Doc No SH-OP-PL-0003

Shelley Field
Decommissioning Programmes

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CONTENTS

List of Tables

List of Figures

1 INTRODUCTION

1.1 Scope of Document

This document sets out the Decommissioning Programmes for the installation and pipelines in the Shelley Field in Block 22/02b and 22/03a of the United Kingdom Continental Shelf (UKCS), approximately 192km from the northeast coast of Scotland and 32km from the UK/Norway median line (Figure 1.1). Premier Oil UK Limited (Premier) is the operator and has a 100 per cent interest in the Shelley Field.

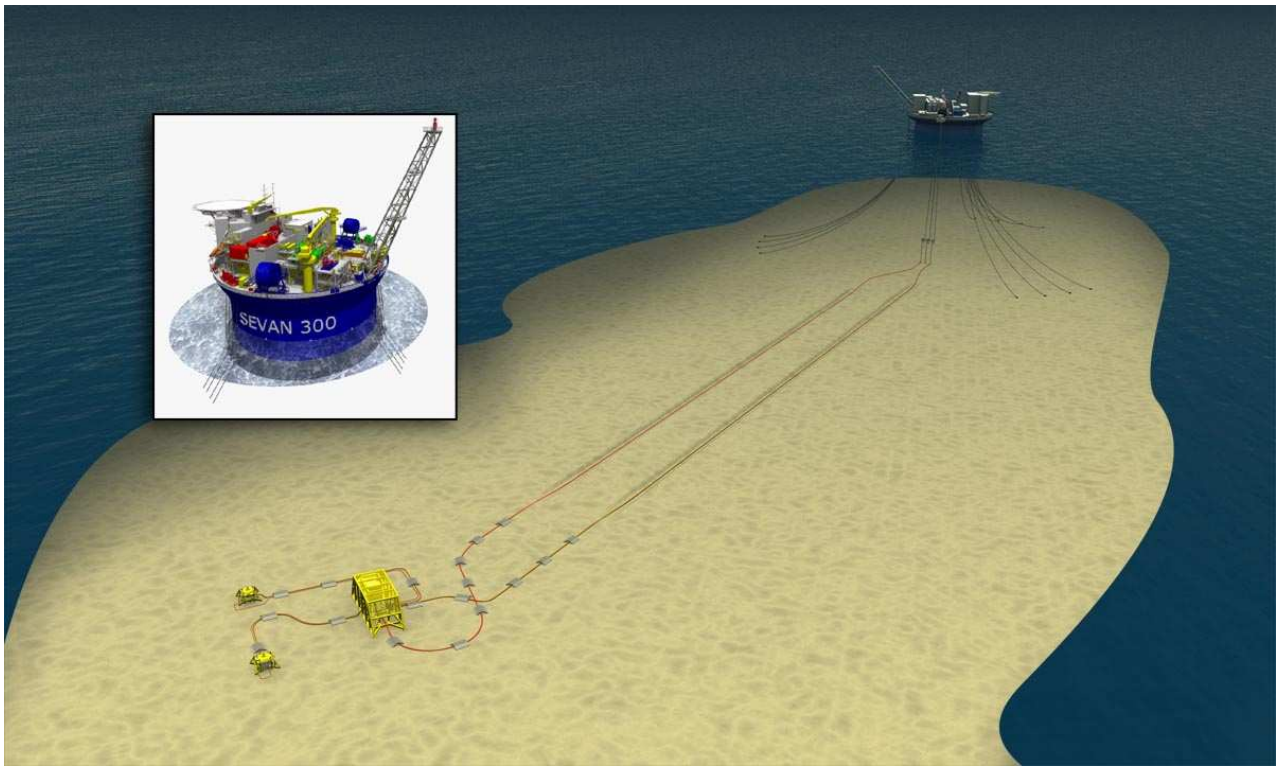
The facilities in the Shelley field comprise two production wells with Xmas trees and fishing-friendly protective structures, and a subsea production manifold and protection structure. These are tied back to the *Sevan Voyageur* FPSO by a 2.02km trenched and rock dumped 8" production pipeline and a 2.42km trenched electro/hydraulic control umbilical, which are located in a 10 m wide corridor between the production manifold and the FPSO (Figure 1.1).

Premier Oil UK Limited are the sole owners of the field, the wellheads and the subsea infrastructure tied back to the Sevan Voyageur FPSO. The FPSO is leased to Premier Oil from Sevan 300PTE Limited (Sevan); the Sevan Voyageur FPSO and the associated mooring systems are solely owned by Sevan.

Premier Oil are solely accountable for the Section 29 notice encompassing the pipeline, umbilical and associated jumpers. Sevan and Premier are accountable for the decommissioning activities of the FPSO and its mooring system as included in the Section 29 notice for the FPSO, manifold and wellheads. However Sevan have no liability for the manifold and wellheads, which are the sole responsibility of Premier. Premier are accountable for the wellhead and manifold; furthermore, as the licence holder Premier are responsible for ensuring that the field is fully decommissioned in accordance with the Decommissioning Programmes contained in this document.

Since production began, the performance of the Shelley wells has not met expectations. The reservoir pressure has fallen significantly and the proportion of water in produced fluids has risen much earlier than expected. The field is expected to become sub-economic during 2010. All the studies Premier has completed to date indicate that it is very unlikely that there are any affordable measures it could take to extend the economical life of the field. Consequently, Premier proposes to cease production at this location and decommission the field. These Decommissioning Programmes are submitted in accordance with the requirements of Section 29 of the Petroleum Act 1998.

Figure 1.1. A diagrammatic representation of the layout of the Shelley Field.



1.2 Structure of this document

The FPSO, manifold and wellheads are covered by one Section 29 notice and the pipeline, umbilical and associated jumpers by a second notice. Two Decommissioning Programmes are therefore presented in this document, and the sections of the Decommissioning Programmes that relate to these respective Section 29 notices are shown in Table 1.1.

Table 1.1. The two decommissioning programmes presented in this document.

No.	Section Heading	Programme 1: FPSO, manifold, wells	Programme 2: Pipeline, umbilical & jumpers
1	Introduction	Combined	
2	Executive Summary	Combined	
3	Background information	Combined	
4	Description of items to be decommissioned	Section 4.2 to 4.4, 4.10 & Section 8	Section 4.5 to 4.9, 4.11 & 4.12
5	Inventory of materials	Section 5 Table 5.1	Section 5 Table 5.3
6	Removal and disposal options	N/A	Section 6
7	Selected removal and disposal option	Section 7.4, 7.5.5 & Section 8	Section 7.3 & 7.5
8	Wells	Section 8	N/A
9	Drill cuttings	Section 9	N/A
10	Debris clearance	Combined	
11	Interested party consultations	Combined	
12	Environmental impact assessment	Combined	
13	Costs	Combined	
14	Schedule	Combined	
15	Project management and verification	Combined	
16	Pre- and post-decommissioning monitoring and maintenance	Combined	
17	Supporting material	Combined	

1.3 Abbreviations

BERR	Department for Business, Enterprise & Regulatory Reform
BOP	Blow-out preventer
CAPEX	Capital Expenditure
CHARM	Chemical Hazard Assessment and Risk Management
CI	Chemical Injection
COP	Cessation of Production
CPA	Closest Point of Approach
cSAC	Candidate Special Area of Conservation
DCR	Design Construction Regulations
DECC	Department of Energy and Climate Change
DSV	Dive Support Vessel
DTI	Department of Trade and Industry
DWT	Dead Weight Tonnage
ED50	European Datum 1950
EHC	Electrical, Hydraulic and Chemical
EHXT	Enhanced Horizontal Subsea Tree
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESP	Electric Submersible Pump
FFS	Fishing-friendly structure
FPSO	Floating Production, Storage and Offloading
HP	High Pressure
HSE	Health and Safety Executive
ICES	International Council for the Exploration of the Sea
IMO	International Maritime Organisation
JNCC	Joint Nature Conservation Committee
kJ	Kilojoule (1,000 joules)
KP	Kilometre Point
LAT	Lowest Astronomical Tide
LSA	Low Specific Activity
LTOBM	Low-Toxicity Oil-Based Mud
MCA	Maritime and Coastguard Agency
MOD	Ministry of Defence
MODU	Mobile Drilling Unit
MPFM	Multi-Phase Flow Meter
NB	Nominal Bore
NFFO	National Federation of Fishermen's Organisations
nm	Nautical Mile
NORM	Naturally Occuring Radioactive Material
OCR	Offshore Chemical Regulations
OIMS	Operations Integrity Management System
OPEX	Operating Expenditure
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PL	(DECC) Pipeline Number
PLU	(DECC) Umbilical Number
PON	Petroleum Operations Notice
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SCM	Subsea Control Module
SFF	Scottish Fishermen's Federation
SHE	Safety, Health and Environment

SOPEP	Shipboard Oil Pollution Emergency Plan
SUTU	Subsea Umbilical Termination Unit
t	metric tonne
UKCS	United Kingdom Continental Shelf
UKDMap	United Kingdom Digital Map
UTM	Universal Transverse Mercator
WBM	Water-Based Mud
WONS	Wells Operations Notification System
WT	Wall Thickness

2 EXECUTIVE SUMMARY

2.1 Status of the field and need for decommissioning

The Shelley Field is a small oil field 192km from the northeast coast of Scotland in Block 22/02b and 22/3a of the central North Sea that is approaching the end of its economic life. Since there are no viable other uses for the facilities and infrastructure at their present locations, Premier Oil UK Limited, the operator and sole owner of the field, has prepared these Decommissioning Programmes as required by Section 29 of the Petroleum Act 1998. The assessment and recommendations contained in the programmes have been informed by technical studies and informal consultation with stakeholders, including fishermen's organisations.

The Shelley Field comprises two producing wells that are linked by jumpers and a subsea manifold to a 2km trenched and rock-dumped 8" production pipeline. A flexible riser links the pipeline to the FPSO *Sevan Voyageur*, which is moored by twelve anchors. The Shelley wells are operated from the *Sevan Voyageur* by means of a 2.42km trenched electro/hydraulic control umbilical.

2.2 Proposed decommissioning programmes

With the exception of the pipeline, all the facilities and infrastructure in the field will be removed from the seabed in accordance with OSPAR decision 98/3. Before decommissioning operations begin, the wells, wellheads, jumpers, manifold and the whole production pipeline will be flushed to remove hydrocarbons. Flushing will continue until the concentration of residual oil in water in the pipe is less than 40ppm. Flushed materials will be pumped to the FPSO for treatment and disposal under appropriate permits, and the pipe will then be filled with treated seawater. The impacts of all the chemicals that may be used or discharged offshore during pipeline cleaning will be assessed and reported to DECC in a separate PON15C.

Similarly, the hydraulic fluid and other chemicals in the umbilical will be flushed and returned to the FPSO for disposal under appropriate permits.

The *Sevan Voyageur* FPSO will be towed away for further use at another location. The production riser, manifold, and all the jumpers will be lifted from the seabed and taken ashore for refurbishment prior to re-use. Similarly, the cables and anchors used to moor the FPSO will be retrieved and either re-used or disposed of responsibly. All the concrete mattresses that protected the subsea facilities will be retrieved to shore, for recycling or disposal as appropriate.

A drilling rig will be moved to the site to carry out the routine programme of work required to plug and abandon the wells. The well casings will then be cut at a depth of about 3m below the seabed and taken ashore for re-use or recycling. The impacts of all the chemicals that may be used or discharged offshore during well plug and abandonment will be assessed and reported to DECC in a separate PON15D.

As required by the Petroleum Act 1998, a detailed Comparative Assessment has been completed to identify the best options for decommissioning the pipeline and umbilical. Options were comprehensively analysed and compared on the basis of their safety risk, environmental impacts, CO_2 emissions, technical feasibility and cost. This assessment indicated that the best option for the pipeline is to remove the short exposed sections lying on the seabed, and leave the remainder of the line in its trench, protected and enclosed by the existing layer of rock-dump. For the umbilical, which is trenched but not protected by rock-dump or backfill, the best option is to

remove the whole line in several sections and take it ashore for recycling or disposal as appropriate.

2.3 Environmental sensitivities

There are no particular environmental sensitivities in the Shelley Field. The seabed is relatively flat and composed of silty sand, and exhibits very low concentrations of hydrocarbons and metals which may be considered to be typical "background" concentrations for sandy sediments at this depth in the central North Sea. The seabed communities at Shelley comprise polychaete worms, burrowing bivalves molluscs, and starfish. None of these species is rare or protected and the communities are typical of those found over a wide area of this part on the North Sea.

The field is located within much larger areas that are known spawning grounds for commercial fish species including Norway pout and sandeels and the shellfish *Nephrops*. Several species of marine mammals have been sighted in the general area at different times of year including harbour porpoise, white-beaked dolphin and white-sided dolphin. Seabirds in the area are very highly vulnerable to oil spills in November, and highly vulnerable in February and from July to October. The area is not heavily fished and the relative value of commercial fishing is very low. The nearest protected coastal sites are on mainland Scotland approximately 192km away, and the closest offshore protected area is the Braemar pockmarks cSAC, approximately 44km away. The UK/Norwegian median line is approximately 32km away. The Shelley Field does not interact in any way with other oil and gas developments (the nearest producing field is 6.9nm away), or any other type of offshore commercial or defence activity or site.

2.4 Environmental impact of operations

No aspect of the proposed programme of work would be likely to give rise to any significant environmental impacts. All of the techniques and procedures that would be employed are routinely used in oil and gas development or decommissioning projects.

The *planned* activities that would be most likely to cause environmental impact are the manipulation, cutting and retrieval of items from the seabed. The resultant disturbance of seabed sediments might damage or smother animals living on or in the sediments, but any such impacts would not be significant; the sediments are not polluted, the area that might be affected would be very small and localised, and recovery would begin soon after the disturbance ceased. The risks of impact to the environment from the normal planned operations associated with this decommissioning programme are therefore assessed as not significant.

The *accidental* events that are most likely to cause environmental impacts are a collision which results in an oil spill from one of the offshore vessels, and the release of oil or chemicals from the mobile drilling unit while plugging the wells. Both these hazards are present in many other offshore oil and gas activities and the industry has numerous controls in place to reduce the likelihood that they would occur, control the situation if it arises, and minimise the resultant impact to marine life. The risks of impact to the environment from accidental events associated with this decommissioning programme are therefore assessed as not significant.

2.5 Long-term environmental impacts

After removal of the short sections lying on the seabed, no part of the production pipeline would be exposed; the 2km long trenched section is completely buried by the existing layer of rock-

dump. The top of this layer is more or less flush with the seabed, and fishermen's organisations have confirmed that this would not present a snagging risk to bottom-towed fishing gear.

The pipeline is presently covered by at least 0.7m of rockdump. At this location and depth in the central North Sea it is very unlikely that this cover would be dislodged by the action of currents or waves, and very unlikely that the pipeline would be scoured by currents to the extent that free-spans developed. Over time, the steel pipeline will gradually corrode and the treated seawater in it will be slowly released into the sediment. The risks of impact to the environment from the gradual release of this water from the rock-dumped pipeline are assessed as not significant.

Eventually, the pipeline would collapse in its trench and the rock-dump would settle to fill the small void. Throughout this period of disintegration, and after collapse, the whole length of pipeline will remain trenched and rock-dumped and over-trawlable. The risks to other users of the sea from the long-term presence and eventual disintegration of the trenched and rock-dumped pipeline are therefore assessed as not significant.

The removal of the umbilical will disturb some clean sediment along the route and possibly over a small area of seabed either side, but it will eliminate a possible snagging hazard. In time, the action of currents and waves will fill the trench with sediment. There will be no risks to the environment or other users of the sea as a result of the fading presence of this shallow trench.

2.6 Duration and management of activities

The proposed offshore decommissioning programme will be carried out over two summer seasons and is due for completion by the end of 2011. On completion of the 2010 workscope any materials remaining on the seabed will be in their present location and condition. These items will be fully over-trawlable or protected against interaction with fishing gear, and will not present any additional snagging risk to commercial fishing operations. Once the programme of offshore work has been completed in 2011, any debris will be removed and Premier will then engage an independent contractor to conduct a sweep of the seabed to confirm that it is free of obstructions.

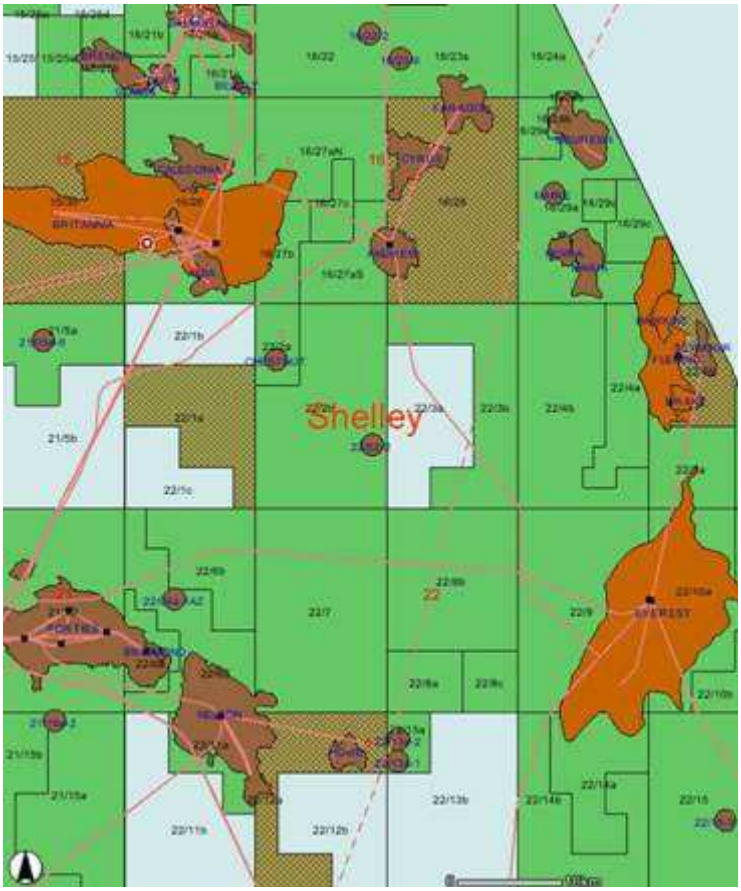
The entire programme will be managed by Premier as the field operator while Sevan AS will be responsible for the FPSO and mooring system. Progress will be reported to DECC, and within four months of the end of the programme Premier will issue a completion report to DECC. It is likely that a full physical and environmental survey of the former site of the Shelley Field would be undertaken within one year of the completion of the programme, and the results reported to DECC. Following a review of these findings, the need for further environmental surveys, and the nature and frequency of future programmes to monitor the condition of the rock-dumped pipeline, will be discussed and agreed with DECC.

3 BACKGROUND INFORMATION

3.1 Introduction

The Shelley Field is a small oilfield situated in the central North Sea in UKCS Block 22/02b and 22/3a, approximately 192km off the northeast coast of Scotland and 32km from the median line with Norway (Figure 3.1). An appraisal well was drilled in 2007 and two production wells were drilled in 2008. Since the start of production in August 2009, more than 750,000 barrels of oil have been produced.

Figure 3.1. The location of the Shelley Field in Block 22/02b and 22/3a of the UKCS.



3.2 Metocean conditions

Table 3.1 summarises the metocean conditions. More detail on these characteristics, and wind-roses, can be found in the separate Environmental Statement (BMT Cordah, 2010).

Table 3.1. Summary of metocean conditions in the Shelley Field.

Characteristics	Values
Water depth, variation over the whole area of the Shelley infrastructure	92-96m
Tidal range	2.7m
Mean spring tidal current speed	0.32m.s
Mean neap tidal current speed	0.16m.s
Extreme tidal current speed	4.4m.s
Maximum 50 year surge current	0.6m.s
Mean temperature of sea surface in winter	5-6^{o}C
Mean temperature of sea surface in summer	14.5-15^{o}C
Mean temperature of sea bed in winter and summer	6.5-8^{o}C
Salinity, annual range	35-35.2ppt

3.3 Seabed conditions

The superficial seabed sediments in the field comprise slightly silty, fine to medium coarse sand with occasional fragments of shell. There is a layer of very soft to soft sandy clay below the sand, typically at depths greater than 2m below the seabed.

Ten stations within 1,310m of the drill centre were surveyed in April 2007, prior to drilling (Gardline, 2007). At all stations, the concentrations of hydrocarbons and metals were typical of the background concentrations that are found in sandy sediments in the central North Sea.

