will be disposed of through the standard route of reprocessing scrap wastes within the manufacture of iron and steel.

The requirements of the Control of Lead at Work Regulations 2002 [28] will be complied with. Exposure to lead must be prevented or, if this is not reasonably practicable, exposure must be reduced to the ALARP level. All personnel who are likely to undertake activities which will result in exposure to lead will be subject to medical monitoring.

11.7.11 Minimisation of Noise

Able will ensure that the work is carried out in such a way that acceptable levels of noise and other forms of environmental nuisance are not exceeded. When the risk assessment has identified that acceptable levels may be exceeded, Able will measure and monitor the work and the work area.

Where practicable, noise levels will be reduced at source. All workplaces and items of plant emitting noise levels that are greater than 85 dBA (A-weighted decibels) will be marked with notices indicating that ear protection is mandatory. If significant noise is noted during operations at the site, the TERRC Site Manager will be informed and will ensure that appropriate action is taken.

11.7.12 Minimisation of Dust and Particulates

Able will ensure that during the work acceptable levels of dust and other forms of environmental nuisance are not exceeded. They will measure and monitor the work and work area, to protect the workforce and to comply with planning obligations and the Waste Management Licence (WML) conditions…

Able will ensure that adequate measures are taken to prevent the production and spread of dust. When dust is identified as a specific hazard and risk, personnel will be required to wear appropriate, specified PPE.
A specific 'Dust Management Plan' will be implemented for the project, which will include regular visual inspections for particulates by the Site Manager during those periods when site operations have the potential to generate such particulates. If the inspections reveal a particulate-generating source or potential source, appropriate mitigating measures will be implemented.

### 11.7.13 Minimisation of Light Pollution

Lighting around the buildings and their service yards will be provided by low-level directional lighting columns, similar to street lighting. Although the lighting will be visible from some parts of the SPA it is not expected to measurably increase illumination on the SPA; measurements of illumination from the existing lighting towers on the TERRC site have indicated that the illumination of the SPA attributable to TERRC’s activities amounted to 1-2 lumens only. The lighting from around the buildings will be less powerful and generally further away from the SPA. To limit the illumination of the neighbouring protected areas, directional lighting will be used at all times during nighttime operations.

### 11.7.14 Minimisation of Odour

The TERRC Site Manager will complete daily inspections for sources of possible odour-generation. If the inspections reveal an actual or potential odour-generating source, appropriate mitigating measures will be implemented.

### 11.7.15 Control of Road Traffic

Able will implement a Traffic Management Plan on the site during the dismantling phase of the project.

### 11.7.16 Minimisation of Run-off and Spillages

An Oil Spillage Management Plan will be implemented and maintained for the project, specifically for operations within Able’s TERRC facility. The plan will be designed to initiate an appropriate response in the event of an incident. It will detail a tiered response strategy that is in accordance with UK legislative requirements and takes into account the spill risk associated with the operation, the nature of the hydrocarbons that could be spilt, the prevailing meteorological and hydrographic conditions, and the environmental sensitivity of the surrounding area. The level of response will be split into three tiers as follows:

**Tier 1**

Operational spills, which can be dealt with by onsite resources. Except for the purposes of notification, a Tier 1 spill is not likely to require intervention by resources outside the facility, an external incident response organisation or external authorities.

**Tier 2**

Medium-sized spills, that can be dealt with by Harbour Board personnel with or without the assistance of a contractor or other external assistance as nominated in the plan.

**Tier 3**

Larger spills, or a loss of containment incident, that will require the full involvement of other authorities and possible mobilisation of Tier 3 and national stockpiles.

The ground at the TERRC site is graded (slightly sloped) to prevent the accumulation of surface water. Two ditches run along the boundaries of the site to intercept surface water run-off; one lies on the eastern boundary adjacent to Hartlepool Power Station and the other on the western boundary. Surface water that accumulates on the Dirty Module Dismantling Pad is drained into a full-retention separator.

### 11.8 Safety and Integrity of Waste Streams

#### 11.8.1 Introduction

Responsibility for the management of all wastes at the site will lie with Able’s Environmental Waste Manager, and their role includes:
1. Managing and controlling all aspects of the waste generated by the project works.

2. Advising on all matters relating to environmental impacts and waste management, including handling and disposal and the applicable legislation.

3. Inspecting and auditing the generation and handling of waste materials and associated environmental concerns.

4. Compiling a waste material inventory (existing and derived streams).

5. Organising any necessary sampling and analysis of wastes.

6. Organising and supervising the disposal of all wastes in accordance with prevailing legislation and best practice.

7. Documenting the origin and destination of all wastes to provide full ‘cradle-to-grave’ traceability to Shell and the Statutory Authority.

