CNR International

Murchison Decommissioning: Jacket Derogation Application

An assessment of proposals for the disposal of the footings of the disused Murchison steel jacket

MURDECOM-CNR-PM-REP-00005

18 November 2013

Contents

Preface 7

Terms and Abbreviations 8

1.0 Executive Summary 9
1.1 The Murchison Field 9
1.2 Murchison Jacket Description 9
1.3 Jacket Decommissioning Options 9
1.4 Drill Cuttings Pile 9
1.5 Comparative Assessment of Decommissioning Options 10
1.6 Stakeholder Engagement 11
1.7 Programme Management 11

2.0 Description of the Murchison Field 12
2.1 Decommissioning Recommendations 13

3.0 Description of the Murchison Jacket 15
3.1 Jacket Structure Description 15
3.2 Inventory of Material 16
3.3 Installation of Jacket 16
3.4 Jacket Survey 18
3.5 Drill Cuttings Pile Description 18

4.0 Jacket Decommissioning Options 20
4.1 Re-use 20
4.2 Leave *in situ* 20
4.3 Full Removal 21
4.4 Partial Removal to Top of Footings 21
4.5 Jacket Removal Methods Summary 22
4.6 Interaction of the Jacket Removal Options and Drill Cuttings 24
4.7 Degradation Mechanisms for the Jacket Footings 25

5.0 Jacket Decommissioning 26
5.1 Preparation for Removal 26
5.2 Jacket Cutting Sequence and Tools 26
5.3 Contingent Measures 29
5.3.1 Use of Explosives 29
5.3.2 Use of Divers 29
5.4 Removal from Field 30

5.5	Onshore Disposal	31
6.0	Comparative Assessment	33
6.1	Options considered in the Comparative Assessment	33
6.2	Comparative Assessment Methodology	33
6.3	Studies Undertaken	33
6.4	Independent Review	34
6.5	Specialist Review Workshops	34
6.5.1	Safety Workshops	34
6.5.2	Environmental Workshop	37
6.5.3	Technical Workshop	37
6.5.4	Societal Workshop	43
6.5.5	Economic Workshop	43
6.6	Stakeholder Engagement	43
6.7	Jacket Removal Comparative Assessment Recommendations	43
7.0	Environmental Impact Assessment	47
7.1	EIA Process	47
7.2	Environmental Description	47
7.2.1	Hydrography and Meteorology	47
7.2.2	Murchison Baseline Survey	48
7.2.3	Description of the Murchison Drill Cuttings Pile	48
7.2.4	Physical and Chemical Analysis	48
7.2.5	Faunal Analysis	49
7.2.6	Plankton and Primary Production	49
7.2.7	Commercial Fish Spawning and Nursery Areas	50
7.2.8	Commercial Fishing	50
7.2.9	Marine Mammals	50
7.2.10	Inshore Areas Adjacent to Reception Facilities	50
7.2.11	Conservation Sites and Species	51
7.3	Offshore Impacts and Mitigation	51
7.3.1	Energy Use and Atmospheric Emissions	51
7.3.2	Underwater Noise Assessment	52
7.3.3	Seabed Disturbance	54
7.3.4	Socioeconomic Impacts	55
7.4	Post Decommissioning Environmental Survey	56
7.5	Environmental Compensation Options and Opportunities	56

8.0	Stakeholder Engagement	57
8.1	Publication of the Draft Decommissioning Programme for Consultation and Responses	57
8.2	Statutory Consultation - Results	57
9.0	Programme Management	59
9.1	Project Management	59
9.2	Project Schedule	59
9.3	Project Costs	60
9.4	Post Decommissioning Surveys	60
9.5	Debris Clearance and Verification	60
9.6	Close Out Report	61
9.7	Post Decommissioning Monitoring of Remains	61
9.8	Legacy Issues	61
10.0	Reference Documents	62
10.1	Regulations and Procedures	62
10.2	Surveys	62
10.3	Removal Studies	62
10.4	Drill Cuttings	63
10.5	Environment	63
10.6	Safety	64
10.7	Comparative Assessment & Stakeholder Workshops	65
11.0	Appendices	66

List of Tables

Table 1: Murchison Platform Section 29 Notice Holders 7
Table 2: Jacket Material Inventory 16
Table 3: Comparative Assessment Summary Results 44
Table 4: Energy and Emissions Arising from Full or Partial Removal of the Murchison Jacket 52
Table 5: Provisional Decommissioning Programme Cost Structure 60

List of Figures

Figure 1: Murchison Field Location 12
Figure 2: Murchison Infrastructure Layout 13
Figure 3: Murchison Infrastructure Post Decommissioning 14
Figure 4: Jacket Elevation 15
Figure 5: Jacket Footings 17
Figure 6: Murchison Drill Cuttings Pile 19
Figure 7: Jacket left in situ after removing topsides 21
Figure 8: Jacket Removal using SSCV 22
Figure 9: Jacket Removal using SLV 23
Figure 10: Jacket Removal using BTAs 24
Figure 11: Jacket Footings - Degradation Rates 25
Figure 12: Removal of Jacket Section 26
Figure 13: Diamond Wire Cutting Tool 27
Figure 14: Abrasive Water Jet Tool 27
Figure 15: Hydraulic Shears 28
Figure 16: Section of Jacket Lifted Using Clamps 29
Figure 17: Backloading Jacket Sections onto Barge 30
Figure 18: Refloating the DP2 Jacket using BTA’s 31
Figure 19: Typical Jacket Sections in Yard 31
Figure 20: Murchison Jacket Footings – Components 39
Figure 21: Lifting Configuration for Jacket Bottle Legs 40
Figure 22: Restraints on Access into Piles to Recover Debris 41
Figure 23: Excavation under Footings 42
Figure 24: Murchison Decommissioning Indicative Schedule 59