3.4 Biological Environment

3.4.1 Benthic communities

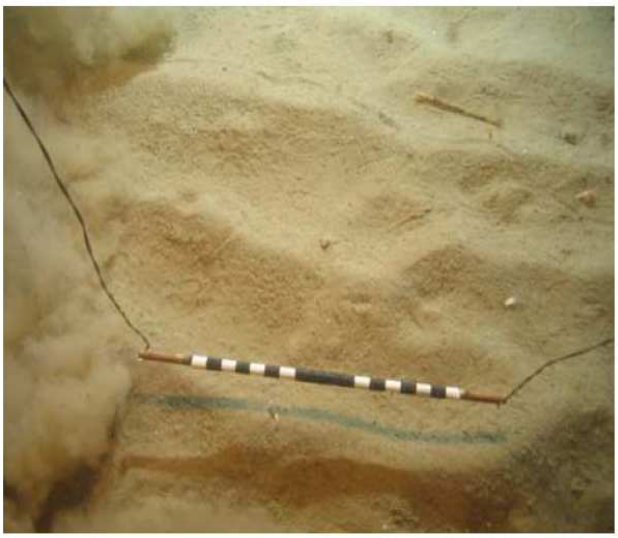
At the 10 stations sampled in 2007, a total of 162 invertebrate taxa were found. The benthic infaunal community was dominated by polychaetes, crustacea and molluscs, and the dominant species were the polychaetes *Galthowenia oculata*, *Owenia* spp. and *Paramphinome jeffreysii*, and the brittlestar *Ophiuroidea* spp juv.

This pre-drilling survey revealed an unperturbed benthic community, typical of sandy sediments at this depth in the central North Sea. More detail on the physical, chemical and biological characteristics of the area around the drill centre can be found in the separate Environmental Statement (BMT Cordah, 2010).

Figure 3.2 is a photograph of the seabed at the location of the *Sevan Voyageur* FPSO, showing the natural sandy sediments with two specimens of the snail *Colus gracilis* (top right and bottom centre) and a tube of the polychaete worm *Hyalinoecia tubicola* (top right). Other epifauna identified from the area include the hermit crabs of the genus *Pagurus* and the sea pen *Virgularia mirabilis*.

Other environmental surveys carried out in the area have indicated that the infaunal communities are dominated by Nematode spp., the polychaete worms *Paradoneis lyra* and *Myriochele* spp., and the sea urchins *Echinocyamus pusillus* and *Echninoidea* spp. (UK Benthos, 2004).

Figure 3.2. Uncontaminated seabed sediments at the location of the *Sevan Voyageur* FPSO.



(Reference: Gardline, 2007)

3.4.2 Plankton

The plankton species found in Quadrant 22 are typically temperate shelf species, indicative of the presence of relatively unmixed Atlantic water due to the influence of the North Atlantic Drift (UKDMAP, 1998). The zooplankton communities of the northern and southern North Sea are dominated by *Calanus* copepods (SAHFOS, 2001). The larger zooplankton (or megaplankton) includes the euphausiids (krill), thaliacea (salps and doloids), siphonophores and medusae (jellyfish).

3.4.3 Fish

Within Block 22/2b there are potential spawning areas for Norway pout (*Trisopterus esmarkii*), sandeels (*Ammodytes marinus*) and *Nephrops*. In addition to spawning grounds, the waters of Block 22/2b also act as a nursery area for haddock (*Melanogrammus aeglefinus*), Norway pout, sandeels, blue whiting (*Micromesistius poutassou*) and *Nephrops*.

3.4.4 Marine Mammals

Six species of marine mammal have been observed in the vicinity of Quadrant 22 - harbour porpoise, minke whale, white-beaked dolphin, white-sided dolphin, killer whales and common dolphins. The densities of marine mammals were highest in summer, over the period from May to November (UKDMAP, 1998). For most species, the greatest densities were rated as “moderate”, but harbour porpoise and white-sided dolphin had “very high” densities in May and July respectively.

Given the distance to shore, common and grey seals are unlikely to be found within the vicinity of the Shelly Field.

3.4.5 Seabirds

Within the vicinity of the Shelley Field, fulmar (*Fulmar glacialis*) densities are high from March to April during the pre-breeding exodus, and kittiwakes (*Rissa tridactyla*) are widely distributed throughout the year. Large numbers of auks are present in August, many of which are flightless juveniles and moulting adults (DTI, 2001).

In Block 22/2b the vulnerability of seabird to oil spills is "very high" in November, "high" in February and from July to October and "low" to "moderate" throughout the remainder of the year. No data is available for Block 22/2 or the surrounding blocks for the months of January and December.

3.4.6 Conservation Interests

There are no 'sandbanks', 'submerged sea caves', 'reefs' or 'submarine structures made by leaking gas' close to the Shelley Field. Although 'pockmarks' alone are not considered to conform to any of the Annex I habitats, the potentially important 'submarine structures' listed in Annex I are often associated with gas seeps and pockmarks. The Scanner Pockmark (cSAC) in Block 15/25 and Braemar Pockmarks (cSAC) in Block 16/3 are located approximately 44km and 114km respectively from the Shelly Field (DTI, 2001; JNCC, 2009).

The only Annex II species recorded within the vicinity of the Shelley Field is the harbour porpoise. Harbour porpoises are present throughout most of the North Sea throughout the year, with higher numbers occurring between May and November.

The sediments at the Shelley Field are typical of silty sandy North Sea areas, with no potential Annex 1 habitats such as pockmarks, or biogenic reefs formed by *Sabellaria spinulsoa* or *Lophelia pertusa,* identified in the area. The baseline environmental survey for the field (Gardline Environmental Limited, 2008) confirmed the absence of such habitats. Due to the silty nature of the sediments, the potential of the area for herring spawning is low to none.

3.5 Commercial Fishing

The central North Sea region is of major importance for its fisheries and is mainly fished by local Scottish vessels. Block 22/2b lies within ICES Sea Area IV, Rectangle 44F1. Species fished in Rectangle 44F1 are predominantly demersal but large catches of pelagic fish (primarily mackerel) are sometimes caught in certain years. The main demersal species landed include haddock, cod and whiting, and the main shellfish species caught is Norway lobster (*Nephrops norvegicus*).

In comparison to other areas of the North Sea, the relative UK fishing effort in the Shelley Field area in 2008 was "very low". Overall, taking into account all species, the 'relative value' for the area of the Shelley field in 2008 is "very low" (Marine Scotland, 2009).

3.6 Shipping

Ten shipping routes pass within 10nm of the Shelley drill centre (Table 3.2). These routes are used by an estimated 701 vessels each year, which corresponds to an average of approximately 1 to 2 vessels each day.

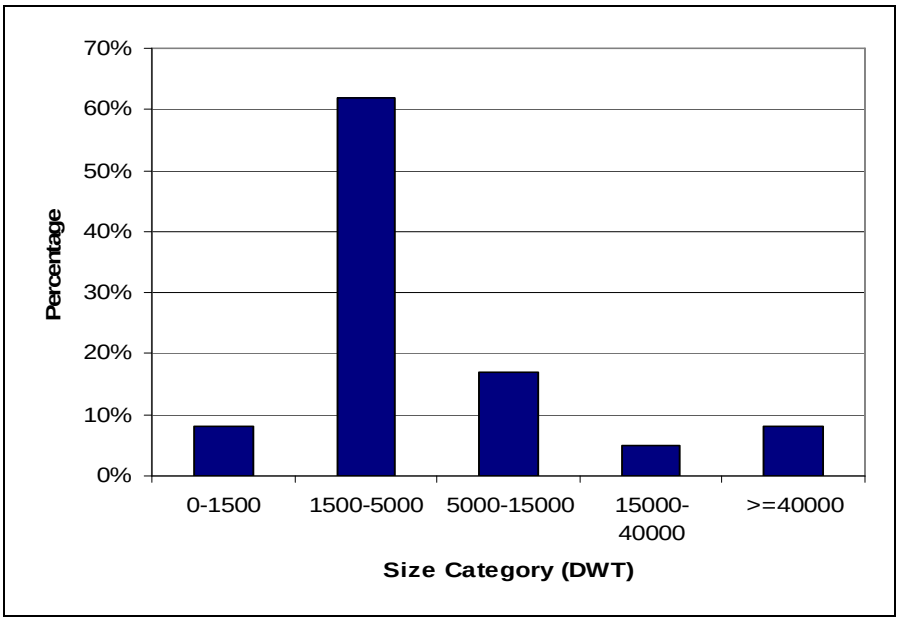
Table 3.2. Shipping routes within 10nm of the Shelley drill centre.

Route No.	Description	CPA (nm)	Bearing (º)	Vessels each year	% of Total
1	Moray Firth-Kattegat*	4.2	179	85	12%
2	Tay-Boknafjorden*	5.3	151	25	4%
3	Tees-N Norway/Russia*	5.3	291	50	7%
4	PolandE-Fraserburgh*	5.6	180	50	7%
5	Tees-Sognefjorden*	7.4	113	100	14%
6	Alba Field-Rotterdam	8.6	254	45	6%
7	Aberdeen-Andrew ASCo CNS*	8.7	334	176	25%
8	Forth-Boknafjorden*	9.0	146	55	8%
9	Thames-Sullom Voe*	9.4	250	15	2%
10	Aberdeen(GBR)-Boknafjorden*	9.9	329	100	14%
Total				701	100%

** Where two or more routes have identical Closest Point of Approach (CPA) and bearing they have been grouped together. In this case, the description lists the sub-route with the most ships each year.*

Approximately 46% of the vessels are cargo vessels, 28% tankers, 25% vessels associated with the offshore oil and gas industry, and 1% ferries. The majority (80%) of vessels are in the size range 1,550-5,000 DWT (Figure 3.3).

Figure 3.3. Size distribution of vessels passing within 10nm of the Shelley drill centre.



3.7 Adjacent Facilities

There is one other oil and gas field development in Block 22/2, the Chestnut Field located approximately 6.9km north-west of the Shelley Field. Table 3.3 gives details of the manned installations close to the *Sevan Voyageur* FPSO. A total of 58 wells have been drilled in Block 22/2, 36 of them in Block 22/2b (DECC, 2009).

Table 3.3. Manned installations adjacent to the Shelley well centre.

Operator	Platform	Block	Approximate position relative to Shelley	
			Distance (nm)	Bearing (°)
Venture	Hummingbird	22/02a	6.9	310
BP	Andrew Platform	16/28	9.9	002
Britannia Operator Ltd	Britannia Platform	15/30a	12.8	321
Chevron	Alba North Platform	16/26	14.5	317
BP	Everest North Production Platform	22/10a	15.0	120

The Shelley pipeline and umbilical cross the boundary between Block 22/2b and Block 22/3a. Both blocks are 100% owned by Premier Oil UK Limited. There are no other pipelines in Block 22/2b and so the Shelley pipeline does not cross any third party pipelines.

There are two Natural Gas pipelines within 5nm of the Shelly Field:

- PL 1079 Andrew CATS TEE 1 Pipeline, approximately 2.8nm NE of the FPSO running NW to SE;
- Langeled Pipeline, approximately 3.9nm ESE of the FPSO running NNE to SSW;

There are no known active or disused cables within the immediate vicinity of the Shelley Field.

3.8 Commercial Activity

Apart from fishing and the transit of shipping, no other commercial or industrial activities take place in the vicinity of the Shelley Field.

3.9 MOD activity

There are no designated submarine exercise grounds or known areas of military activity in the vicinity of the Shelley Field.

3.10 References

The environmental references cited in this section are detailed in the separate Environmental Statement.

4 DESCRIPTION OF ITEMS TO BE DECOMMISSIONED

4.1 Overview

Figure 4.1 shows the arrangement of the facilities and infrastructure in the field, which comprise:

- the two Shelley well heads, Xmas trees and fishing-friendly protective structures;
- 4" jumper lines from the well heads to the manifold (PL 2541J1 and PL 2541J2);
- the production manifold and protection structure (PL 2541);
- 6" jumper line from the production manifold to the pipeline(PL 2541);
- a 2.02km 8" production pipeline and flexible riser (PL2541);
- a 2.42km combined static and dynamic electro/hydraulic control umbilical (PLU2543);
- Control and chemicals well jumpers from the well heads to a manifold (PLU 2543J2 and PLU 2543J3); and
- the *Sevan Voyageur* FPSO, mooring lines and anchors.

Figure 4.1. A schematic representation of the layout of the Shelley Field production system.

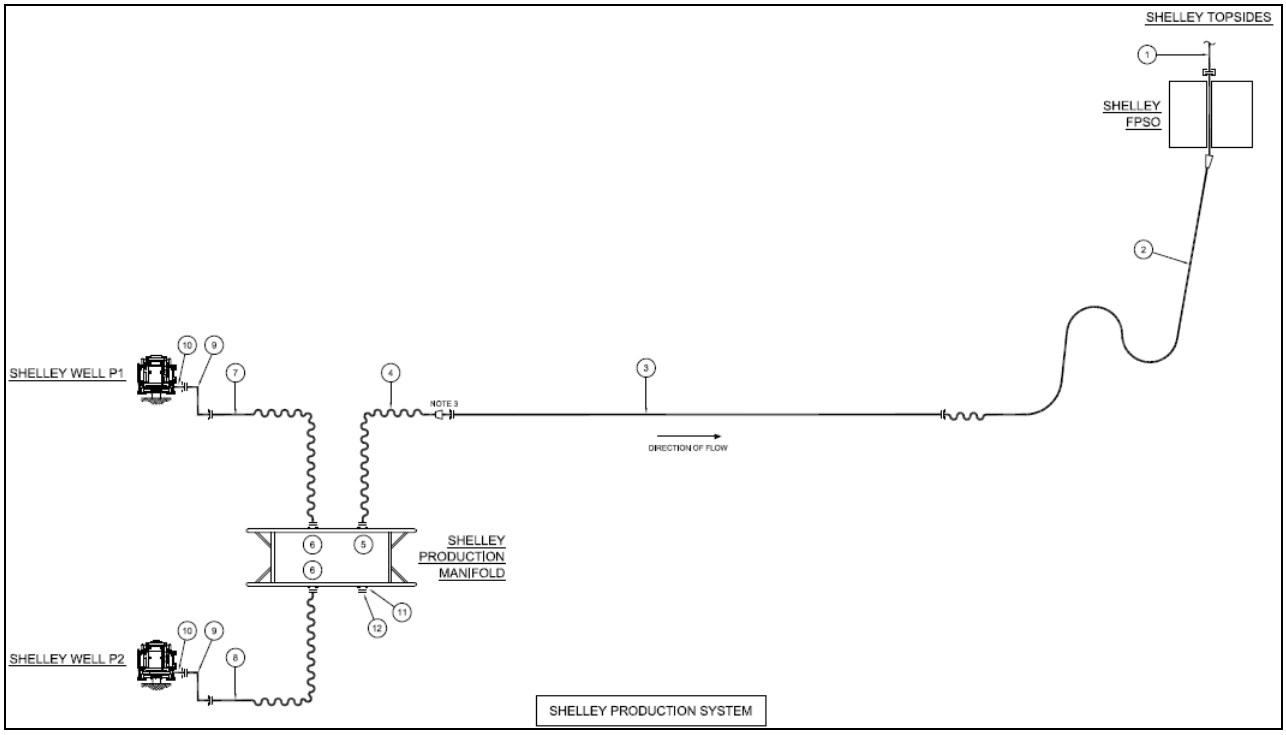


Table 4.1 lists the coordinates of the main facilities in the field. The production pipeline and the control umbilical run in a straight line from the FPSO to the production manifold at the drill centre.

Table 4.1. The co-ordinates of the main facilities in the Shelley Field.

Facility	UTM Co-ordinates	
	Easting	Northing
Sevan Voyageur FPSO	405 503	6 419 147
Drill Centre Production Manifold	404 845	6 417 046
Production Well No. 1	404 824	6 417 030
Production Well No. 2	404 813	6 417 041

The Universal Transverse Mercator co-ordinates are referenced to Zone 31, Central Meridian 3º East, European Datum 50 (ED 50).

4.2 *Sevan Voyageur* FPSO

The *Sevan Voyageur* FPSO (Figures 4.2 and 4.3) is a 55,000 tonne cylindrical vessel with a main hull diameter of 60m and an oil storage capacity of 300,000 barrels. The vessel contains tanks for cargo oil storage, ballast water, slops and diesel, plus machinery spaces. The cargo tanks are arranged around a central shaft, and the ballast tanks, which are outside the cargo tanks, provide double hull protection to the sides and base of the cargo tanks.

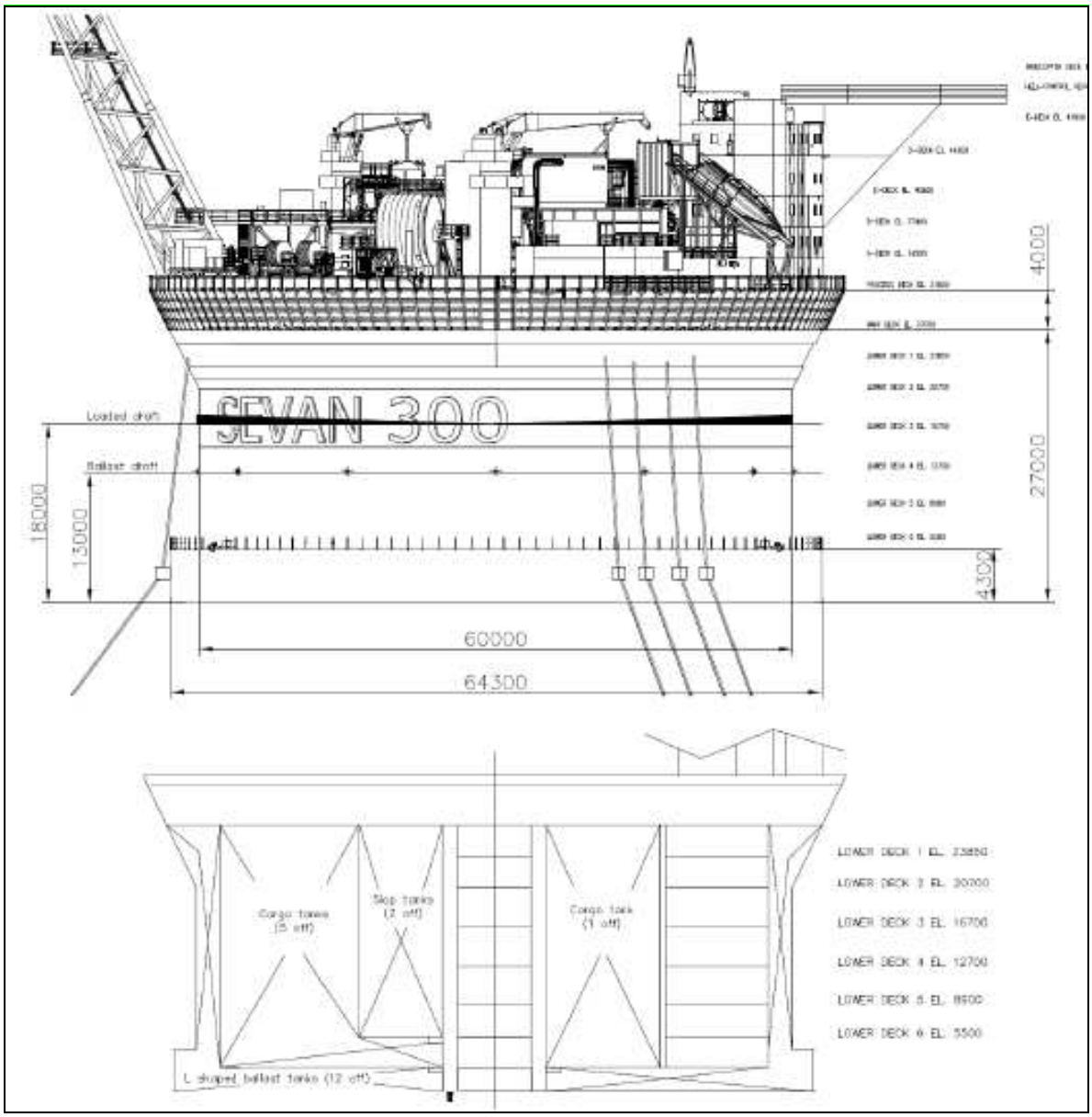
The top of the cargo tanks is the Main Deck. The main items of equipment on this deck are the cargo loading ring main, cargo tank blanket gas pipe work, drains vessels and associated pipe work and pumps, and the mooring line chain lockers.