A Waste Inventory Map and a Waste Summary Sheet (WSS) will be created to identify the location of all the different types of waste on the structures, so that a detailed method statement for their removal can be prepared. The inventory and method statements will be used as a reference by personnel engaged in removing the wastes. All waste will be logged using European Waste Codes (EWC), and this will enable the Project Site Manager to complete waste consignment notes. EWC will also be used to identify suitably-licensed disposal facilities capable of receiving the waste. Third party disposal facilities have provided Able with copies of their permits and licences, to enable the Project Manager to confirm that the nominated sites are appropriate for handling the waste generated during the project.

Where necessary, wastes will be sampled to confirm that their composition and characteristics are as stated in the WSS. Our dismantling and disposal contractor Able will compare analytical results with the acceptance criteria of proposed recycling and disposal sites, to confirm that the proposed recycling or disposal route is appropriate.

11.8.2 Management and Disposal of Residual Hydrocarbons

The location of oils and other petroleum hydrocarbons within any structure will be identified through a combination of knowledge of the item to be dismantled, reference to design drawings, and information that we will provide to Able.

All sumps, lines, tanks and fixed storage vessels will be surveyed and identified. Access points will be opened and any hydrocarbons found will be sampled by the Environment, Health and Safety Manager (or his deputy) and, where necessary, analysed through a laboratory accredited by the UKAS. Drip trays and collection drums will be used as necessary, and the need for such items will be identified during the survey and identification process.
Any petroleum hydrocarbons discovered in the pipework, equipment, vessels or tanks in the structure will be drained into suitably-labelled receptacles. Systems will be drained by removing drain plugs or breaking pipework at the bottom of a system. Small quantities of oils/petroleum hydrocarbons will be transferred into suitable containers for storage and will be transferred to the hazardous waste storage area; the containers will be clearly marked to identify their contents. The transfer of oils and petroleum hydrocarbons to storage containers will take place on an impermeable concrete pad with drainage being directed through a Class 1 separator. Bulk oils and petroleum hydrocarbons will be transferred directly into road tankers which will be positioned close to the structure; a detailed method statement will be submitted and agreed with the EA before the removal of any bulk oil. Any accidental spills will be absorbed in “spill-dry” or sand in line with the site spillage procedure.

Oils and petroleum hydrocarbons will be stored within the hazardous waste storage area using suitable containers, and segregated from incompatible materials and from insulating oils containing PCBs and its derivatives.

Where possible oils, and petroleum hydrocarbons will be recycled through a licensed facility, but if this is not be possible owing to contamination or the oil’s particular chemical composition, the oil will be burned as a fuel rather than being disposed of by waste treatment and disposal.

11.8.3 Management and Recycling of Steel

Scrap ferrous steel is not hazardous, but processing can result in the production of hazardous materials such as volatile lead.

Steel will be removed by dismantling, or by hot cutting (oxy-propane flame) or cold cutting (hydraulic shears). Personnel engaged in hot cutting will wear PPE and suitable respirators. Personnel engaged in cutting ferrous materials coated with lead-based paints will wear approved RPE and will be medically monitored.

Dismantled steel will be loaded into dump trucks and delivered to the processed scrap storage area on TERRC to await transportation by road, rail or sea to suitably-licensed facilities for processing.

11.9 Tracking, Audit and Verification of Fate of all Retrieved Material

All the above information will enable the Able Project Manager to keep track of different waste streams. Our contractor Able will develop a comprehensive waste inventory and material tracking system. This will enable the movement of wastes, and in particular the agreed handover of wastes at various points in the waste management “chain”, to be accurately recorded. The system will be implemented throughout the contract and we will perform duty of care audits to verify compliance.
12 SUPPORTING MATERIAL

[26] OGP Guidelines for the management of NORM in the oil and gas industry.
[27] Control of Asbestos Regulations 2012 (Section 9.7.8).
[28] Control of Lead at Work Regulations 2002.
## 13 ACRONYMS AND GLOSSARY