The process facilities are arranged over two levels in the port-aft quadrant of the Process Deck. The starboard aft quadrant contains the chemical injection package. The process consists of two-stage separation and produced water clean-up. Oil is routed to the cargo tanks and gas is routed to the flare, with side-streams to the fuel gas package and a cargo oil tank blanket gas package. Produced water is cleaned-up and discharged to sea.

The *Sevan Voyageur* is equipped with two stations for offloading the produced crude to conventional tankers or dedicated shuttle tankers. The offloading stations are located aft of the blast wall on the process deck.

Figure 4.2. A photograph of the *Sevan Voyageur* FPSO in the Shelley Field.

Figure 4.3. *Sevan Voyageur*: Starboard side elevation (top) and vertical section through hull (bottom).



4.3 Mooring System

The FPSO is anchored to the seabed by twelve mooring lines, arranged in 3 groups of 4 lines with each group separated into 2 pairs (Figure 4.4). The lines are 1,372m long and consist of a 147mm diameter bottom chain, a 242mm diameter polyester mooring line and a 142mm diameter top chain.

Figure 4.5 shows the configuration of a typical mooring line and indicative dimensions. Specific data on the sizes of each mooring line are given in Table 4.2.

Figure 4.4. Plan of the *Sevan Voyageur* mooring lines.
Note: The scales are metres.

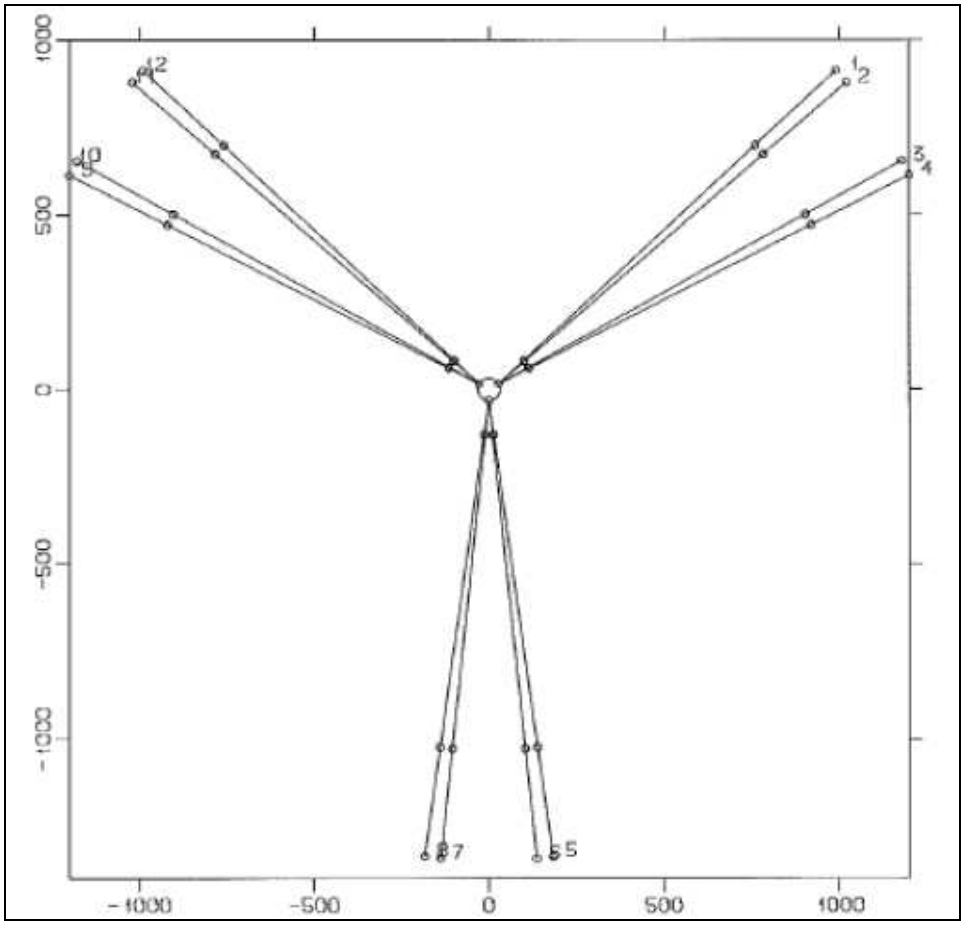


Figure 4.5. The components of a typical mooring line for the FPSO.

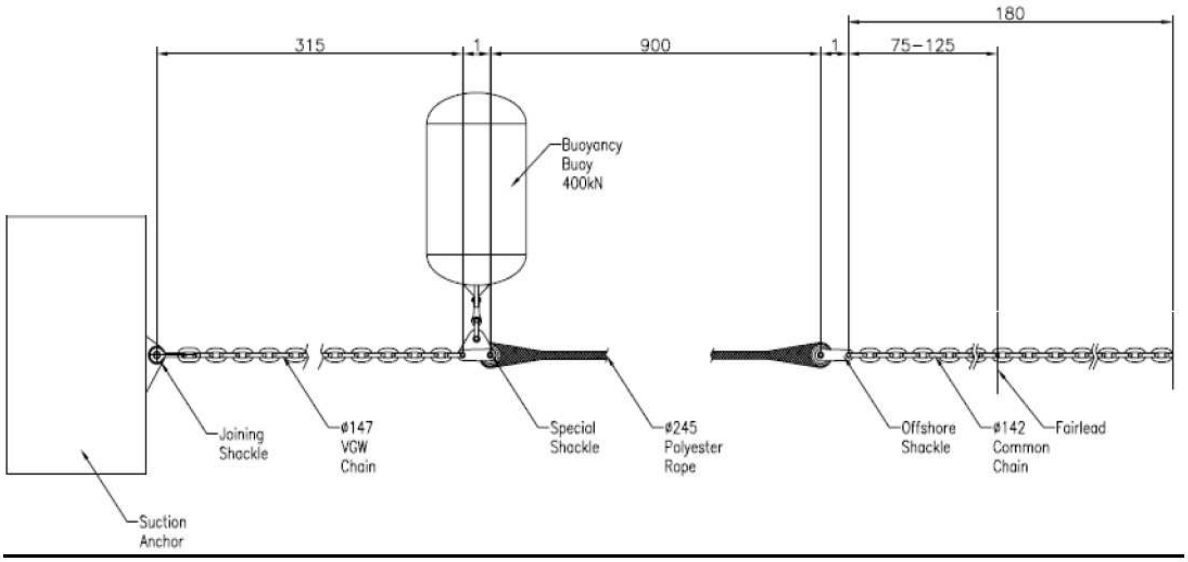


Table 4.2. Details of the FPSO mooring lines.

Line No	Heading Relative to Platform N (deg)	Length Lower Chain (m)	Length Polyester Rope (m)	Length Upper Chain (m)	Distance to Centre Anchor (m)
1	47	315	900	75-125	1372
2	49	315	900	75-125	1372
3	61	315	900	75-125	1372
4	63	315	900	75-125	1372
5	177	315	900	75-125	1372
6	179	315	900	75-125	1372
7	186	315	900	75-125	1372
8	188	315	900	75-125	1372
9	297	315	900	75-125	1372
10	299	315	900	75-125	1372
11	311	315	900	75-125	1372
12	313	315	900	75-125	1372

4.4 Suction anchors

Each mooring line is fixed to the seabed by a suction anchor, which is essentially a cylindrical steel can 6 or 7m in diameter and 15m long (Figure 4.6). Each anchor is buried vertically to a depth of 14.0m to 14.5m. Table 4.3 lists the anchor dimensions, weights and co-ordinates (Universal Transverse Mercator co-ordinates are referenced to Zone 31, Central Meridian 3º East, European Datum 50 (ED 50)).

Figure 4.6. A suction anchor of the type used for the *Sevan Voyageur*.

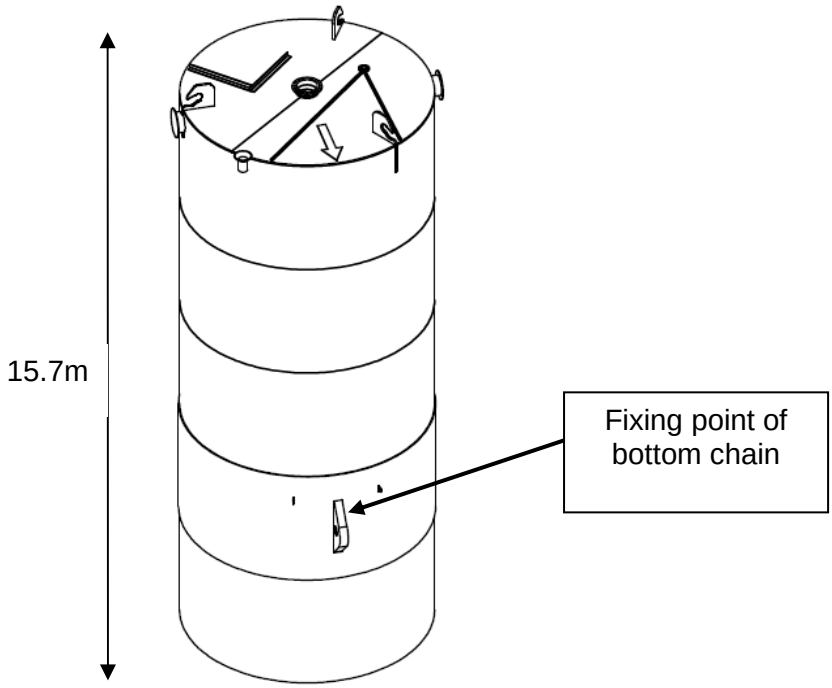


Table 4.3. Locations and sizes of suction anchors.

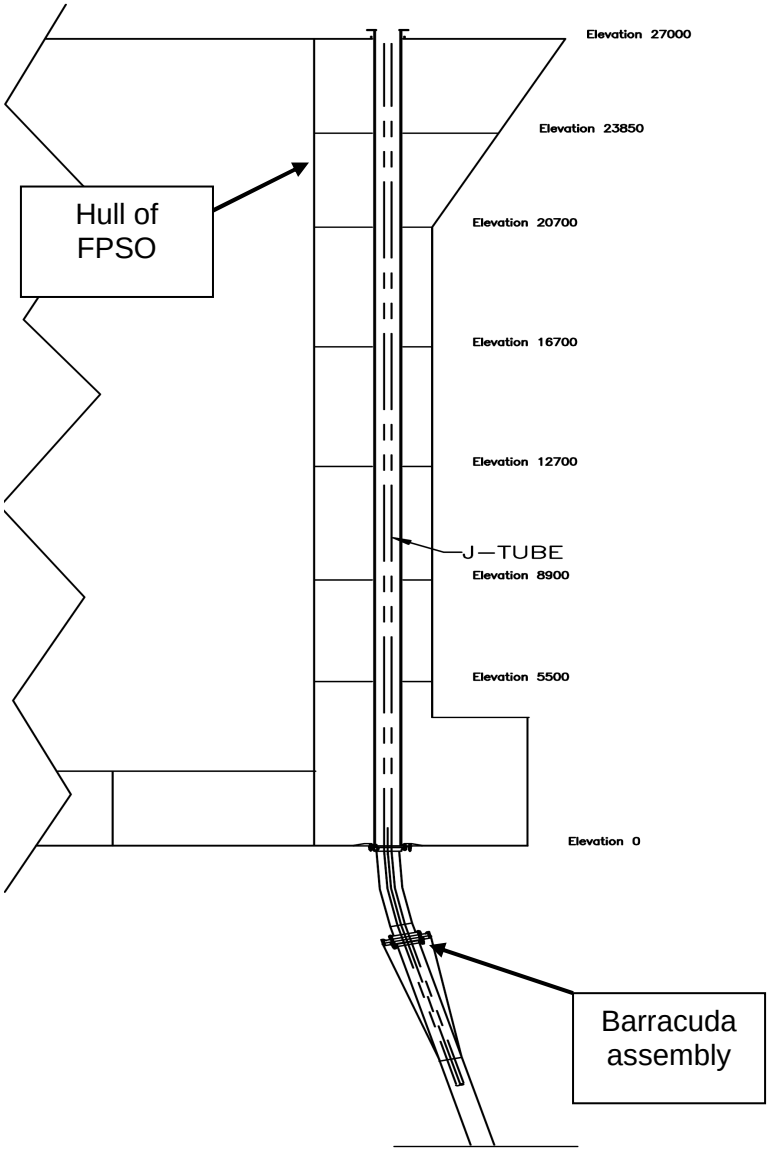
Line No	Heading Relative to Platform N (deg)	Heading Relative to Platform N	UTM East	UTM North	Anchor Diameter (m)	Anchor Length (m)	Anchor Weight (Te)
1	47	NE	405 551	6 420 518	6	15.69	120
2	49		405 599	6 420 516	6	15.69	120
3	61		405 881	6 420 466	6	15.69	120
4	63		405 927	6 420 452	6	15.69	120
5	177	S	406 523	6 418 229	7	15.69	140
6	179		406 490	6 418 194	7	15.69	140
7	186		406 367	6 418 081	7	15.69	140
8	188		406 329	6 418 051	7	15.69	140
9	297	NW	404 198	6 418 723	6	15.69	120
10	299		404 184	6 418 768	6	15.69	120
11	311		404 134	6 419 051	6	15.69	120
12	313		404 132	6 419 099	6	15.69	120

4.5 Attachment of risers to the FPSO

The flexible production riser and umbilical riser are brought on to the *Sevan Voyageur* via I-tubes which run vertically through the ballast tanks (Figure 4.7) The risers and umbilical are hung-off at main deck level, in an area in the port aft quadrant which is separated from the rest of the main deck by a fire / blast wall.

At the interface with the base of each 'I'-tube is a transition spool piece installed with an Oilstates female Barracuda© assembly designed to lock and seal the risers into position. The hang-off configuration and the radial clearance between riser / umbilical and I-tube inside diameter are designed to allow equipment to be inserted to monitor the condition of the I-tube and riser / umbilical.

Figure 4.7. Cross section through the hull of the FPSO showing the I-tube.



4.6 Flexible Production Riser

The production pipeline is connected to the FPSO by a 335m long flexible riser, pulled into the 'I' tube and locked in place by the Barracuda© assembly. The riser is of a Pliant Wave Distributed Buoyancy type design and has 22 buoyancy modules attached over approximately one third of its length, held in place by separate clamp modules. As with the dynamic section of the umbilical (Section 4.8), clump weights on the seabed and a hold-back tether maintain the position of the riser.

4.7 Production pipeline

4.7.1 Description

The production manifold is connected to the *Sevan Voyageur* FPSO riser by a 2.02km long 8" NB production pipeline, PL2541. The pipeline is constructed of low alloy carbon steel and is protected against corrosion by a coating of polypropylene/polypropylene foam and three sacrificial anodes spaced evenly along its length.

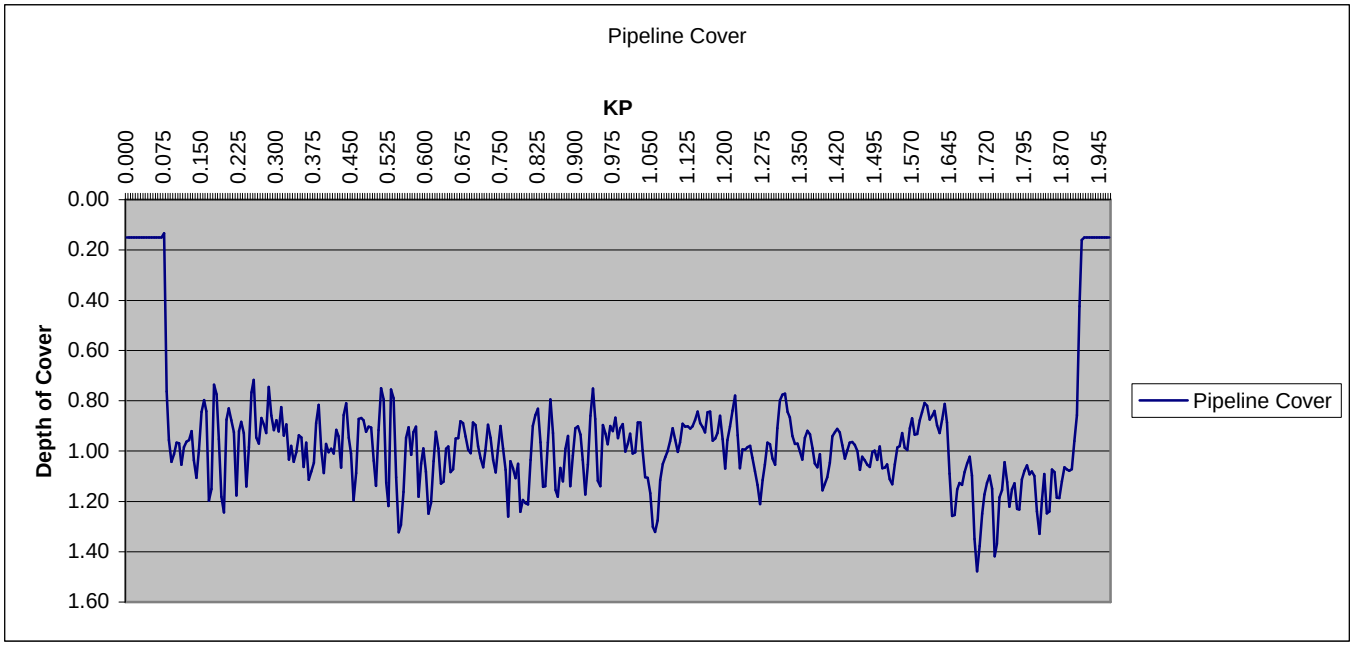
Approximately 93% of the length of the pipeline lies in a trench approximately 1.6m deep, with the top of the pipeline at least 0.7m below the surface of the seabed. The line is further held in place and protected by approximately 10,000 tonnes of 4"-6" graded rock-dump. The rock-dump fills the trench and its upper surface is approximately flush with the surface of the seabed.

At either end of the pipeline, where it emerges from the trench, there is a short section lying exposed on the seabed. These sections are held in place, and protected, by a total of 41 concrete mattresses. Each mattress measures 6m x 3m x 0.15m and weighs approximately 4.7t.

4.7.2 Depth of burial

After its installation in September 2008, the "as built" condition of the production pipeline was surveyed (Technip, 2009b). For the section of pipeline lying in the trench, the survey measured the depth of rock-dump cover over the pipeline, at 50m intervals. The survey showed that the rock-dump cover over the top of the pipe was from 0.72m to 1.32m thick, with an average thickness of 1.01m. Figure 4.7 shows the variation in the depth of burial along the whole pipeline.

Figure 4.8. Depth of pipeline burial (m) in 2009.
Note: The variation in burial depth is exaggerated in this graph because the scale on the vertical axis is approximately 400 times greater than that on the horizontal axis.



4.8 Umbilical

A single continuous umbilical (PLU2543) with an external diameter of 88.5mm connects the *Sevan Voyageur* FPSO to the production manifold (Figure 4.8)). Approximately 319m of the umbilical hangs beneath the FPSO as a "dynamic" riser section, and the remaining 2.1km length of umbilical is "static". The position of the umbilical riser is maintained by two clump weights (36t and 23t) attached by fibre rope tethers to tether clamps on the umbilical (Figure 4.8).

The static section of the umbilical lies in a separate trench approximately 10m away from the pipeline. The trench is approximately 1.5m deep and has been left to naturally back fill. Like the pipeline, the umbilical has exposed sections at either end where it lies on the seabed. These exposed sections are held in place and protected by a total of 48 concrete mattresses, each 6m x 3m x 0.15m and weighing approximately 4.7t.

The dynamic section is a pliant wave design (Figure 4.8) with 29 buoyancy modules (Figure 4.9) spaced over approximately one fifth of its length. The modules are constructed of syntactic foam and are typically 1.5m in diameter and 1.5-1.8m long.

Figure 4.9. The arrangement of the dynamic riser from the FPSO to the umbilical.

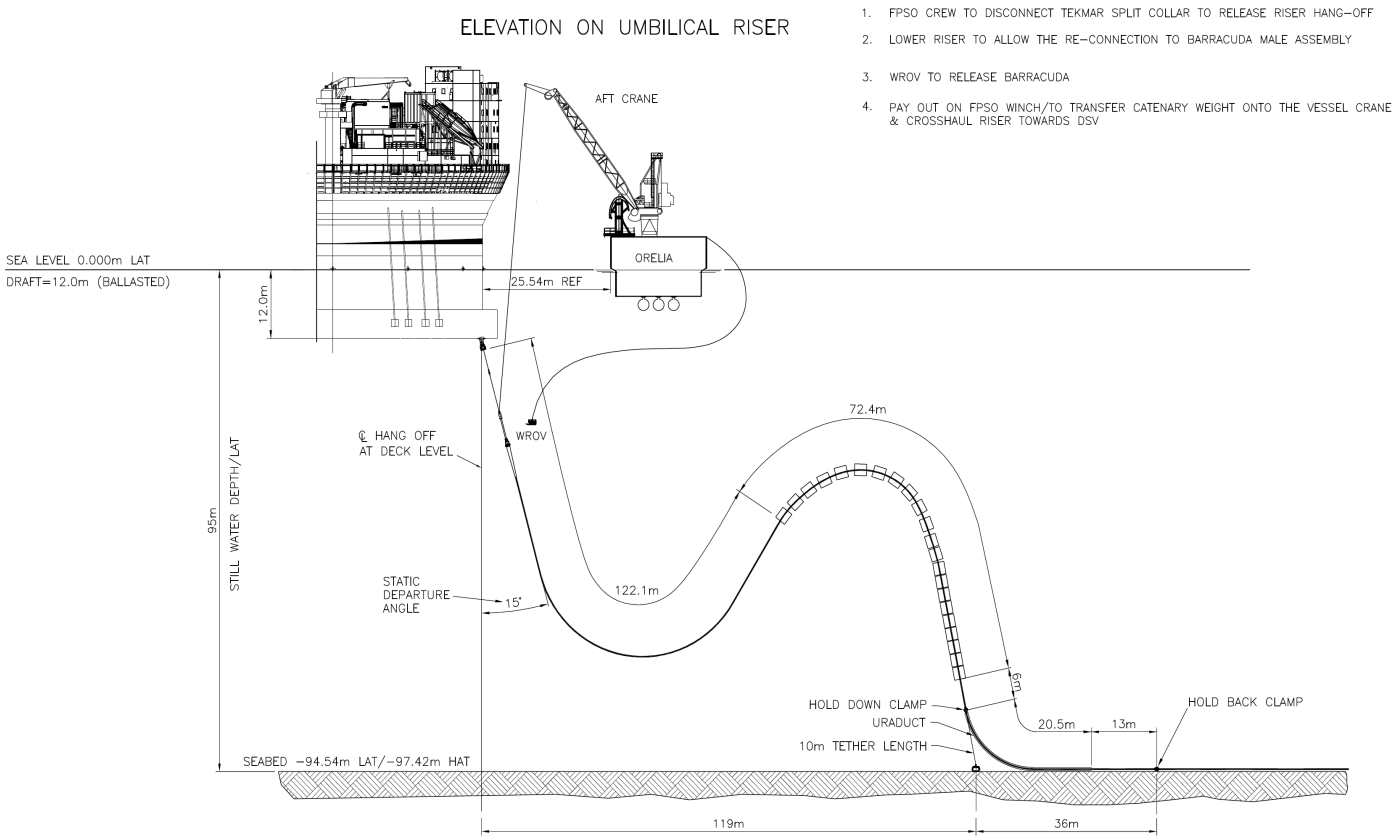
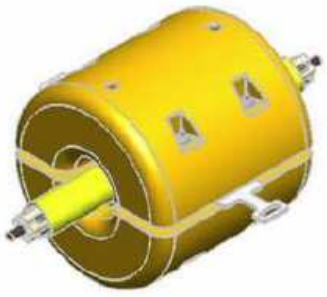


Figure 4.10. A typical buoyancy module.



The umbilical comprises three separate control lines - an 8 way hydraulic/chemical control line, an LV signal line and an HV control line. Figure 4.10 shows a cross-section of the umbilical and Table 4.4 lists the component lines in the umbilical.

Figure 4.11. Cross section of the umbilical showing component lines.

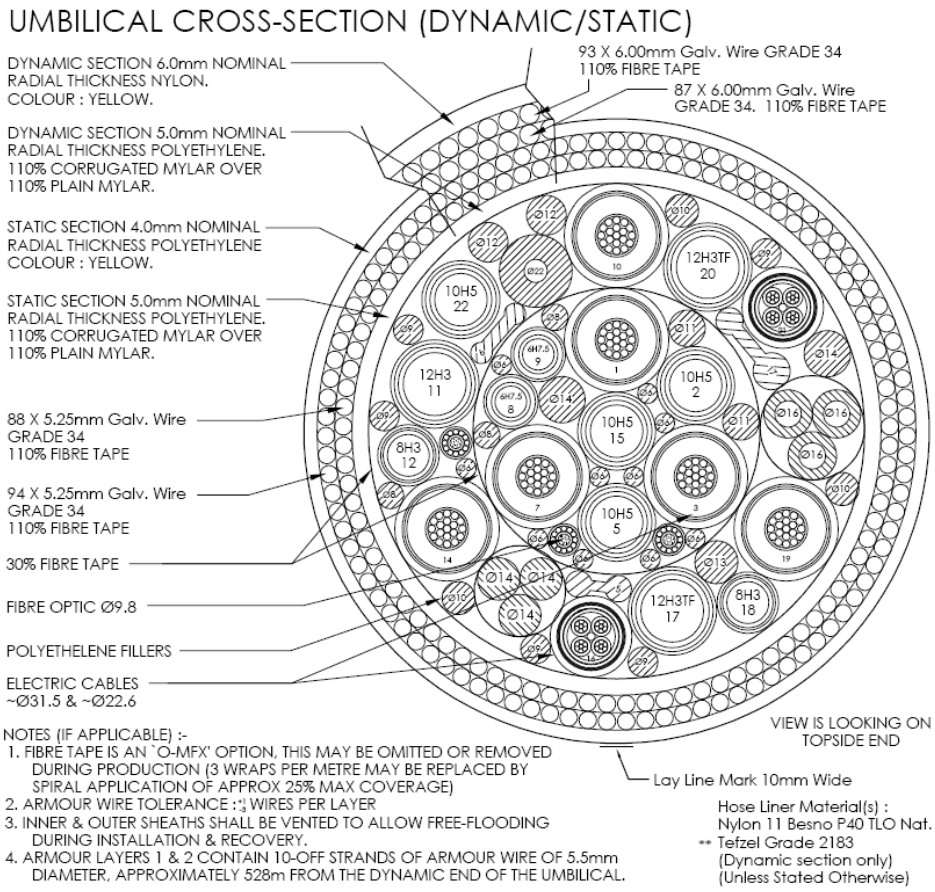


Table 4.4. The component lines in the Shelley umbilical.

Line No.	Qty	Type	Size	Rating	Function	Service Fluid
2, 5	2	10H5 Nylon Hose	5/8”	5,000 psi	LP Supply	HW 443R
8, 9	2	6H7.5 Nylon Hose	3/8”	7,500 psi	HP Supply	HW 443R
11	1	12H3 Nylon Hose	3/4”	3,000 psi	Spare chemical injection	Aquaglycol 24F
12	1	8H3 Nylon Hose	5/8”	3,000 psi	Demulsifier	EC2179A
18	1	8H3 Nylon Hose	1/2”	3,000 psi	Corrosion Inhibitor	FX 2665
15, 22	2	10H5 Nylon Hose	1/2”	5,000 psi	Spare chemical injection	Aquaglycol 24F
17, 20	2	12H3 Tefzel	3/4”	3,000 psi	MeOH	MeOH
1, 19	2	Copper	95 mm^2	12/20/(24) kV	ESP Power	NA
3, 10	2	Copper	95 mm^2	12/20/(24) kV	ESP Power	NA
7, 14	2	Copper	95 mm^2	12/20/(24) kV	ESP Power	NA
16	1	Copper TSQ	10 mm^2	0.6/1.0(1.2) kV	LV Power	NA
21	1	Copper TSQ	10 mm^2	0.6/1.0(1.2) kV	LV Power	NA
4	1	12 Single mode Fibre	NA	9/125µm 1550nm	Comms	NA
6	1	12 Single mode Fibre	NA	9/125µm 1550nm	Faulted	NA
13	1	12 Single mode Fibre	NA	9/125µm 1550nm	Comms	NA

Tables 4.5 lists the chemicals that will be present in the chemical lines at the time of decommissioning, before flushing takes place. Section 7.3 describes the proposed flushing operations. As required under the Offshore Chemicals Regulations 2002, the environmental risks associated with the use and discharge of chemicals during flushing operations will be fully assessed in a separate PON15C.

Table 4.5. Chemicals in the Shelley umbilical.

Chemical	Use
HW443R	Water-based hydraulic fluid
Methanol	Hydrate inhibitor
Nalco CI FX 2665	Corrosion inhibitor
Nalco EC 2179A	Demulsifier
Aqua Glycol 24F	Hydraulic fluid

4.9 Production jumper

The production pipeline is connected to the production manifold by an 85m long 6" NB flexible production jumper, PL2541. This jumper lies untrenched on the seabed and is held in place and protected by a total of 12 concrete mattresses, each measuring 6m x 3m x 0.15m and weighing approximately 4.7t.

4.10 Production manifold

The Production Manifold consists of the manifold protection structure, mini manifold and ballast weights.

4.10.1 Manifold protection structure

The protection structure is a steel tubular cage 27m long, 10m wide and 6.5m high, weighing approximately 122t, which sits over the manifold to protect it from damage by mobile fishing gear and dropped objects (Figure 4.11 and 4.12).

The protection structure houses a Framo mini manifold, ballast weights and connections to land and locate two Subsea Umbilical Termination Units (SUTU). It is held in place by ballast weights and has integrated mud mats and skirts to prevent lateral movement on the seabed. The protection structure is designed to minimise the likelihood that trawling gear would become snagged on it, but if snagging were to occur it can withstand loads of up to 35 tonnes (applied horizontally) and impacts with a force of up to 15kJ.

Figure 4.12. The manifold protection structure with Framo Mini-Manifold Installed.

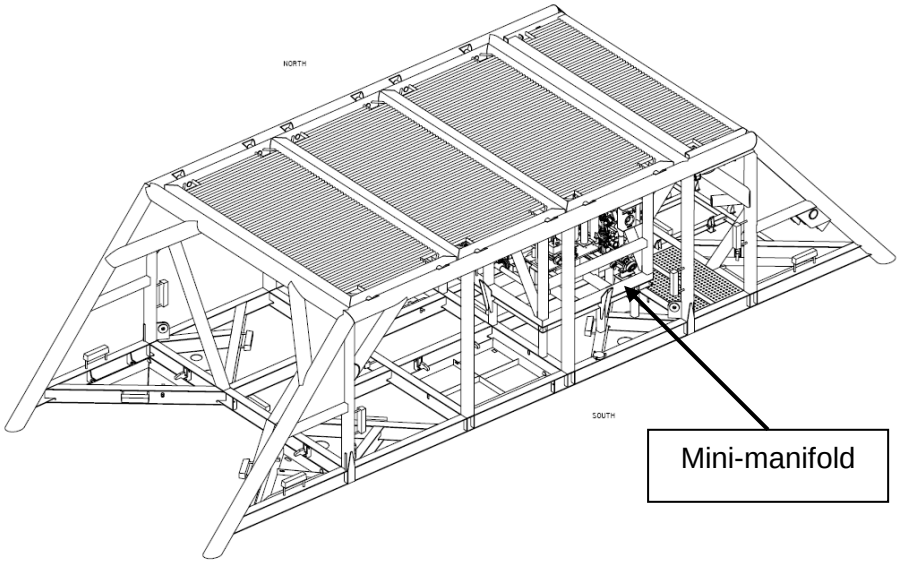
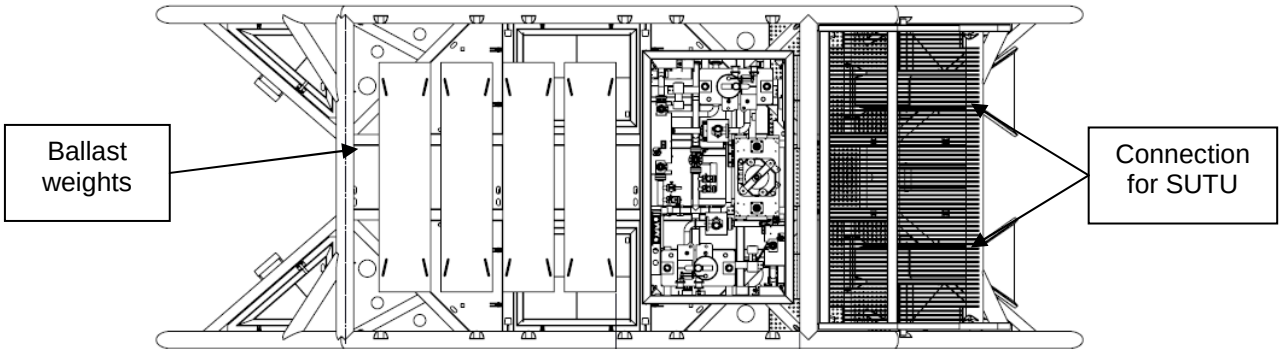


Figure 4.13. Plan view of the Shelley production manifold without roof panels.



4.10.2 Mini-manifold

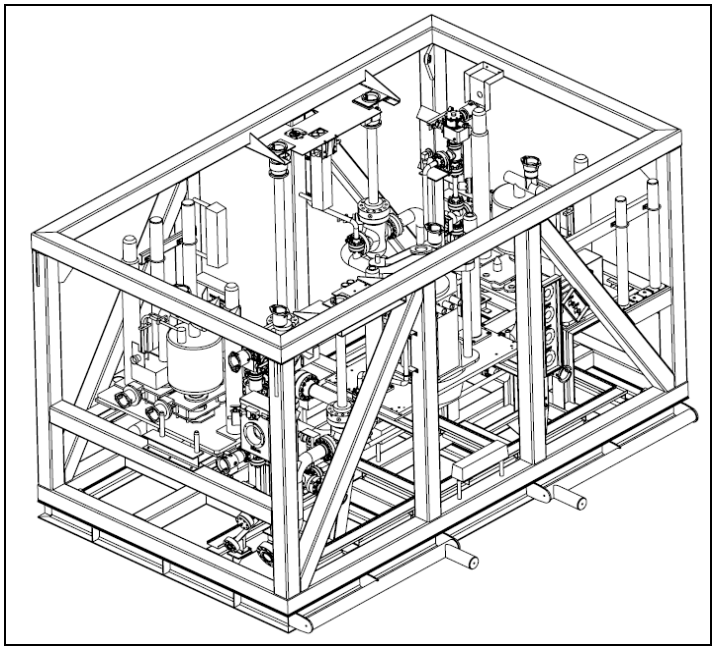
The mini-manifold is 7.4m long, 5.1m wide and 4.3m high and weighs 38t (Figure 4.13).

The Framo Mini-Manifold incorporates a 6" NB production header and three 6" NB production slots. Two slots are installed with actuated choke valves and Multi-Phase Flow Meter (MPFM) and hot stab tie-in points for flushing and leak testing. The third is a direct 6" tie-in to the production header. Integrated into the manifold is a chemical injection manifold, with tie-ins to the production header for three chemical injection points. All production tie-in points have ROV-operated double block and bleed valves to fully isolate the Mini-Manifold from the pipe and flow lines.

The Mini-Manifold also houses a single Subsea Control Module (SCM) used for the control and condition-monitoring of the two Production Trees, and EHC distribution equipment to interface the SUTU to the Production Trees.

The manifold roof panels can be removed to allow access for the removal and replacement of all components. The total weight of the manifold with mini-manifold and ballast weights in air is approximately 315 tonnes.

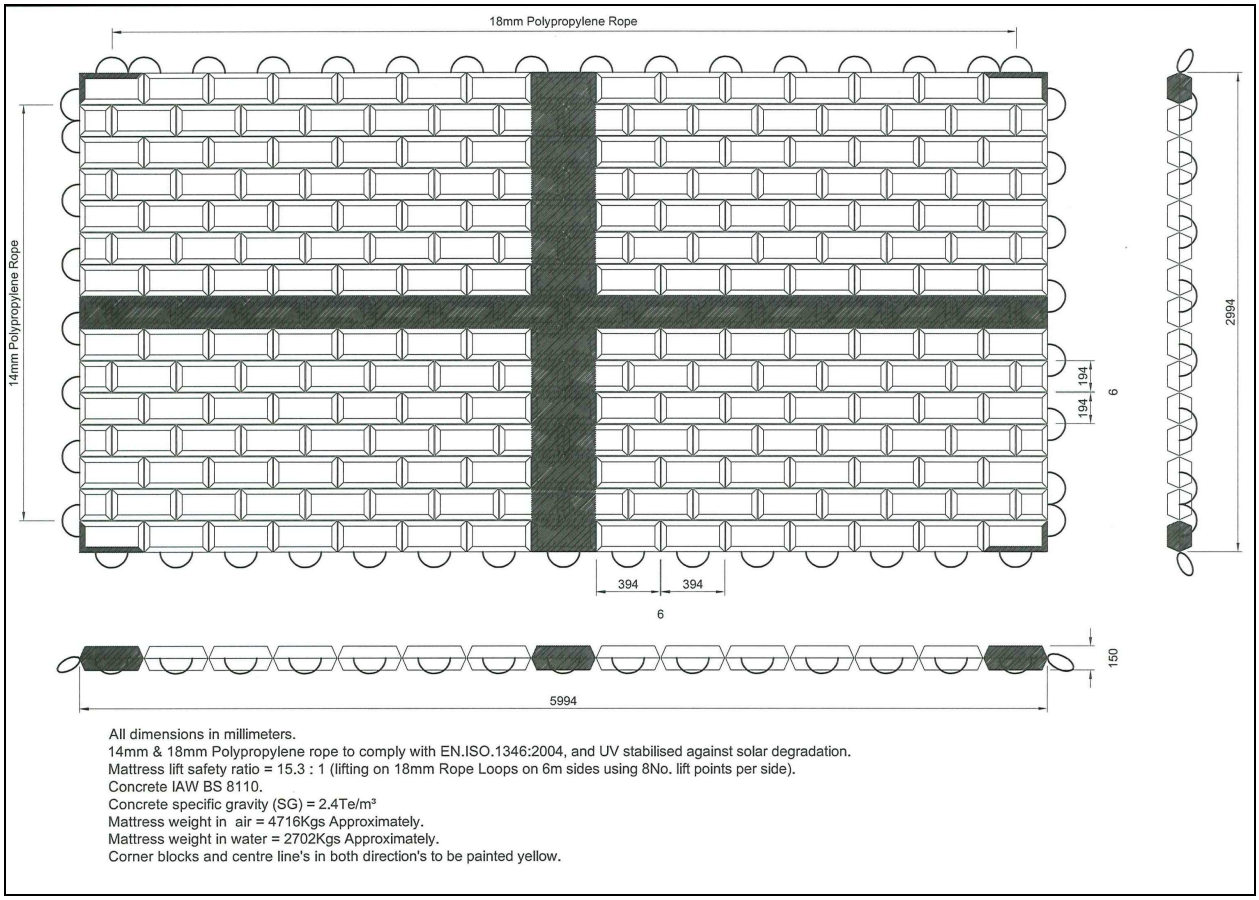
Figure 4.14. The Framo mini-manifold.



4.11 Production jumpers

The Shelley wells are connected to the production manifold by two 4" NB flexible production jumpers, PL2541J1 which is 45m long and PL2541J2 which is 65m long. These jumpers lie untrenched on the seabed, held in place and protected by a total of 17 concrete mattresses, each measuring 6m x 3m x 0.15m and weighing approximately 4.7t (Figure 4.14).

Figure 4.15. An illustration of a typical concrete mattress.



4.12 Electrical, hydraulic and chemical (EHC) jumpers

The production manifold is connected to the wells by 4" NB flexible control jumpers, PLU2543J2 (to well P1) which is approximately 55m long, and PLU2543J3 (to well P2) which is approximately 95m long. Each jumper comprises three separate control jumpers - an 8 way hydraulic/chemical control jumper, an LV signal jumper and an HV control jumper for the down-hole ESPs (Table 4.6) – which together enable the wells to be remotely controlled from the FPSO.

The jumpers lie untrenched on the seabed and are held in place and protected by the same concrete mattresses used to protect the Production Jumpers.

Table 4.6. Details of the lines in the Shelley controls jumpers.