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ABS</td>
<td>Acrylonitrile Butadiene Styrene</td>
</tr>
<tr>
<td>ACM</td>
<td>Asbestos-containing Material</td>
</tr>
<tr>
<td>Ac</td>
<td>Actinium</td>
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<tr>
<td>ALARP</td>
<td>As Low As Reasonably Practicable</td>
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<tr>
<td>Alpha</td>
<td>Brent Alpha Platform</td>
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<tr>
<td>ARPS</td>
<td>Aberdeen Radiological Protection Services</td>
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<td>ASP</td>
<td>Able Seaton Port</td>
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<tr>
<td>AtoN</td>
<td>Aids to Navigation</td>
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<tr>
<td>BA</td>
<td>Brent Alpha</td>
</tr>
<tr>
<td>BATNEEC</td>
<td>Best Available Technology Not Entailing Excessive Cost</td>
</tr>
<tr>
<td>BB</td>
<td>Brent Bravo</td>
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<tr>
<td>BC</td>
<td>Brent Charlie</td>
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<tr>
<td>BD</td>
<td>Brent Delta</td>
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<td>BDP</td>
<td>Brent Decommissioning Project</td>
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<td>BEIS</td>
<td>Department for Business, Energy and Industrial strategy</td>
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<tr>
<td>BPEO</td>
<td>Best Practicable Environmental Option</td>
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<tr>
<td>Bq</td>
<td>Becquerel, the SI unit measuring the activity of a quantity of radioactive material</td>
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<tr>
<td>Bravo</td>
<td>Brent Bravo Platform</td>
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<tr>
<td>BSI</td>
<td>British Standards Institute</td>
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<tr>
<td>CA</td>
<td>Comparative Assessment</td>
</tr>
<tr>
<td>CCS</td>
<td>Carbon Capture and Storage</td>
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<tr>
<td>CFC</td>
<td>Chlorofluorocarbon</td>
</tr>
<tr>
<td>Charlie</td>
<td>Brent Charlie Platform</td>
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<tr>
<td>CMS</td>
<td>Shell Corporate Management System</td>
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<tr>
<td>CoP</td>
<td>Cessation of Production</td>
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<tr>
<td>COSHH</td>
<td>Control of Substances Hazardous to Health Regulations 2002</td>
</tr>
<tr>
<td>CtL</td>
<td>Consent to Locate</td>
</tr>
<tr>
<td>dB</td>
<td>Decibels</td>
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<tr>
<td>dBA</td>
<td>A-weighted decibels, an expression of the relative loudness of sounds in air as perceived by the human ear</td>
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<tr>
<td>DECC</td>
<td>Department of Energy and Climate Change</td>
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<tr>
<td>Delta</td>
<td>Brent Delta Platform</td>
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<tr>
<td>DP</td>
<td>Brent Field Decommissioning Programme</td>
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<tr>
<td>DTOO</td>
<td>Dr techn. Olav Olsen</td>
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<tr>
<td>DWC</td>
<td>Diamond Wire Cutting</td>
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<tr>
<td>DyP</td>
<td>Dynamic Positioning</td>
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<tr>
<td>EA</td>
<td>Environment Agency [England]</td>
</tr>
<tr>
<td>EMS</td>
<td>European Marine Site</td>
</tr>
<tr>
<td>EPDM</td>
<td>Ethylene propylene diene monomer (a type of rubber)</td>
</tr>
<tr>
<td>ES</td>
<td>Environmental Statement</td>
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<tr>
<td>ESHIA</td>
<td>Environmental Societal and Health Impact Assessment</td>
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<tr>
<td>EWC</td>
<td>European Waste Code</td>
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<tr>
<td>FEED</td>
<td>Front-end Engineering and Development</td>
</tr>
<tr>
<td>F-Gas</td>
<td>Fluorinated Gas</td>
</tr>
<tr>
<td>FLAGS</td>
<td>Far North Liquids and Gas System</td>
</tr>
<tr>
<td>GBS</td>
<td>Gravity Base Structure</td>
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<tr>
<td>GRP</td>
<td>Glass-reinforced plastic</td>
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<tr>
<td>H₂S</td>
<td>Hydrogen Sulphide</td>
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<tr>
<td>ha</td>
<td>Hectares</td>
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<tr>
<td>HAZID</td>
<td>Hazard Identification</td>
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<tr>
<td>HC</td>
<td>Hydrocarbon</td>
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<tr>
<td>HFC</td>
<td>Hydrofluorocarbon</td>
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<tr>
<td>HLV</td>
<td>Heavy Life Vessel</td>
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<tr>
<td>HSE</td>
<td>Health and Safety Executive</td>
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<tr>
<td>HSSE &amp; SP</td>
<td>Health, Safety, Security, Environment and Social Performance</td>
</tr>
<tr>
<td>IBC</td>