Line No	type	Size	Rating	Function	Service Fluid
L2	Nylon 11 Hose	3/8”	7,500 psi	SCSSV	HW 443R
L4	Nylon 11 Hose	1/2”	3,000 psi	PWV	HW 443R
L6	Nylon 11 Hose	1/2”	3,000 psi	AMV	HW 443R
L 7	Nylon 11 Hose	1/2”	3,000 psi	PMV	HW 443R
L 9	Nylon 11 Hose	1/2”	3,000 psi	MeOH	MeOH
L 11	Nylon 11 Hose	1/2”	3,000 psi	LP	HW 443R
L 12	Nylon 11 Hose	1/2”	3,000 psi	CIV	HW 443R
L 13	Nylon 11 Hose	1/2”	3,000 psi	XOV	HW 443R
-	Pressure compensated, oil filled hose	3x95 mm2	12/20/(24) kV	ESP Power	-
-	Pressure compensated, oil filled hose	5 x 2.5 mm2 TSP	0.6/1.0(1.2) kV	LV Signal	-

4.13 Shelley production wells

Details of the production wells are presented in Section 8.

5 INVENTORY OF MATERIALS

5.1 Introduction

Tables 5.1, 5.2 and 5.3 present estimates of the mass of different types of materials in the various structures discussed in these combined Decommissioning Programmes.

Table 5.1. Inventory of the main materials comprising the facilities and items in DP 1, FPSO, manifold and wellheads.

Item	Description	Mass (metric tonnes)				
		Concrete	Steel	Aluminium	Copper	Plastics
FPSO	Sevan Voyageur FPSO (Note 1)		**55,000.00**			
FPSO Mooring system	Top chain		895.00			
	Polyester rope		12.00			438.00
	Buoy		300.00			
	Suction anchors		1,520.00			
	Bottom chain		1,681.00			
Sub-total			**4,408.00**			**438.00**
Production manifold	Protective structure		122.55	2.20		0.00
	Mini-manifold		36.81	0.67		0.00
	Ballast weights	144.99	2.45			
	SUTU		5.06	0.14	0.25	0.01
Sub-total		**144.99**	**166.87**	**3.01**	**0.25**	**0.01**
Wells	Production EHXT assembly		**106.02**			
Total for all items in DP1 for FPSO		**144.99**	**59,680.89**	**3.01**	**0.25**	**438.01**

Note 1.
The bulk of the *Sevan Voyageur* is steel but it also contains small amounts of other materials typical of the fabric of an FPSO, including metals, plastics, rubber, wood, and electronic instrumentation. The anticipated inventory of fluids and chemicals, other than fuel oil, that will be present at COP and during the tow away from the Shelley Field, is shown in Table 5.2.

All of the fabric of the FPSO and its liquid inventory, after the final tanker uplift of produced hydrocarbons, would be removed from the field when the *Sevan Voyageur* is relocated for further use elsewhere. The inventory will not be discharged on site or onshore, and the FPSO will not be subject to any planned operations that would be likely to cause environmental impacts or give rise to gaseous emissions.

Table 5.2. Inventory of the main chemicals and liquids on the *Sevan Voyaguer* at COP.

Material	Inventory
Methanol	6 m^3
Helifuel	5.4m^3
Marine diesel	1,929m^3
Scale inhibitor	9m^3
Demulsifier	3m^3
Antifoam	6m^3
Biocide, O_2 scavenger and corrosion inhibitor	3m^3 each

Table 5.3. Inventory of the main materials comprising the facilities and items in DP 2, Pipeline, umbilical and jumpers.

Item	Description	Mass (metric tonnes)				
		Concrete	Steel	Aluminium	Copper	Plastics
Production pipeline	Pipeline		156.21			
	Coating					51.55
	Anodes			0.24		
Sub-total			**156.21**	**0.24**		**51.55**
Umbilical, dynamic section	Umbilical		28.71		3.67	1.28
	Ancilliary fittings	8.00	52.13	1.63		3.67
	Bouyancy modules					12.09
Sub-total		**8.00**	**80.84**	**1.63**	**3.67**	**17.04**
Umbilical, static section	Umbilical		**94.59**		**24.17**	**8.41**
Flexible production riser	Riser		40.35			8.27
	Ancilliary fittings	77.51	3.80	2.00		0.83
	Buoyancy modules		0.80			13.50
Sub-total		**77.51**	**44.95**	**2.00**		**22.61**
Production jumpers	4" well P1 (PL 2541J1)		4.15			0.56
	4" well P2 (PL 2541J2)		5.65			0.80
	6" pipeline to manifold		6.93			0.61
Sub-total			**16.73**			**1.97**
ECH control jumpers	Jumper Well P1 (PLU2543J2)		0.01	0.10		0.14
	Jumper Well P2 (PLU2543J3)		0.01	0.15		0.20
	ESP power jumper to Well P1			0.10		0.00
	ESP power jumper to Well P2			0.15		0.00
Sub-total			**0.02**	**0.50**		**0.34**
Mattresses	Mattresses	**507.60**				
Total for all items in DP2, pipeline, umbilical & jumpers		**593.11**	**393.34**	**4.37**	**27.84**	**101.91**

6 REMOVAL AND DISPOSAL OPTIONS FOR THE PIPELINE AND UMBILICAL

6.1 Introduction

Under the DECC decommissioning guidelines all the facilities in the Shelley Field, with the exception of the production pipeline and the control umbilical, must be removed from the seabed. The general methods that will be employed to undertake this programme of offshore and onshore work are described in Section 7.

There are no prescribed decommissioning options for pipelines or umbilicals and all lines must be assessed individually (DECC, 2009). This section therefore:

- describes the procedures that Premier used to identify and select options for decommissioning the 8" production pipeline and umbilical; and
- describes the results of the Comparative Assessments of options for decommissioning the 8" production pipeline and the umbilical.

6.2 Identification of feasible options

Feasible options for the decommissioning of the production pipeline and control umbilical were identified and described in a detailed technical study undertaken on behalf of Premier by Technip (Technip 2009a).

6.3 Method used to compare and select options

6.3.1 Selection criteria

As required by the Petroleum Act 1998, Premier carried out a Comparative Assessment of the available options for decommissioning the pipeline and umbilical, to determine which option was most suitable in view of the status, condition and environmental setting of those facilities. Premier used the selection criteria recommended by DECC to compare different options. Some of these criteria were assessed quantitatively and some qualitatively, and the specific criteria used were as follows:

Safety risk

Definition: A qualitative assessment of the potential safety risk (serious injury or fatality) to persons directly or indirectly involved in the programme of work offshore and onshore.

Criteria The safety of the personnel who would be engaged in carrying out the decommissioning programme; and

The safety of third parties offshore and onshore that may be affected by the programme.

Environmental Impacts

Definition: An assessment of the significance of the risks to any environmental compartment as a result of *operations* (the activities that would be undertaken to complete the option) or the *end-points* (the final state of the facilities, materials or environment as a result of successfully completing the option).

Criteria: The impacts to the marine and terrestrial environments of operations; and

the impacts to the marine and terrestrial environments of end-points.

CO_2 emissions

Definition: The emissions of CO_2 from the proposed activities offshore and onshore associated with the complete programme of work for each option, including the emissions that would arise during the new manufacture of material to replace otherwise recyclable materials that were deliberately left offshore.

Criterion: The estimated total net emissions of CO_2, including emmisions from future monitoring surveys.

Societal Impacts

Definition: The effects of any of the operations or end-points on the standard of living or commercial activity of individuals, organisations or companies.

Criteria: The impacts on fisheries or other users of the sea, and

the impacts on onshore communities or the infrastructure or amenities of those communities.

Technical feasibility

Definition: The feasibility of carrying out the planned programme of work successfully using the facilities, equipment and procedures which are currently being used by the offshore oil and gas industry, or could reasonably be expected to be available in time for the Shelley decommissioning operations.

Criterion: The risk of encountering an unrecoverable failure, such that the whole option could not be completed as planned.

Cost

Definition: The total net cost specifically attributable to the execution of the proposed decommissioning programme (including CAPEX and OPEX), and allowing for the proper recycling, treatment and disposal of all wastes.

Criterion: The estimated total cost of the complete programme of work, including offshore and onshore operations, waste treatment and disposal, and any requirement for future monitoring surveys.

6.3.2 Options selection workshop

The findings of a number of individual technical studies on the various options were assessed and the results collated during an options selection workshop. A team of engineers, safety engineers and environmental consultants assessed the relative performance of each option in each of the criteria separately.

6.3.3 Ranking the options

In each criterion, the option that had the "best" performance was ranked 1, and the worst ranked 3. If options had very similar performances, they were given an equal rank.

The rankings in the individual criteria were then summed, and the option with the lowest overall score was identified as the recommended option.

6.4 Comparison of options for the production pipeline

6.4.1 Introduction

Within the framework of the DECC guidelines, three options were considered for the decommissioning of the pipeline.

In identifying the three options subjected to the comparative assessment, Premier Oil and our incumbent contractor Technip considered other technically feasible ways of decommissioning the pipeline. The alternative option of removal by "cut and lift" was discarded at this stage because, based on experience and knowledge, it was clear that this option would take longer, involve more underwater work, involve more work by divers, and therefore carry more risk and expense than any of the other removal options.

In all of the options examined below, the pipeline would be flushed and cleaned before decommissioning, as described in Section 7.4. This aspect therefore does not serve to differentiate the options and is not considered in the comparative assessment. The environmental impacts of this activity were, however, examined in the EIA.

6.4.2 Description of options

Reuse *in situ*

Premier has no further use for this pipeline. It is a relatively short length of pipeline, and Premier have not been able to identify any third party that would wish to acquire this asset for further use at its present location. If the trenched and buried pipeline were recovered in one piece it is extremely unlikely that sufficient guarantees could be given regarding its structural integrity which would enable the pipeline to be redeployed at another location for use in the offshore oil & Gas industry.

Option 1, Leave *in situ*

After flushing and cleaning the whole pipeline, the short exposed sections lying on the seabed at either end of the line would be removed by cold cutting, and the exposed cut ends buried to a depth of at least 0.7m under natural sediment by water-jetting. This option would require the use of a DSV for a total of approximately 6 days.

After the completion of this option, the remaining 2km long pipeline would be left in its trench, covered by the existing layer of rock dump. The risk of the line being exposed and thus causing a safety risk to third parties is extremely low because it is well buried (already confirmed by survey), covered by rock dump, stable, and will be subject to regular monitoring and, if needed, remediation.

Option 2, Remove by dredging

After flushing and cleaning the whole pipeline, a subsea dredge system would be used to excavate the rock dump from the trench to expose the line. Approximately 10,000 tonnes of graded rock dump would be re-deposited on the seabed (Figure 6.1). The line would then be retrieved to the surface by reverse reeling (Figure 6.2), and taken ashore for recycling or disposal as appropriate. This option would require the use of a dredging vessel for approximately 5 days, and a reeling vessel for approximately 3 days.

After completion of this option, the original pipeline trench would be empty and unfilled. A new seabed feature - a long, low rock "berm" perhaps about 1m high, 2-3m wide and up to 2km long - would be present parallel to and approximately 30-50m away from that open trench.

Figure 6.1. Schematic showing typical operations to remove and displace existing rock-dump from production pipeline.

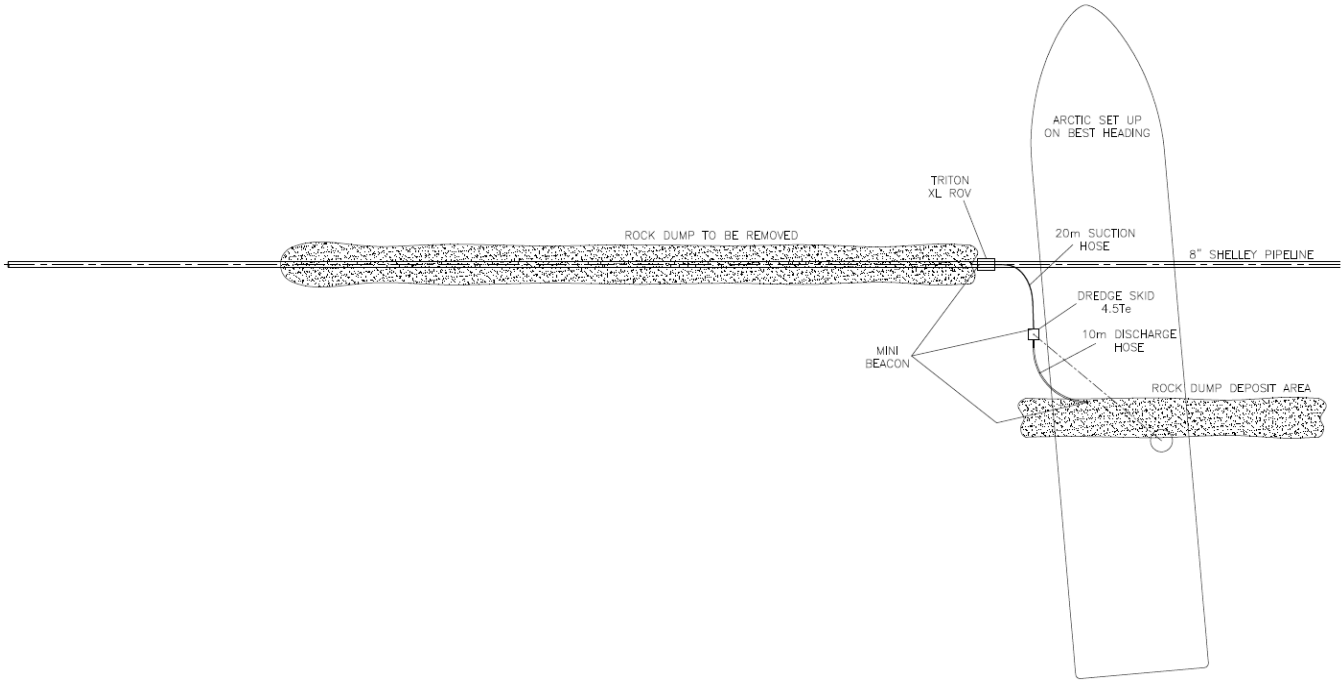
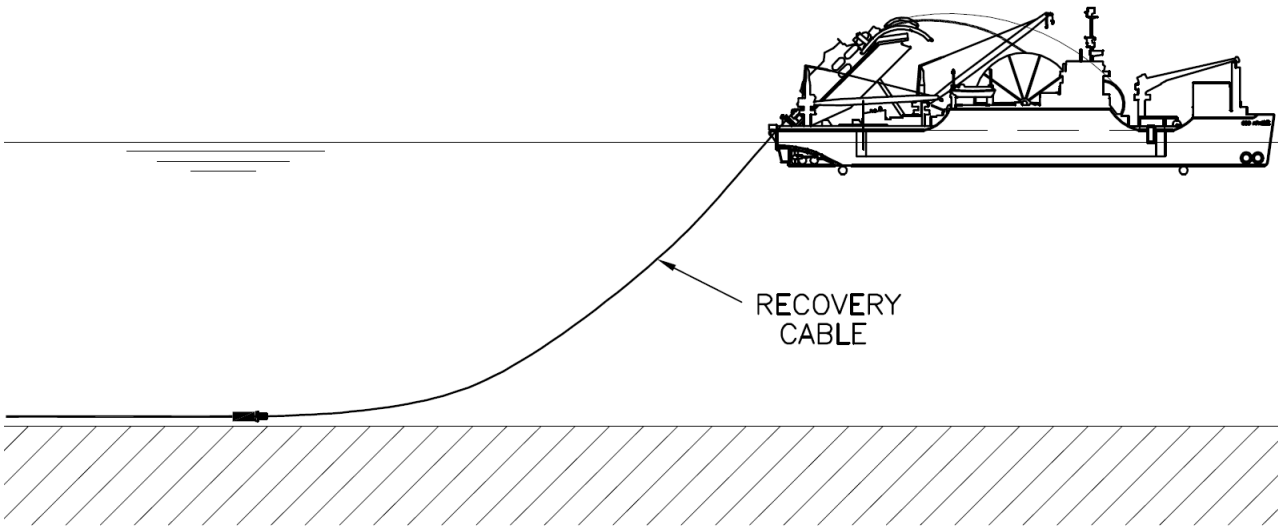


Figure 6.2. Schematic showing typical operations to remove a pipeline by reverse reeling.



Option 3, Remove by pulling

After flushing and cleaning the whole pipeline, it would be progressively pulled bodily through the overlying cover of rock-dump and retrieved by reverse reeling. The whole line would be taken ashore for recycling or disposal as appropriate. This option would require the use of a reeling vessel for approximately 7 days.

After completion of this option, the existing pipeline trench and its filling of rock-dump would remain as a feature on the seabed. The rock dump may have been disturbed by the forceful removal of the pipeline, and in some places may be elevated above the natural level of the surrounding seabed. Some rock-dump may have been displaced onto the surface of the adjacent seabed.

6.4.3 Comparison of options

Safety of personnel

In all three options, the safety risk to personnel offshore and onshore would be very low, and within the limits that are widely accepted as tolerable by the offshore oil and gas industry. Option 1 “Leave *in situ*” would have a lower safety risk than either Option 2 or 3 by virtue of the fact that overall, fewer people would be exposed to risk and for a shorter period of time.

After the successful completion of all of the options, the pipeline would no longer pose a snagging risk to other users of the sea. In Option 2 “Remove by dredging” and to a lesser extent in Option 3 “Remove by pulling”, there may be a very small risk to other users of the sea from the presence of the new rock berm on the surface of the seabed (Option 2) or small amounts of scattered rock-dump (Option 3). In Option 1, Premier is confident that the rock-dumped pipeline would remain stable and buried to a depth that ensured it would not pose a risk to other users of the sea.

Environmental impacts

Option 1 has a very low risk of environmental impacts from offshore operations. The rock dump would remain undisturbed and there would be no impacts on the adjacent natural seabed. Cutting and lifting the short sections of exposed pipe, and burying the ends, would resuspend a small amount of clean natural sediment, but this effect would be localised and of short duration, and the benthic community would quickly recover from any localised smothering that might occur. In Option 3, there may be slightly greater impacts caused by the scattering of part of the rock-dump, and in Option 2 there would be a markedly greater impact caused by the removal and then deposition of the entire rock-dump cover of approximately 10,000 tonnes

Option 2 "Remove by dredging", would have relatively greater end-point impacts than the other options. The dredging of the rock-dump cover would create a new feature on the seabed (perhaps 1m high, 2.5m wide and up to 2km long). This would smother a very small area of the previously natural benthic habitat, and alter the character of this small area of seabed permanently. In Option 3, the small effects of the existing rock-dumped trench would continue but would essentially remain the same. In Option 1, if the line were flushed to an agreed level of cleanliness (as determined by the concentration of residual oil in water in the pipe) then only a very small amount of oil, at a low concentration, would eventually enter seabed sediments and then the water column as the line gradually corroded. (If the pipeline were flushed to attain 40ppm oil-in-water concentration, the total amount of residual oil in the line would be approximately 2.4 litres.)

CO_2 emissions

Option 1 has the highest total CO_2 emissions of the options because, if the steel in the pipeline is not recovered and recycled, then in theory an equivalent amount of steel would have to be newly manufactured to replace it. This approach to calculating CO_2 emissions (and energy use) is necessary in order to properly demonstrate the savings that may be made in some decommissioning options when recyclable materials are retrieved from the sea rather than being left.

The total amount of CO_2 that might be emitted in all three options is, however, relatively small. The difference in the estimated totals for Option 2 and Option 3 (38t, approximately 5% more than Option 3) is within the generally accepted margin of error for such calculations. The emissions from Option 2 and Option 3 can therefore be considered to be essentially the same. The difference between Option 1 and Option 2 (434t, approximately 53% more than Option 2) is probably a real difference.

Societal impacts

No operation in any of the options would have a significant effect on commercial fisheries, but there are some differences in the end-points. Option 3 appears to perform best because the pipeline would no longer be in place, and the existing rock-dump would remain located in its present trench, more or less flush with the surface of the seabed. Option 2 was judged to perform more poorly because the entire rock-dump is removed and relocated as a new rock berm on the surface of the seabed parallel to and about 50m away from the existing route. The trench would not be backfilled, and is could be argued that there would be two features on the seabed that fishermen would seek to avoid. In Option 1, although the trenched pipeline would remain buried by the existing rock-dump, there is a very small risk that part of the pipeline could become exposed and thus present a potential snagging risk to bottom-towed fishing gear.

For communities onshore, Option 1 presents no impact, but both Option 2 and Option 3 might have some localised and transient impacts due to the activities associated with storing, transporting, treating or disposing of materials.

Technical feasibility
All of the options were judged to have the same, very low level of a risk of project failure. The equipment and procedures that would be employed offshore and onshore are commonly used in the oil and gas industry. There is a wealth of experience in the management of such procedures and in the assessment, control and mitigation of all of the risks associated with their implementation.