<td>Intermediate Bulk Container</td>
</tr>
<tr>
<td>IMDG</td>
<td>International Maritime Dangerous Goods [Code]</td>
</tr>
<tr>
<td>IRR</td>
<td>Ionising Radiation Regulations (1999)</td>
</tr>
<tr>
<td>ISO</td>
<td>International Standards Organisation</td>
</tr>
<tr>
<td>JLS</td>
<td>Jacket Lifting System</td>
</tr>
<tr>
<td>kg</td>
<td>Kilogramme</td>
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<tr>
<td>km</td>
<td>Kilometre</td>
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<tr>
<td>LAT</td>
<td>Lowest Astronomical Tide</td>
</tr>
<tr>
<td>LOLER</td>
<td>Lifting Operations and Lifting Equipment Regulations 1998</td>
</tr>
<tr>
<td>LSA</td>
<td>Low Specific Activity</td>
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<tr>
<td>LTFFD</td>
<td>Long-term Field Development</td>
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<tr>
<td>MAH</td>
<td>Major Accident Hazards</td>
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<tr>
<td>Abbreviation</td>
<td>Definition</td>
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<tr>
<td>MBq</td>
<td>MegaBecquerel, one million (10^6) Becquerels</td>
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<tr>
<td>MEG</td>
<td>Monoethylene Glycol</td>
</tr>
<tr>
<td>MEWP</td>
<td>Mobile Elevated Work Platform</td>
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<tr>
<td>m</td>
<td>Metre</td>
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<tr>
<td>mSv</td>
<td>Millisieverts</td>
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<tr>
<td>NDT</td>
<td>Nondestructive Testing</td>
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<tr>
<td>Ni</td>
<td>Nickel</td>
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<tr>
<td>nm</td>
<td>Nautical mile</td>
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<tr>
<td>NNR</td>
<td>National Nature Reserve</td>
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<tr>
<td>NORM</td>
<td>Naturally Occurring Radioactive Material</td>
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<tr>
<td>OGP</td>
<td>International Association of Oil and Gas Producers</td>
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<tr>
<td>OPEP</td>
<td>Oil Pollution Emergency Plan</td>
</tr>
<tr>
<td>OSPAR</td>
<td>Oslo Paris Convention</td>
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<tr>
<td>OSRL</td>
<td>Oil Spill Response Limited</td>
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<tr>
<td>P&amp;A</td>
<td>Plug and Abandon</td>
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<tr>
<td>P&amp;L</td>
<td>Plug and Lubricate</td>
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<tr>
<td>Pb</td>
<td>Lead</td>
</tr>
<tr>
<td>PCB</td>
<td>Polychlorinated Biphenyls</td>
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<tr>
<td>PGDS</td>
<td>Plate Girder Deck Structure</td>
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<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
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<tr>
<td>ppm</td>
<td>Parts Per Million</td>
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<tr>
<td>PTFE</td>
<td>Polytetrafluoroethylene</td>
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<tr>
<td>PVC</td>
<td>Polyvinylchloride</td>
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<tr>
<td>Ra</td>
<td>Radium</td>
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<tr>
<td>RPA</td>
<td>Radiation Protection Advisor</td>
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<tr>
<td>RPE</td>
<td>Respiratory Protection Equipment</td>
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<tr>
<td>RPM</td>
<td>Replacement Process Module</td>
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<tr>
<td>RPS</td>
<td>Radiation Protection Supervisor</td>
</tr>
<tr>
<td>RSA</td>
<td>Radioactive Substances Act</td>
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<tr>
<td>SCE</td>
<td>Safety Critical Elements</td>
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<tr>
<td>SLV</td>
<td>Single Lift Vessel</td>
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<tr>
<td>SOPEP</td>
<td>Shipboard Oil Pollution Emergency Plan</td>
</tr>
<tr>
<td>SPA</td>
<td>Special Protection Area</td>
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<tr>
<td>SSSI</td>
<td>Site of Special Scientific Interest</td>
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<tr>
<td>STASCO</td>
<td>Shell Trading and Shipping Company</td>
</tr>
<tr>
<td>TD</td>
<td>Technical Document</td>
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<tr>
<td>TEG</td>
<td>Tri-ethylene glycol</td>
</tr>
<tr>
<td>TERRC</td>
<td>Teesside Environmental Reclamation and Recycling Centre</td>
</tr>
<tr>
<td>TLS</td>
<td>Topside Lifting System</td>
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<tr>
<td>UKAS</td>
<td>United Kingdom Accreditation Service</td>
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<tr>
<td>UKCS</td>
<td>United Kingdom Continental Shelf</td>
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<tr>
<td>UPS</td>
<td>Un-interruptible Power Supply</td>
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<tr>
<td>WML</td>
<td>Waste Management Licence</td>
</tr>
<tr>
<td>WSS</td>
<td>Waste Summary Sheet</td>
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