Costs
It was possible to prepare detailed budget costings on the basis of the considerable experience which the industry has of the procedures involved in each option. The estimated costs for Option 2 and Option 3 were approximately the same, and approximately 50% higher than the estimated cost of Option 1.

6.4.4 Recommended option for the production pipeline

Table 6.1 presents a summary of the performance of each option for the decommissioning of the pipeline in each of the selection criteria.

The comparative assessment indicated that, overall, the recommended option for decommissioning the pipeline is Option 1, "Leave *in situ*".

6.4.5 Sensitivity analysis

Ranking the performance of the options in each criterion is a means of identifying the option with the "best" overall performance, but discretion may be applied when assigning ranks to a range of different measures which are both qualitative and quantitative For example, options may exhibit absolute differences in some quantitative or semi-quantitative measure, but this difference may in reality be judged to be not significant given the overall accuracy of the methods used to measure option performance in that criterion.

The robustness of the apparent final ranking was therefore examined by carrying out two additional ranking exercises. In the first, a "strict" ranking protocol was applied whereby options were assigned a unique rank on the basis of their quantitative or qualitative performance in each criterion, and only ranked as being equal in performance if the their performances were actually the same. The method served to enhance the differences between options. In the second, a "generous" ranking protocol was applied whereby a much greater degree of judgment was used such that options were ranked equally in a criterion if their performances were approximately the same or of approximately the same order of magnitude. This method served to narrow the differences between options.

The results of these sensitivity analyses were compared with the original rankings shown in Table 6.1. It was found that although the differences between options changed, the "order of preference" remained the same; Option 1 Leave *in situ*, always performed best, Option 3 Remove by pulling, was next, and Option 2 Remove by dredging, was always poorest.

Table 6.1. Comparison of 3 options for decommissioning the Shelley production pipeline.

CRITERION	OPTIONS		
	1. Leave *in situ*	**2. Remove by dredging**	**3. Remove by pulling**
SAFETY			
Safety of personnel	No unacceptable risk to personnel. The total exposure of personnel to risk would be very small.	No unacceptable risk to personnel. The exposure of personnel to risk would be slightly higher than in Option 1 because of the handling of materials.	No unacceptable risk to personnel. The exposure of personnel to risk would be slightly higher than in Option 1 because of the handling of materials.
Ranking	*1*	*2=*	*2=*
Safety of third parties	No risk if the pipeline remains buried.	A very low risk from the new rock berm.	No risk if rock-dump stays in the trench.
Ranking	*1*	*2=*	*2=*
ENVIRONMENTAL IMPACT			
Environmental impacts of operations	No significant impacts if pipeline flushed.	Impacts to benthos caused by dredging of rock-dump and creation of new rock berm.	Minor impacts to local benthos if rock-dump partially scattered.
Ranking	*1*	*3*	*2*
Environmental impacts of end-points	No significant risks if pipeline flushed.	New rock berm covers small area of benthos.	Effects of existing rock-dumped trench continue.
Ranking	*1=*	*3*	*1=*
CO_2 EMISSIONS			
Total CO_2 emissions (t)	1,249	815	777
Ranking	*3*	*1=*	*1=*
SOCIETAL IMPACTS			
Impacts on fisheries	Risk of small effect if pipeline becomes a snagging risk.	A small effect from presence of new rock berm.	No effects on fisheries if rock-dump stays in the trench.
Ranking	*2=*	*2=*	*1*
Impacts on communities	No effect.	Small transient effect from onshore waste handling.	Small transient effect from onshore waste handling.
Ranking	*1*	*2=*	*2=*
TECHNICAL FEASIBILITY			
Risk of unrecoverable failure	Option is feasible with a very low risk of encountering an unrecoverable failure.	Option is feasible with a very low risk of encountering an unrecoverable failure.	Option is feasible with a very low risk of encountering an unrecoverable failure.
Ranking	*1=*	*1=*	*1=*
COST			
Cost (£K)	1,000	1,600	1,400
Ranking	*1*	*2=*	*2=*
Total "score"	**12**	**18**	**14**
Overall ranking	**1**	**3**	**2**

6.5 Comparison of options for the control umbilical

6.5.1 Introduction

Within the framework of the DECC guidelines, three options were considered for the decommissioning of the umbilical.

In all of the options examined below, the umbilical would be flushed and cleaned before decommissioning, as described in Section 7.4. This aspect therefore does not serve to differentiate the options and is not considered in the comparative assessment. The environmental impacts of this activity were, however, examined in the EIA.

6.5.2 Description of options

Reuse *in situ*

Premier has no further use for the umbilical and have not been able to identify any third party that would wish to acquire this asset for further use at its present location.

Option 1, Leave *in situ*

After flushing the whole umbilical, the short exposed sections at either end of the line would be removed. The remaining 2km long umbilical lying in the trench would be backfilled with natural seabed sediment using an underwater plough, to ensure that it was completely buried to a depth of at least 0.7m along its entire length. This option would require the use of a DSV for a total of approximately 4 days.

After the completion of this option, the remaining 2km long umbilical would be located within its trench, buried at a depth of at least 0.7m by natural sediments.

Option 2, Remove in one piece by pulling

After flushing and cleaning, the whole umbilical would be retrieved to a surface vessel by reverse reeling. The entire line, weighing approximately 169t in air, would be spooled onto one reel, and this would require a heavy-lift operation to transfer it to land. Onshore, the umbilical would be cut into sections for recycling or disposal as appropriate. This option would require the use of a reel vessel for a total of approximately 7 days.

After the completion of this option, the existing trench would be left empty and uncovered, and would gradually fill with natural sediment.

Option 3, Remove in 3 or 12 sections by pulling

After flushing and cleaning, the whole umbilical would be retrieved to a surface vessel by reverse reeling. During retrieval, the line would be cut into 3 or 12 sections so that it could be spooled onto smaller, lighter reels that would be easier and safer to transfer to shore. Onshore, the

umbilical would be cut into sections for recycling or disposal as appropriate. This option would require the use of a reel vessel for a total of approximately 8 days.

After the completion of this option, the existing trench would be left empty and uncovered, and would gradually fill with natural sediment.

6.5.3 Comparison of options

Safety of personnel

In all three options, the safety risk to personnel offshore and onshore would be very low, and within the limits that are widely accepted as tolerable by the offshore oil and gas industry. Option 1 "Leave *in situ*" would have a lower safety risk than either Option 2 or 3 by virtue of the fact that overall, fewer persons would be exposed to risk and for a shorter period of time. In Options 2 and 3 there would be a small additional safety risk to personnel when cutting the umbilical into sections, either offshore or onshore.

After the successful completion of all of the options, the umbilical would no longer pose a snagging risk to other users of the sea. In Option 1, there may be a very small risk to other users of the sea if the umbilical was incompletely or improperly buried, or were to become exposed.

Environmental impacts

Option 1 has slightly greater environmental impacts than either Option 2 or 3, because there is likely to be much greater disturbance of the seabed sediments in this option caused by ploughing. In contrast, the pulling of the umbilical, in one piece or in sections, is likely to disturb only the relatively thin layer of sediment presently lying over the umbilical in its trench.

Option 1 would also have potentially greater end-point impacts than either of the other options, because there is the possibility that the buried umbilical could become exposed and affect other users of the sea. In addition, the buried umbilical will eventually degrade and probably break up, and this might led to local degradation of the immediate benthos.

CO_2 emissions

Option 1 has the highest total CO_2 emissions of the options because, if the recyclable material in the umbilical is not recovered and recycled, then in theory an equivalent amount of material would have to be newly manufactured to replace it. This approach to calculating CO_2 emissions (and energy use) is necessary in order to properly demonstrate the savings that may be made in some decommissioning options when recyclable materials are retrieved from the sea rather than being left. In addition, Option 1 would involve two sets of marine operations – the removal of the exposed ends, and then the ploughing of the main section of umbilical to bury it.

The total amount of CO_2 that might be emitted in all three options is, however, relatively small. Option 2 "Remove in one piece" and Option 3 "Remove in sections" have very similar estimated net CO_2 emissions. The value for Option 1, however, is approximately twice that of the other options and even with the limitations of the emission calculations this can be considered a real difference.

Societal impacts

No operation in any of the options would have a significant effect on commercial fisheries, but there are some differences in the end-points. Option 1 appears to perform worse than either Option 2 or 3, because the buried umbilical may present a snagging hazard and thus may affect the way that commercial fisheries in the immediate area are prosecuted.

For communities onshore, Option 1 presents no impact, but both Option 2 and Option 3 might have some localised and transient impacts due to the activities associated with storing, transporting, treating or disposing of materials.

Technical feasibility

All of the options were judged to have the same, very low level of a risk of project failure. The equipment and procedures that would be employed offshore and onshore are commonly used in the oil and gas industry. There is a wealth of experience in the management of such procedures and in the assessment, control and mitigation of all of the risks associated with their implementation.

Costs

It was possible to prepare detailed budget costings on the basis of the considerable experience which the industry has of the procedures involved in each option. At the level of detail available to Premier at this time, it appeared that Option 1 was the most expensive and was approximately twice the cost of the next option, Option 2. This is because Option 1 would require two separate vessel operations offshore, for cutting the ends, and then ploughing the bulk of the umbilical. Option 2, is, in turn, approximately twice the cost of Option 3, mainly because a heavy lift operation would be needed in this option to transfer the single large reel to shore.

6.5.4 Recommended option for the umbilical

Table 6.2 presents a summary of the performance of each option for the decommissioning of the umbilical in each of the selection criteria.

The comparative assessment indicated that, overall, the recommended option for decommissioning the umbilical is Option 3, “Remove in sections”. In the overall scoring there is little to choose between this option and Option 2 “Remove in one piece”, but Option 3 presents a slightly lower risk to personnel because there is no requirement for a heavy lift to transfer the reeled umbilical to the shore.

Table 6.2. Comparison of 3 options for decommissioning the Shelley umbilical.

CRITERION	OPTIONS		
	1. Leave *in situ*	**2. Remove in one piece**	**3. Remove in sections**
SAFETY			
Safety of personnel	No unacceptable risk to personnel. Small risk to divers removing exposed ends.	No unacceptable risk to personnel. Major risk would be during heavy lift of single reel and onshore cutting.	No unacceptable risk to personnel. Cutting on deck would slightly increase risk to personnel.
Ranking	*1*	*2=*	*2=*
Safety of third parties	Small potential for snagging if umbilical is exposed.	No risk to other users.	No risk to other users.
Ranking	*3*	*1=*	*1=*
ENVIRONMENTAL IMPACT			
Environmental impacts of operations	Obvious local impacts from ploughing of whole umbilical.	Minor impacts from disturbing clean sediments.	Minor impacts from disturbing clean sediments.
Ranking	*3*	*1=*	*1=*
Environmental impacts of end-points	Small potential risk to other users if umbilical is exposed.	No source of snagging or contamination in seabed.	No source of snagging or contamination in seabed.
Ranking	*3*	*1=*	*1=*
CO_2 EMISSIONS			
Total CO_2 emissions (t)	964	466	472
Ranking	*3*	*1=*	*1=*
SOCIETAL IMPACTS			
Impacts on fisheries	May affect fisheries if umbilical becomes a snagging risk.	No effect on fisheries if all umbilical is removed.	No effect on fisheries if all umbilical is removed.
Ranking	*3*	*1=*	*1=*
Impacts on communities	No effect.	Small transient effect from onshore waste handling.	Small transient effect from onshore waste handling.
Ranking	*1*	*2=*	*2=*
TECHNICAL FEASIBILITY			
Risk of unrecoverable failure	Option is feasible with a very low risk of encountering an unrecoverable failure.	Option is feasible with a very low risk of encountering an unrecoverable failure.	Option is feasible with a very low risk of encountering an unrecoverable failure.
Ranking	*1=*	*1=*	*1=*
COST			
Cost (£K)	1,000	500	240
Ranking	*3*	*2*	*1*
Total "score"	**21**	**12**	**11**
Overall ranking	**3**	**1=**	**1=**

7 PROPOSED PROGRAMME OF WORK TO DECOMMMISSION THE SHELLEY FIELD

7.1 Introduction

This section describes the programme of work that will be carried out offshore to decommission the *Sevan Voyageur*, the pipeline, riser and umbilical, the production manifold and jumpers, and the mattresses. The programmes of work for the plugging and abandonment of the wells and for the removal of seabed debris are described in Section 8 and Section 10 respectively.

The proposed Decommissioning Programme has been developed following the guidance given by DECC, Premier's HSE philosophy, and the views and concerns of stakeholders.

7.2 Phased programme of execution

The Shelley Field will be decommissioned in a phased programme of work spread over two summer seasons in 2010 and 2011 (Table 7.1). The approximate timing and duration of the main activities are shown in Figure 14.1 in Section 14, Schedule.

Table 7.1. Summary of the main activities in the Shelley field decommissioning programme.

Year	Activities
2010	**Phase 1: Suspension of Field and removal of FPSO**
	▪ Flush pipeline and umbilical
	▪ Isolate and make safe the subsea system
	▪ Engineer-down and release the FPSO
	▪ Cut and retrieve the production and umbilical riser
2011	**Phase 2: Subsea facilities**
	▪ Remove protection mattresses
	▪ Retrieve exposed ends of production pipeline
	▪ Retrieve umbilical static section
	▪ Disconnect and recover production jumpers, EHC jumpers, drop-down spools
	Phase 3: Subsea facilities
	▪ Retrieve the mini-manifold
	▪ Retrieve the manifold ballast weights
	▪ Retrieve the manifold protection structure
	Phase 4: Wells
	▪ Plug and abandon the wells

7.3 Subsea decommissioning 2010

7.3.1 Introduction

This section describes the workscope that will be completed in 2010 to remove the inventory from the pipeline and wellhead, the chemicals and other fluids from the umbilical and decommission the umbilical and pipeline risers.

7.3.2 Shutting-in the wells and commencement of flushing operations

After cessation of production the subsea production pipeline will be depressurised to reduce the amount of hydrocarbon drop-out in the pipeline. Before the decommissioning of the facilities begins, the wells will be shut-in and isolated, prior to being plugged and abandoned as described in Section 8. At the P1 well, a temporary jumper will be installed from the DSV to the wellhead. Barrier tests on the annulus wing valve will be performed before the DSV jumper is hooked up to the tree annular flange outlet. On the DSV, a flushing unit will pump treated seawater from the DSV, through the xmas tree and into the manifold. This will move the well fluids to the manifold, leaving the tree and its jumper filled with treated seawater.

The DSV will repeat this programme at the P2 well, but the pumping operations will be extended to flush all the fluids from the manifold through the production pipeline to the FPSO (Section 7.4.2).

7.3.3 Flushing the umbilical

Initially, a flushing spread located on the *Sevan Voyageur* FPSO will displace all used chemical lines within the production control umbilical through the umbilical, well head and manifold to the production pipeline. Suitable barrier fluids and treated seawater will be used to ensure that there are no remaining production residues, chemicals or other materials in the umbilical prior to final disconnection at the production manifold SUTU.

The pipeline flushing operations (Section 7.3.4) will then move the displaced fluids flushed from the umbilical into the FPSO. The umbilical will be left filled with seawater, and all the fluids from the umbilical will be routed to the FPSO process system and discharged under appropriate permits.

7.3.4 Flushing the pipeline

The produced fluids presently found in the entire production pipeline system (flexible riser, pipeline, manifold and jumper to the production manifold) will be displaced with treated seawater by a programme of flushing operations, so that sections can be detached or cut and removed without the risk of spilling oil.

The total volume of fluids in the production pipeline and production riser is approximately 61m^3 and at the time of decommissioning it is expected that 95% will be produced water (58m^3) and 5% oil (3m^3). The likely contents and condition of the pipeline at COP has been investigated (Post Abandonment Pigging Requirement Technical Note Maxoil Process Solutions (2009)). This study concluded that, because of the nature of the Shelley fluids and the operating conditions, it is

anticipated that there will be very little wax or scale inside the pipeline. It is therefore proposed that the pipeline contents would be cleared by means of a flushing operation rather than pigging. Seawater will be used as a flushing agent and will be treated with scale inhibitor to mitigate against the possibility of the formation of barite scale upon interaction with Shelley formation water. Naturally Occurring Radioactive Material (NORM) has not been found in the process system on the FPSO and it is therefore very unlikely that there is any NORM (in the form of LSA scale) in the operating pipeline.

After flushing the P2 well, the DSV will continue the flushing operation to remove all hydrocarbons and process chemicals from the production pipeline, the manifold and all the interconnecting jumpers. In a carefully designed programme of flushing operations, a chemical "slug" (seawater treated with various chemicals to loosen or dissolve residual material) will be pumped from the DSV to the manifold, and then on through the production pipeline and riser to the FPSO. A detailed assessment of the specific chemicals that would be used and discharged during the flushing of the pipeline will be prepared in a separate PON15.

All the fluids flushed from the line would be routed to the FPSO process system for treatment and discharge under appropriate permits. The flushing operations will continue until the concentration of oil in the water received at the FPSO is no greater than 40ppm. The line will be deemed to be clean and the majority of hydrocarbons removed, when this oil-in-water concentration is achieved and when visual inspection of the flushing equipment reveals no significant traces of hydrocarbons.

7.3.5 Riser Recovery

Mattresses at the production and umbilical riser bases will be temporarily removed to allow the risers and umbilical dynamic section to be recovered.

The production riser will then be disconnected from the static section of pipeline on the seabed, and recovered by reverse reeling onto a DSV. It is planned that the production riser will be recovered intact in one piece, so that it can be re-used.

The umbilical riser at the dynamic / static transition where it enters the trench will be cut using hydraulic cutting shears or similar and then removed for onshore disposal, either by cutting into section then lifted onto a vessel or by being pulled directly onto a vessel by a powered reeling system.

The exposed ends of the umbilical and pipeline will then be covered using the existing mattresses* and if required by water jetting to ensure they are not exposed and do not pose a snagging risk to other users of the sea. The riser ancillary equipment; clump and holdback weights will then be recovered to the vessel.

* note, all mattresses will be removed by the end of the decommissioning in 2011, this is an intermediate measure to ensure there are no snagging risks between the decommissioning works in 2010 and the scope of work to be completed in 2011.

7.4 Topside facilities decommissioning 2010

7.4.1 Decommissioning the Sevan Voyageur

After COP the *Sevan Voyageur* will be depressurised and made safe from its production mode, in preparation for relocation. No chemicals, hydrocarbons or solid wastes will then be discharged to sea, other than those necessary for the normal operation of the *Sevan Voyageur* as a vessel rather than as an FPSO. The vessel will retain its present inventory of fuel oil, chemicals, hydraulic fluid and other solid, liquid and gaseous materials, which are properly and securely contained and stored.

The mooring lines would be disconnected from the upper chains attached to the FPSO and laid on the seabed.

The *Sevan Voyageur* FPSO will then be towed away and will no longer feature in the proposed programme of work to decommission the Shelley Field. After COP, it will not cause any further environmental impacts, safety risks or gaseous emissions attributable to the Shelley Field decommissioning programme.

7.4.2 Decommissioning the mooring system

All the mooring lines and the lower chains will be removed from the seabed, for re-use or recycling. These operations will be undertaken by ROVs deployed from a support vessel and should take approximately 50 days.

7.5 Decommissioning seabed infrastructure 2011

This section describes the workscope that will be completed in 2011 to decommission the remaining subsea infrastructure and the mooring system suction anchors.

7.5.1 Decommissioning the suction anchors

The base case is for the buried suction anchors to be completely removed by a “reverse suction” process. In the event that this process is unsuccessful Sevan / Premier will approach DECC for further consultation on an acceptable way to proceed.

7.5.2 Decommissioning the pipeline

The pipeline will have been flushed in 2010 (Section 7.3.4) and left open to the sea.

At both ends of the production pipeline, divers would use water-jetting to uncover the end of the static pipeline on the seabed back to the deepest part of the trench. This short section will then be cut off using a band saw or similar equipment, and lifted to the DSV for transportation to shore. The cut ends of the pipeline will then be buried by water-jetting natural sediment into the trench, so that they were not exposed and did not pose a snagging risk to other users of the sea

The majority of the pipeline, approximately 2km long, will then be left in place in its trench, covered by the existing low mound of rock-dump. Surveys have shown that the top of the pipeline is at least 0.7m below the level of the seabed (Section 4.7.2). There is every expectation that this would not change over the design life of the pipeline; experience of similar pipelines at these

depths in the central North Sea indicates that it is very unlikely that natural movement of the seabed sediments would expose this line. Over time, the steel pipeline will corrode and collapse in the trench, and at this time it can be assumed that even if the line were partially exposed, it would no longer pose a snagging risk to fishermen. An appropriate programme of post-decommissioning monitoring will be agreed with DECC (Section 16).

7.5.3 Decommissioning the umbilical

The control umbilical lies in a trench and is covered by a thin layer of natural seabed sediments; there is no rock-dump over this line. Following displacement of the concrete mattresses, the whole of the umbilical will be recovered in several pieces. The umbilical material will be taken ashore for recycling or disposal.

Removal of the umbilical will leave a trench approximately 1.5m deep where the static line was previously located, but since it will not contain any oilfield material or debris it will not present a snagging risk to fishermen. Over time, the gradual natural movement of seabed sediments will slowly fill the trench. The post-decommissioning monitoring programme (Section 16) will include the umbilical trench as appropriate.

7.5.4 Flexible production jumper

Divers and an ROV, deployed from a DSV, will be used to disconnect the flexible production jumper from the static pipeline at the flange which joins the two lines. The jumper will then be taken to shore for refurbishment prior to re-use.

7.5.5 Static production jumper

The static production jumper will be disconnected from the manifold, lifted onto a DSV, and taken to shore for refurbishment prior to re-use.

7.5.6 Well jumpers

The production and umbilical jumpers will be disconnected from the wells and the production manifold, and then lifted by crane onto the DSV. They will be taken to shore for refurbishment prior to re-use.

7.5.7 Production manifold

The mini-manifold, ballast weights and protection structure will be removed from the seabed in three separate lifts, and taken to shore for refurbishment prior to re-use.

7.5.8 Mattresses

All the concrete mattresses will have been moved aside and gathered together on the seabed to allow the jumpers to be decommissioned. After removal of the jumpers, the mattresses will be removed from the seabed by lifting them onto the DSV and taken ashore for recycling or disposal as appropriate.

8 WELLS

8.1 Introduction

This section describes the programme of work that will be carried out offshore to plug and abandon the two wells in the Shelley Field.

8.2 Status of the wells

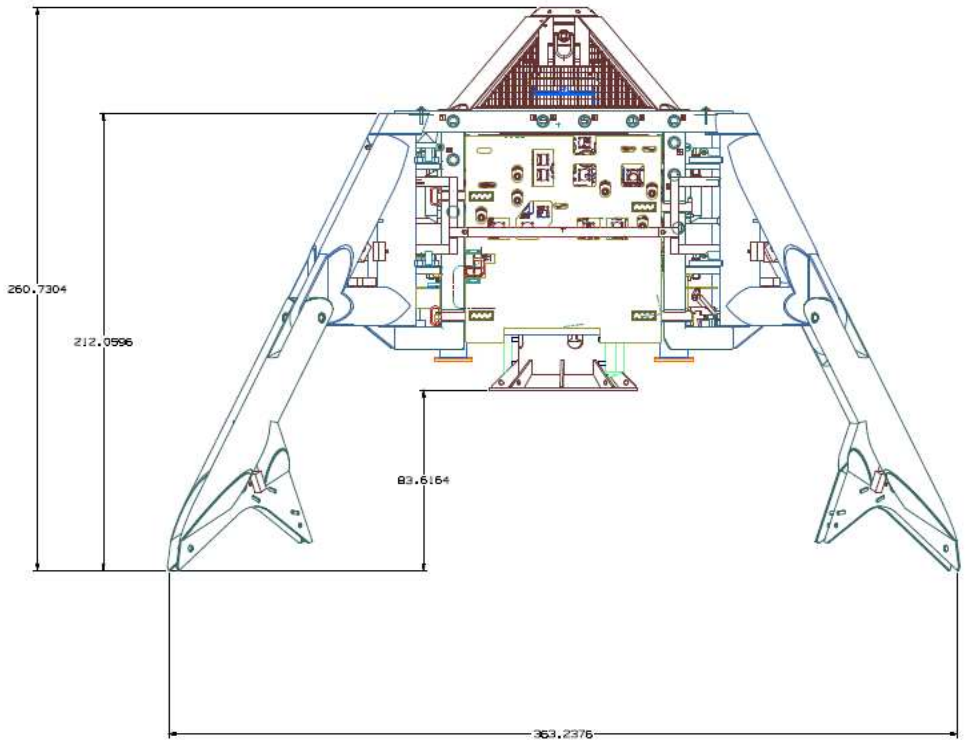
There are two wells in the Shelley Field, DECC reference numbers 22/2b-P1Z and 22/2b-P2S. Under the guidelines produced by Oil & Gas UK (Oil & Gas UK (2009), both wells are currently category 3, requiring significant intervention for full abandonment.

8.3 Well Head and Completion

Both production wells are installed with Enhanced Horizontal Subsea Trees (EHXT), protected by a Fishing-Friendly Structure (FFS) (Figure 8.1). The FFS is a large fabricated component approved by the Scottish Fisherman's Federation designed to protect the tree from:

- Dropped object impacts (up to 75kJ)
- Fishing equipment impacts (up to 13kJ)
- Trawl gear snag loads (up to 60 Tonnes)

Figure 8.1. Illustration of an Enhanced Horizontal Subsea Tree and Fishing-Friendly Structure.



8.4 Method for plugging and abandoning the Shelley wells

The well abandonment programme will comply with Oil and Gas UK guidelines Issue 3, January 2009.

A mobile drilling unit (MODU) will be anchored over the wells. The wells will be killed using calcium chloride brine, which will also be weighted to control the pressure in the well. The well tubing will be mechanically cut at a depth of approximately 5,000ft below the seabed and tubing recovered.

The first barrier will be created by perforating the 9 5/8" casing at a depth of approximately 4,850 ft below the seabed and setting a 500ft long cement plug. The 13 3/8" and 9 5/8" casing strings will be perforated again at approximately 2,350ft below the seabed, and a second 500ft long cement plug set.

After pressure-testing the plugs the BOP will be recovered, at which point either the drilling rig or a DSV will complete the well abandonment. The Xmas tree will be unlatched and retrieved, the well casing will then be cut at a depth of about 3m below the seabed, and the wellhead recovered. It is estimated that the programme to plug and abandon each well will take approximately 17 days.

8.5 Preparation of Permits and Consents

An application to abandon the wells will be submitted to DECC through the WONS portal. This will detail the timing and operations to be carried out. In addition, a PON15b will be submitted which will assess the environmental aspects of the operation and list the chemicals to be used in each stage of the abandonment e.g. well kill, cementing and rig utility chemicals. Each chemical will be risk-assessed using appropriate modelling techniques such as CHARM.

9 DRILL CUTTINGS

9.1 Introduction

This section describes the fate of the cuttings generated during the drilling of the two Shelley wells, and the condition of the seabed at the wells.

9.2 Fate of drill cuttings from Shelley wells

The Shelley production wells were both drilled in 2008.

The upper hole sections were drilled with water-based muds (WBM) and cuttings from these sections were discharged onto the seabed. Subsequently, the small cuttings piles that had accumulated on the seabed as a result of the top hole drilling were cleared away by water jetting, so that the Xmas trees and wellheads could be properly located on the seabed.

All other sections were drilled with Low Toxicity Oil Based Muds (LTOBM). The cuttings from these sections were returned to the drilling rig and treated by a thermal desorption unit to recover the drilling muds for re-use. The residual inert solids from this process, a fine powder, were discharged under permit to sea. This material would have been dispersed by currents as it sank through the water column. Consequently, the residual cuttings material would have settled as a very thin layer over a wide area of seabed and would not have formed a cuttings pile.

9.3 Condition of the seabed at the Shelly wells

The final as-laid survey carried out by ROV in July 2009 showed that there is no build up of cuttings around either of the wells (Technip, 2009b)). There may be some WBM cuttings co-mingled with natural sediments. There may also be very small amounts of the residual solids material discharged to sea after the thermal desorption treatment of the LTOBM cuttings. It is certain, however, that there is no accumulation of LTOBM cuttings at the site nor any pile that requires to be screened under OSPAR Recommendation 2006/5 regarding the assessment and possible further treatment of historic cuttings piles containing hydrocarbons.

The possible environmental impacts associated with the disturbance of such material during the decommissioning programme are assessed in the EIA, summarised in Section 12.

10 DEBRIS CLEARANCE

10.1 Introduction

With the exception of the trenched section of the 8" production pipeline and its existing cover of rock-dump, the infrastructure presently on or in the seabed, or linking the *Sevan Voyageu*r FPSO to the production manifold, will be completely removed to shore. The locations of all items are well-known, and it is planned that every item will be found and retrieved during the offshore programme of work. Any major piece of equipment or material that is accidentally lost overboard during this programme will be located and retrieved.

10.2 Seabed clearance survey

On completion of the planned offshore programme of work the seabed will be surveyed using side-scan sonar to ensure that it is clear of items or obstructions that might pose a safety risk to fishermen or other users of the sea. The areas that will be surveyed will be:

(i) a 500m radius circle centred on the former location of the *Sevan Voyageur* FPSO;
(ii) the locations of each of the suction anchors;
(iii) a 500m radius circle centred on the former site of the Shelly manifold; and
(iv) a corridor 2.1km long and approximately 210m wide, centred between the production pipeline and the umbilical trench, running from the Shelly manifold to the FPSO site (the pipeline and umbilical lie parallel to each other on the sea bed approximately 10m apart).

If any significant oil-related debris is found it will be retrieved and taken ashore for recycling or disposal, as appropriate.

10.3 Verification of clear seabed

After the removal of any residual debris, the areas will be swept to verify that they are clear of obstructions. The sweeps will be carried out by an independent contractor, using specially-designed trawling equipment. The results of the sweeps, and a copy of the seabed clearance certificate that would be issued by the independent verifier, will be submitted to DECC.

10.4 Final condition of the offshore site

At the former location of the *Sevan Voyageur* FPSO, the surface of the seabed will be clean and free of all items and debris. Along the route of the trenched production pipeline, the existing layer of rock dump will remain in place; over time, it is likely that this would be partially covered by a layer of natural seabed sediment. At no point along the route or at the ends of the pipeline would any pipeline be exposed. The seabed will be free of debris. Along the former route of the umbilical, the seabed will be free of all items and debris. The trench in which the umbilical lay will be partially filled with natural sediment and it is likely that over time this would be more or less filled with natural sediment.

At the former location of the manifold and two wellheads, the surface of the seabed will clean and free of all items and debris. The severed ends of the well casings will be located at a depth of about 3m below the natural level of the seabed.

11 INTERESTED PARTY CONSULTATIONS

11.1 Introduction

This section describes the consultation that Premier has undertaken with stakeholders, statutory consultees and other interested parties regarding the proposed decommissioning programmes.

11.2 Consultation process

Premier began its programme of consultation in October 2009, when it became clear that the Field was not performing as expected and that decommissioning may occur earlier than forecast. The process was initiated through consultation with DECC, who subsequently advised which statutory consultees should be contacted.

On publication of this draft Decommissioning Programme, Premier consulted the following statutory consultees as specified by DECC:

- Scottish Fishermen's Federation
- National Federation of Fishermen's Organisations
- Global Marine Systems
- Northern Ireland Fishermen's Federation

Most of the consultations have been conducted by letter, but individual meetings have been held with DECC'.

Table 11.1 presents a summary of the results of the consultation process. Copies of the correspondence received and Premier's replies have been included as an appendix to this Decommissioning Programme.

Consultation with relevant stakeholders will continue as necessary during the execution of the Decommissioning Programme.

11.3 Publication and advertisement of the Decommissioning Programme

The Decommissioning Programme has been advertised by means of a Public Notice printed in selected appropriate national and local newspapers. CD-ROM copies of the full Programme have been sent to every statutory consultee. A PDF version of the full programme can be down-loaded from the Premier Oil website www.premier-oil.com/UK/Decommissioning.

Table 11.1. Summary of the views of consultees and Premier's response.

Organisation	Comments	Premier response
National Federation of Fishermen's Organisations	Important to consider the safety of fishermen and the risk posed by items left on the seabed at the site. Any pipeline, umbilical or other material left at the site should be trenched and completely buried. NFFO feel they can support the proposed decommissioning programme if the umbilical is removed completely and the exposed ends of the production pipeline are buried. See Appendix A – Statutory Consultation Responses	All comments are noted. Premier confirms that safety of other users of the sea was one of the prime criteria used in the Comparative Assessment of the options for pipeline and umbilical. Premier confirms that the cut ends of the production pipeline will be buried under natural sediment to a depth of at least 0.7m.
Scottish Fishermen's Federation	The FFS states that they are fully supportive of the Decommisioning Programme, that they are fully content that the Decommissioning Programme in that it meets the shared objective of ensuring the maximum removal to shore of all relevant Shelley hardware and that this should be achieved in such a manner that affords no compromise to either the environment nor to Fishermens Safety - both in the short and long term. See Appendix A – Statutory Consultation Responses	All comments are noted.
Global Marine Systems	No concerns; there are no cables in the vicinity of the Shelley Field.	Information noted.
Irish Fishermen's Federation	No concerns; they do not fish in the vicinity of the Shelley Field.	Information noted.

12 ENVIRONMENTAL IMPACT ASSESSMENT

12.1 Introduction

Premier has conducted an Environmental Impact Assessment (EIA) of the proposed programme of work, including a Comparative Assessment of the environmental impacts of different decommissioning options for the pipeline and umbilical. The results of these assessments are fully reported in a comprehensive Environmental Statement (ES)(BMT Cordah, 2009).
This section summarises the results of the EIA. In particular it:

- identifies the main environmental impacts associated with the proposed programme of work;
- highlights the potential environmental and societal impacts that were of concern to consultees;
- describes how significant potential impacts would be mitigated in the proposed programme of work; and
- quantifies the total energy use and the total gaseous emissions that would occur as a result of the proposed programme.

The full ES contains much information that is summarised in Sections 3, 4, 5, 6, 7 and 11 of this Decommissioning Programme. Unless such information is essential for a proper understanding of potential environmental impacts, it is not repeated in this section.

12.2 Summary of method used to conduct the EIA

12.2.1 Introduction

The EIA was carried out in accordance with the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999, as amended by the Offshore Petroleum Production and Pipelines (Assessment of Environmental Impacts)(Amendment) Regulations 2007. An environmental impact assessment is a procedure that is used to:

- identify all the environmental risks associated with a proposed project;
- selectively identify those risks that are likely to cause significant impact to the environment;
- describe the measures that the project owner proposes to employ to eliminate or reduce (mitigate) these impacts;
- ensure that the knowledge, views and concerns of stakeholders are taken into consideration when evaluating environmental risks and their mitigation; and
- present a summary of the environmental management plan that the project owner will enact in order to mitigate risks.

12.2.2 Types and sources of environmental risk in decommissioning projects

The options in decommissioning projects comprise the *operations* or activities undertaken offshore and onshore, and the *end-points* or consequences which are achieved by the successful completion of those operations. Both the operations and the end-points can cause environmental impact; operational impacts may generally be short-term and possibly localised, whereas end-point impacts may be less acute but of longer duration.

The environmental risks associated with the proposed Shelley decommissioning programme were therefore assessed and described in terms of *operations* and *end-points*.

12.2.3 Method

The EIA was completed by undertaking the following tasks:

- Preparing a description of the environmental setting and sensitivities of the Shelley field.
- Preparing a description of the operations and end-points, and the potential accidental events, associated with the proposed decommissioning programme.
- Completing a scoping study to identify the significant potential environmental risks associated with the programme, taking into account the views and concerns of stakeholders.
- Describing, and if possible quantifying, the residual environmental risk of the significant impacts after the application of generic or project-specific mitigation measures.

12.3 The environmental setting of the Shelley Field

The environmental setting and sensitivities of the Shelley field were summarised in Section 3 and are described more fully in the ES (BMT Cordah, 2009). There are no pockmarks, or biogenic reefs formed by *Sabellaria spinulosa* or *Lophelia pertusa*, in the area of the field.

12.4 Environmental impacts of the Shelley decommissioning programme

12.4.1 Impacts from planned operations

No aspect of the proposed programme of work would be likely to give rise to any significant environmental impacts. All of the techniques and procedures that would be employed are routinely used in oil and gas development projects or decommissioning projects.

The planned operations that would be most likely to cause environmental impact are the manipulation, cutting or retrieval of items in or on the seabed. The resultant disturbance of seabed sediments might damage or smother animals living on or in the sediments, but any such impacts would not be significant. The sediments are not polluted, the area that might be affected would be very small and localised, and recovery would begin soon after the disturbance ceased. There is no discernible drill cuttings pile at either of the well sites and it is not anticipated that any subsea operations will disturb or liberate contaminated sediments.

All of the subsea cutting operations will use either hydraulic shears, band saws or abrasive water-jetting; explosives will not be used.

There will be no planned discharges of hydrocarbons or chemicals to sea. Hydrocarbons in the production pipeline and hydraulic fluids in the umbilical would be flushed back to the *Sevan Voyageur* FPSO. The hydrocarbons would be exported and the hydraulic fluids discharged under appropriate permits.

The wells will be plugged and abandoned using a semi-submersible drilling rig anchored on site for approximately 14 days. Anchoring may cause some local disturbance to the seabed but will not generate any obstructions or features that might give rise to snagging risks for bottom-towed fishing gear.

The risks of impact to the environment from the normal *planned operations* associated with this decommissioning programme are therefore assessed as not significant.

12.4.2 Impacts from unplanned operations or accidental events

The *accidental* events that are most likely to cause environmental impacts are a collision which results in an oil spill from one of the offshore vessels, or a collision with the *Sevan Voyaguer*.

At certain times during the programme, two vessels may be operating together in the field. These combined activities will be of short duration, however, and the risk of collision is very low. The environmental risks associated with a spillage of hydrocarbons as a result of a vessel collision were therefore assessed as not significant.

It is very unlikely that there would be a collision between one of the decommissioning vessels and the FPSO before it leaves the Shelley Field, and even more unlikely that this would result in an oil spill. It is planned that the last uplift of hydrocarbons including removal of all flushing and decommissioning fluids from the *Sevan Voyaguer* will take place shortly after COP, leaving the cargo tanks clean. The cargo tanks are surrounded by ballast tanks containing uncontaminated seawater, and it is therefore very unlikely that a collision at low speed (the most likely event) would result in a cargo tank being punctured. The environmental risks associated with a spillage of hydrocarbons from the FPSO as a result of a collision were therefore assessed as not significant.

Accidental spillages may also occur during the flushing operations. All the equipment in the Shelley Field is less than 3 years old, however, and is in excellent condition and unlikely to fail. It is very unlikely that the flushing operations would result in a spillage of material from any part of the pipeline infrastructure.

The volumes of fluid in the pipeline, umbilical and jumpers lines are relatively small, and at COP the proportion of oil in the produced fluids is expected to be less than 5%. Premier and Sevan will have their existing oil spill contingency plan in place throughout the decommissioning programme. The environmental risks associated with a spillage of hydrocarbon fluids from the production pipeline or chemicals from the umbilical were therefore assessed as not significant.

There is a very small risk that oil or chemicals could be spilled from the mobile drilling unit while plugging the wells. These are well-known hazards and the industry has numerous controls in place to reduce the likelihood that they would occur, control the situation if it arises, and minimise the resultant impact to marine life. The risks of impact to the environment from accidental events associated with the programme to plug and abandon the wells are therefore assessed as not significant.

12.4.3 Impacts from planned end-points

The proposed operations will ensure that, with the exception of the trenched and rock-dumped production pipeline, all items on the seabed are entirely removed. There will be three main positive effects from these outcomes, namely:

1. The opportunity for fishermen to fish at the former sites of the FPSO and the drill centre.
2. The relocation and reuse of the *Sevan Voyaguer* FPSO for future oil and gas operations,
3. The refurbishment and re-use of the majority of the sub-sea infrastructure including the manifold, and jumpers and wellhead.

Table 12.1 presents an assessment of the planned fates of the materials presently in the Shelley Field.

Table 12.1. Summary of the planned fate of different materials presently in the Shelley Field.

Material	Existing Mass (t)	Re-used		Re-cycled		Disposed of		Left *in situ*	
		t	%	t	%	t	%	t	%
Concrete	738	230	31.2	0	0.0	508	68.8	0	0.0
Steel (1)	60,074	59,889	99.7	17	0.0	12	0.0	156	0.3
Aluminium	7	7	90.0	1	6.8	0	0.0	0.2	3.3
Copper	28	28	100.0	0	0.0	0	0.0	0	0.0
Plastics	540	48	8.9	2	0.4	438	81.1	52	9.5
TOTAL	**61,388**	**60,203**	**98.1**	**20**	**0.03**	**958**	**1.6**	**208**	**0.3**

Note 1: Section 5 acknowledges that small amounts of other materials will be present in the FPSO. All these materials will be re-used when the FPSO is re-deployed at another location for further use in the oil and gas industry.

The ends of the production pipeline will be fully buried, and the trenched length will remain firmly in place with its existing cover of undisturbed rock-dump. Given the location and depth of this pipeline, it is very unlikely that natural forces would expose it or cause spanning. After decommissioning, all items of debris in the area will be identified and retrieved, and an independent debris sweep performed to verify that the area is clear. It is therefore extremely unlikely that this trenched and rock-dumped line would pose a snagging risk to bottom-towed fishing gear.

12.4.4 Impacts from unplanned end-points

There would be no significant impacts from unplanned end-points in this programme. If objects or items were dropped, they would be located and retrieved. If the suction anchors cannot be fully extracted, they will be cut below the level of the seabed and buried by natural sediment. The existing cover of rock-dump on the production pipeline will be left undisturbed. During consultation, the NFFO indicated that they would prefer the existing rock-dump to remain undisturbed.

It is planned that the FPSO and most of the retrieved facilities would be reused (Section 12.4.3). If a suitable re-use cannot be found, some items may have to be recycled or disposed of to landfill. The small negative effects of these less desirable outcomes would not be significant.

12.4.5 Energy use and gaseous emissions

The proposed decommissioning programme would use energy and produce emissions of CO_2 and other gases. Because some recyclable material would be left in the sea (the trenched and rock-dumped production pipeline) some of the energy and emissions attributable to this programme are "theoretical", to account for the replacement of "lost" recyclable material. Table 12.2:

1. shows the total energy use, and the total CO_2 emissions;
2. shows the actual energy use and actual CO_2 emissions for the programme; and
3. compares the estimated CO_2 emissions for the programme with the latest published value for all oil and gas operations on the UKCS.

The gaseous emissions associated with the proposed decommissioning programme are extremely small in comparison with the emissions attributable to oil and gas operations on the UKCS. Furthermore, given the very high proportion (by mass) of material from the Shelley Field that would be retrieved and re-used (Table 12.1, Section 12.4.3), there is very little scope for gaining further savings in energy or emissions. The comparative assessment of the options for the production pipeline showed that more energy would be expended moving the rock-dump and retrieving the pipeline than would be "saved" by recycling the steel.

Table 12.2. The total and actual energy use and CO_2 emissions for the Shelley decommissioning programme.

Aspect	Total (1)	Actual (2)	Actual as % of UKCS (3)
Energy use (GJ)	157,995	153,530	N/A
CO2 emissions (tonnes)	12,079	11,336	0.07

Notes:

1. Total means the amounts that would be used or emitted, including the theoretical energy that would be needed for the replacement of recyclable material left in the sea.

2. Actual means the amounts that would actually be used or emitted during the decommissioning programme.

3. Total CO_2 emissions from oil and gas operations on the UKCS in 2007 were 16,890,408 tonnes (DECC, 2008).

12.5 Conclusions

1. There are no particular environmental sensitivities in the Shelley Field, and no Annex I habitats in the field or close to it.

2. No aspect of the proposed programme of work would be likely to give rise to any significant environmental impacts. All of the techniques and procedures that would be employed are routinely used in oil and gas development or decommissioning projects.

3. The proposed programme would result in the removal of all of the facilities and infrastructure from the field, with the exception of a 2km length of 8" production pipeline. This is presently trenched to a depth of at least 0.7m to the top of the pipe, and covered with a layer of rock-dump that is flush with the surface of the seabed. After the removal and burial of the exposed ends of this pipeline, it will be completely buried and will not present a snagging risk to bottom-towed fishing gear. Before decommissioning the pipeline will be flushed, and after decommissioning it will contain only trace amounts of hydrocarbons.

4. Given the depth of water in the field and the prevailing conditions, it is very unlikely that the trenched and rock-dumped pipeline would become exposed by natural forces. It is therefore expected that it will remain completely buried until it corrodes and finally disintegrates.

5. The proposed programme would result the reuse of approximately 98% (by mass) of the materials presently in the field.

13 COSTS

Premier has prepared an initial estimate of the total cost of the decommissioning programme, based on the assumption that all work would be carried out and completed by the end of 2011 (Table 13.1).

The final cost of the whole programme will be heavily dependent on the specific contracts awarded and the synergies that might be available with similar offshore programmes that coincide with the timetable for Shelley.

Table 13.1. Summary of the total estimated cost of the Shelley decommissioning programme.

Item	Premier estimated cost (£m)*	Sevan estimated cost (£m)*
2010 programme to remove subsea facilities	7.3	0
2010 programme to remove the *Sevan Voyageur* FPSO	0	9.7
2011 programme to remove subsea facilities	5.6	0
2011 programme to plug and abandon wells	11.9	0
OPEX and other charges post-COP	0.5	0
Post decommissioning surveys	0.5	0
Total	**25.8**	**9.7**

*Estimate April 2010

14 SCHEDULE

14.1 Introduction

This section describes the schedule for the proposed programme of work, giving information on the likely timing and duration of the main phases of work that were described in Sections 7, 8 and 10. The schedule has been developed with reference to the following important aspects:

- the agreed COP for the Field;
- the time required to prepare, and obtain approval for, the necessary licences and consents;
- the desire to decommission the *Sevan Voyageur* FPSO as soon as possible so that it may be deployed to another field;
- the requirement to plug and abandon the wells in a safe and efficient manner; and
- the desire to complete a safe offshore programme of work by an agreed date, while making best use of available vessels.

There are no licence conditions or environmental sensitivities (Section 3) that suggest that there are particular times of year when certain activities in the decommissioning programme should not be undertaken. Premier plans to complete all the offshore operations and submit the verification and close reports (Section 15) by the end of 2011.

14.2 Proposed programme of work

Figure 14.1 shows the main activities in the proposed programme, the resources that would be used, and the approximate duration of activities.

Throughout the execution of the decommissioning project, Premier and Sevan (the owner of the *Voyaguer* FPSO and its mooring system) will work closely to take advantage of any synergies in their respective activities.

The exact timing of events would be decided on award of contracts, and may be subject to change depending on the availability of vessels and the possible benefits of co-operation with other offshore activities. Premier will apprise DECC of all such proposed changes. The environmental impact assessment did not indicate that there were particular times of the year when environmental sensitivities offshore would be heightened.

Figure 14.1. Summary of the main stages of the Shelley decommissioning programme.

Shelley Abandonment Summary Schedule

Task	Start	End		2011 J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Window for COP	01/07/10	01/07/10	0																		
Phase 1: Preperations	14/08/10	24/08/10	10																		
Phase 2: Subsea Decommissioning (Flushing & Riser Recovery)	24/08/10	14/09/10	21																		
Phase 3: FPSO Removal (FPSO Disconnection & Tow)	10/09/10	20/09/10	10																		
Phase 3: FPSO Removal (Moooring recovery)	20/09/10	09/11/10	50																		
Phase 4: Subsea Decommissioning (Infrastructure recovery)	01/04/11	01/05/11	30																		
Phase 5: Well Abandonment	28/04/11	01/06/11	34																		
Close out report to DECC	01/06/11	29/09/11	120																		

Notes

1. The COP date is indicative to allow the development of a decommissioning schedule but is subject to change based on field performance.

15 PROJECT MANAGEMENT AND VERIFICATION

15.1 Introduction

This section describes how Premier will manage the proposed decommissioning programme and report progress to DECC, and confirms Premier's undertaking to provide the required verification and close-out reports to DECC.

15.2 Project Management

As operator of the Shelley Field, Premier will be solely responsible for the management of the decommissioning programme of work, which comprises:

- Setting the health, safety and environmental standards for the programme.
- Approving the final detailed programme of work and schedule of operations.
- Appointing and managing contractors.
- Monitoring progress and reporting to DECC.
- Exercising a "duty of care" with respect to all items and materials taken ashore for re-use, recycling or disposal.
- Ensuring that the offshore sites, and any items permitted to remain offshore, are left in the planned conditions described in the Decommissioning Programme.

15.3 Controlling documents

The whole programme of work will be performed and managed under the auspices of relevant Premier policies and procedures, including:

- Health, Safety and Environmental Policy
- Environmental Management System

15.4 Notifying other users of the sea

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

15.5 Status of seabed infrastructure during phased decommissioning

On completion of the 2010 workscope any materials remaining on the seabed will be in their present location and condition. These items will be fully over-trawlable or protected against interaction with fishing gear, and will not present any additional snagging risk to commercial fishing operations.

15.6 Reporting Progress

Premier will report progress to DECC on a quarterly basis.

15.7 Duty of care in the handling, treatment, recycling or disposal of all retrieved material

All equipment and material retrieved from the seabed will be returned to the UK for re-use, recycling, or treatment and disposal as appropriate by suitably licensed facilities. It is not intended that any waste products will be exported overseas. Movement of any Hazardous Waste will comply with the consignment requirements of the Special Waste Regulations 1996 (as amended).

Premier will engage the services of a contractor for handling all waste and recycling of recovered materials. The contractor selected will provide Health & Safety and Environmental Policy Statements, BS EN ISO14001 Registration Certificate, Registered Waste Carriers Certificate, and Waste Management Licenses prior to award of contract.

Premier will keep a register of all items, and record their transportation, treatment and ultimate disposal.

15.8 Verification

The outcome of the well abandonment programme will be specifically examined under Regulation 18 of the Offshore Installation and Well Design and Construction Regulations (DCR, 1996).

Within four months of the completion of the decommissioning work, Premier will provide DECC with:

- the post-decommissioning survey report (Section 16);
- the debris clearance survey report (Section 10); and
- the project close-out report.

16 PRE- AND POST-DECOMMISSIONING MONITORING AND MAINTENANCE

16.1 Pre-decommissioning surveys

The Shelley well sites and pipeline corridor were surveyed in 2008, after the placement of the rock-dump (Technip, 2009b). The umbilical and all other subsea infrastructure was surveyed in August/September 2009 following its installation and commissioning (Technip, 2009b).

Together these surveys essentially provide a complete and detailed assessment of the present condition of the seabed and the infrastructure at the sites that might be affected by the proposed decommissioning operations.

Before the various activities in the decommissioning programme begin, a DSV will carry out specific surveys to confirm the status of the facilities and the condition of the adjacent seabed.

16.2 Post-decommissioning surveys

The former site of the *Sevan Voyageur* FPSO, the sites of the wells and manifold, the route of the trenched and rock-dumped pipeline, and the umbilical trench, will be surveyed when all the offshore operations have been completed. The areas that will be surveyed and the types of data that will be collected will be discussed and agreed with DECC. It is likely, however, that the survey will:

(i) map the seabed and any items left in place, to confirm that they are in the planned and agreed locations and condition; and

(ii) acquire samples to determine the extent and magnitude of any perturbation or chemical contamination that may have been caused by the decommissioning operations.

The results of this survey will be submitted to DECC. If the status of the trenched and rock-dumped pipeline does not conform to that proposed in the decommissioning programme, Premier will discuss the need for possible remedial action with DECC.

The need for further environmental surveys will be discussed with DECC in the light of the findings of the first post-decommissioning survey. Existing survey data show that there is no measurable chemical contamination in any part of the Shelley Field; oil-based drill cuttings were not discharged at the well site, and there have been no planned or accidental releases of chemicals to the seabed during production.

16.3 Monitoring of remains

The trenched and rock-dumped pipeline will remain Premier's responsibility.

The post-decommissioning survey will provide a detailed assessment of the location of the trenched and rock-dumped pipeline and the depth of burial. Based on the results of this survey, an appropriate monitoring programme will be discussed and agreed with DECC. It is likely that this will comprise one or more offshore surveys that would employ remote techniques to assess the depth of burial of the line. The findings of every survey will be reported to DECC.

17 SUPPORTING MATERIAL

BMT Cordah (2010).	Environmental Statement for the Shelley field Decommissioning programme. A report to Premier Oil UK Limited.
Gardline Environmental Limited (2008).	Environmental Baseline Report, Shelley Field Development UKCS Blocks 22/1 and 22/2. Report for Oilexco North Sea Limited, April 2008.
Maxoil Process Solutions (2009).	Post Abandonment Pigging Requirement Technical Note, MAX-PMO-004-TN-001 Rev 01, November 2009.
Gardline Geosurvey Limited (2007).	Shelley NE1 to Shelley FPSO Route Survey, UKCS 22/2. Report to Oilexco North Sea Limited, August 2007.
Oil & Gas UK (2009)	Suppression and Abandonment of Wells / North Sea Abandonment study 2009 WEL03.
Oilexco North Sea Limited (2007).	Shelley Field Development Environmental Statement. BERR Ref. No. D/3578/2007). December, 2007.
Sevan Marine (2009)	FPSO Sevan Voyageur Decommissioning Methods. Doc. No. 434-147-RE-151005, Rev B.
Technip (2009a).	Decommissioning Study Document. Report for Premier Oil ONS Limited, Doc. No. UK 011774-DES-001, December 2009.
Technip (2009b)	Shelley Field Development As Built Report Doc No. UK011686-AB-012 Rev Z.

18 APPENDIX A – STATUTORY CONSULTATION RESPONSES

18.1 National Federation of Fisherman's Organisations

National Federation of Fishermen's Organisations

Shelley Field Decommissioning

2 November 2009

Katie Martin
Environmental coordinator
Premier Oil plc
40 Queens Road
Aberdeen
AB15 4YE

Dear Katie

Thank you for the letter dated 28th October 2009 re the Shelley Field Decommissioning Plan.

The Federations response is as follows;

Safety of fishermen during any decommissioning operations is paramount. Dismantled or partially dismantled equipment presents a threat to the safety of fishermen and on that basis we would ask you to constantly assess this element in your plans.

In Phase 2 it is suggested that the pipelines, umbilical and jumpers will be flushed and disconnected. Presumably when the FPSO is towed off location, under existing legislation the 500m Safety Zone will automatically be removed?

Under such a scenario, exposed pipe ends and other existing equipment at that stage presents a potential danger to fishing activity and therefore we support Premier's proposed safety measures for fishermen.

NFFO policy on decommissioned pipelines is quite clear. Pipelines and umbilicals may be left in situ providing they have been trenched and are completely buried.
Any exposed pipe-ends should be jetted or trenched with ends turned downwards to minimise risk to other users of the sea.
Pipelines, umbilical's or sections of the same not totally buried but covered with a layer of rock are not regarded as being satisfactory status for being left in situ. Rock disperses over time as a result of natural settlement and disturbance effects from fishing activity and would lead to exposed pipelines and possible risk of snagging for fishing vessels.

The options set out in Phase 3 seem to support the Federation policy.

NFFO preferred position is a clean sea-bed following field decommissioning. Any equipment left in situ on completion of a decommissioning plan must be supported with an appropriate contribution the Fishermen's Legacy Trust Fund.

On the basis of the comments above we feel that at this stage we can support your decommissioning plan.

[redacted] NFFO. 30 Monkgate, York, YO31 7PF

National Federation of Fishermen's Organisations

Shelley Field Decommissioning

We look forward to playing an active role in the consultation process and future communication on the Shelley decommissioning program.

Yours sincerely

Dave Bevan
NFFO

[redacted] NFFO. 30 Monkgate, York, YO31 7PF

18.2 Scottish Fisherman's Federation

SCOTTISH FISHERMEN'S FEDERATION
24 Rubislaw Terrace · ABERDEEN · AB10 1XE

Telephone: 01224 646944 · Fax: 01224 647058
e-mail: sff@sff.co.uk
Website: www.sff.co.uk

Our ref: MJS/amg

21 April 2010

Michael Jeffries
Project Engineer
North Sea & West Africa Business Unit
Premier Oil Plc
Blenheim Gate
53 Blenheim Place
ABERDEEN
AB25 2DZ

Dear Michael

Premier Oil : Shelley Field Decommissioning Programme Statutory Consultation

I refer to the above referenced programme which is set out in your Document Doc No SH-OP-PL-0003; which Document we received a copy of earlier this year, all as foreshadowed during our regular meetings with yourselves.

We had circulated your Document amongst our relevant Constituent Associations and I am now able to provide their/our feedback. We apologise that our formal response has taken longer than normal.

Our Federation welcomes the opportunity to review and offer comments on this Programme. We found the Programme Document to be User Friendly, Well Laid out and in all respects Complete. At the outset, we would clearly like to preface our general response by confirming that our Federation is fully supportive of the Programme - all as laid out in the above referred Document.

We further note that the Document also embraces two inter related sections to the Decommissioning Programme.

Premier Oil are fully aware, as indeed are all relevant UK Government Authorities (and others) that the Scottish Fishermen's Federation's long held and consistent policy stance towards the decommissioning of all redundant offshore energy infrastructure is that of achieving the maximum, timely and safe removal of all relevant hardware from the seabed (and sea environment) for efficient disposal ashore. To this end we are pleased to note that the Shelley FPSO – the Sevan Voyageur – shall be disconnected and towed away for re-use. We are also pleased to note that the associated production riser manifold, jumpers and related mooring/anchors and cables shall be retrieved from the seabed for either re-use or disposal ashore. We are particularly rewarded to note that all the concrete mattresses which are currently on the seabed within the Shelley area shall also be retrieved ashore for recycling or disposal. As explained at our meetings, concrete mattresses have proved to be particularly problematic for our industry and indeed for other Decommissioning Projects.

We note and are content with your proposals for removing all Shelley Wells and note that they shall be cut to a depth of 3m, well below the seabed.

Our Federation notes that the 2 Km pipeline and associated umbilical connecting the producing wells to the FPSO are currently trenched/rock dumped. Trenching or rock dumping has always been the Federation's preference in respect of the production life of any pipeline/umbilical - and therefore we would not normally seek to force the removal of such assets from the seabed or from within rock layers; accordingly we are content with Premier's proposal to leave these items in situ and thereafter simply note that they shall be the subject of a regular monitoring regime/timetable (to be agreed by DECC). We do register however, that Premier have stressed that no part of the production pipeline or umbilical would be left exposed and that you have undertaken to backfill etc any exposures along the pipe/umbilical route and indeed at pipeline/umbilical ends. We also note that these items are unlikely to be subject to future upheaval buckling stresses whilst left in situ.

We additionally note that all these assets shall be carefully flushed and purged of hydro-carbons etc in full accordance with cleaning and discharging operations under the PON 15C regime.

We are also comfortable with the approach and methodology that Premier have adopted in considering the various options for selecting your preferred approach to addressing the pipeline/umbilical legacy matters.

The Scottish Fishermen's Federation also notes Premier's comments in respect of Shelley related drill cuttings and that in essence, it is your conclusion that no significant residual cuttings materials shall be left on the seabed and also that given your historical use of WBM's there shall be no residual toxicity issues. We would though take this opportunity to highlight that our Federation continues to contribute to cross industry debates and JIPS's in respect of the general drill cuttings issue.

We are also pleased to note that the key effected seabed areas – including the anchor points etc shall be the subject of side scan sonar surveys and that if any significant oil related debris items were found that Premier are committed to retrieving and taking these items ashore. We are further pleased to note that a relevant trawl sweep/overtrawling exercise will be undertaken by yourselves following the completion of the Side Scan Survey. The detail of such sweeps should be addressed during future discussion.

We note that the Decommissioning Programme shall be undertaken on a phased basis and recall that we have committed to work with each other to ensure an information awareness/policing strategy that shall cumulatively ensure that these assets are fully protected from/to fishing activities until the completion of the Programme.

As mentioned earlier we are content for DECC to agree with yourselves an acceptable overall post Shelley decommissioning surveying/monitoring regime.

We also confirm that we had reviewed and are fully content with your relevant supporting EIA, which Document we had received previously.

Our Federation also takes this opportunity to firmly place on record our appreciation of Premier's ongoing support for mutually beneficial industry safety etc initiatives such as FishSAFE, the Fisheries Legacy Trust Fund Etc – cumulatively, these initiatives shall be important to both our industries in the future.

We reaffirm then that we are fully content that the Decommissioning Programme meets our shared objective of ensuring the maximum removal to shore of all relevant Shelley hardware and that this should be achieved in such a manner that affords no compromise to either the environment nor to Fishermens Safety - both in the short and long term.

The Scottish Fishermen's Federation wishes the Shelley Decommissioning Project success and we particularly thank Premier for the open and fair manner in which you have conducted dialogue with ourselves – we trust that we are able to continue this open approach going forward.

Yours sincerely

Michael J Sutherland
Director of Operations

Cc: SFF Internal
SFF Constituent Associations
John Watt

Michael Jeffries, Premier Oil
Katie Martin, Premier Oil
Jan Rusin, Premier Oil