List of Appendices

Appendix 1: Comparative Assessment Criteria 67

Appendix 2: Summary of Stakeholder Responses to the Statutory Consultation.................................... 70

Appendix 3: The Independent Review Consultant (IRC) 75

CNR International

Preface

This document supports a proposal by the owners of the Murchison Field in Block 211/19 in the UK sector of the Northern North Sea to leave *in situ* the footings of the Murchison platform's steel jacket under the terms of the OSPAR Decision 98/3 on the disposal of disused offshore installations.

Murchison Decommissioning Programmes have been submitted to the UK Government's Department for Energy and Climate Change (DECC) for consideration. A full version of the decommissioning programmes together with supporting documents, comprising an Environmental Statement, Comparative Assessment Report, Stakeholder Engagement Report and the Independent Review Consultants Report, are available at www.cnri-northsea-decom.com .

This document summarises the basis for the recommendation that the Murchison jacket footings should be left *in situ* and has been prepared by CNR International (UK) Ltd (CNRI) as Operator on behalf of the Murchison Owners (Co-venturer Wintershall Norge AS) and other (non-equity) companies listed under the Petroleum Act as section 29 Notice Holders.

Table 1: Murchison Platform Section 29 Notice Holders

Section 29 Notice Holders
CNR International (U.K.) Limited
Wintershall Norge AS
AS Norske Shell
AS Norske Shell (formerly Enterprise Oil Norge Ltd)
Statoil Hydro ASA
Maersk Oil North Sea U.K. Limited
Norske ConocoPhillips AS (Dissolved)
Mobil Development Norway AS (Dissolved)
Exxonmobil Exploration and Production Norway AS
Exxonmobil Production Norway Inc.

In preparing this application, cognisance has been taken of comments raised by OSPAR Contracting Parties to previous derogation applications particularly relating to the potential risk to fishermen, requirements for post decommissioning monitoring and the impact of developing technology.

Terms and Abbreviations

Abbreviation	Explanation
BTA	Buoyancy Tank Assemblies
CA	Comparative Assessment
CNRI	CNR International (UK) Limited
CSV	Construction Support Vessel
DECC	Department of Energy and Climate Change
EDC	Engineer Down and Clean
DPN	Disused Pipeline Notification
EIA	Environmental Impact Assessment
EL	Elevation
FLTC	UK Fisheries Offshore Oil and Gas Legacy Trust Fund Limited
HLV	Heavy Lift Vessel
ICES	International Council for the Exploration of the Sea
IRC	Independent Review Company
IRPA	Individual Risk Per Annum
LAT	Lowest Astronomical Tide
MCAA	Marine & Coastal Access Act
MODU	Mobile Offshore Drilling Unit
NLGP	Northern Leg Gas Pipeline
OPEP	Oil Pollution Emergency Plan
OGUK	Oil and Gas UK
OSPAR	Oslo Paris Convention
OSRL	Oil Spill Response Ltd
PLL	Potential Loss of Life
PON	Petroleum Operations Notice
PSA	Petroleum Safety Authority – Norway
SEPA	Scottish Environmental Protection Agency
SLV	Single Lift Vessel
SSCV	Semi-Submersible Crane Vessel
SSIV	Sub-sea Isolation Valve
te	Tonne
TBC	To Be Confirmed
UKCS	UK Continental Shelf

1.0 Executive Summary

This document supports a derogation application by the Murchison Platform Owners to remove the Murchison jacket down to the top of the footings and to leave the footings *in situ* under the terms of OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations.

1.1 The Murchison Field

The Murchison Field lies approximately 240 km north east of Shetland in UK Block 211/19 and extends into the Norwegian Block 33/9 in the Northern North Sea. The Murchison platform sits entirely within the UK Block 211/19. Decommissioning of the platform will therefore be in accordance with the UK Petroleum Act and overseen by DECC.

Oil is exported from the Murchison platform via the Dunlin A and Cormorant A platforms and finally to Sullom Voe Oil Terminal. Fuel gas is imported from a tie-in into the Northern Leg Gas Pipeline (NLGP) network.

1.2 Murchison Jacket Description

The Murchison jacket is an eight leg structure of welded steel construction measuring 75 m by 75 m at the base and 52.8 m by 62.5 m at the top. The jacket was installed in 1978 and supports topsides weighing 24,584 te. It stands in 156 m of water, with a further 10 m rising from the water line to the underside of the module support frame,

The weight of the jacket during installation in 1979 was 25,000 te. The weight of the jacket (if fully removed and assuming foundation piles are cut 3 m below the mud line) is 27,584 te. The difference in weight is due to grout connecting piles to the jacket and the weight of marine growth accumulated over 35 years.

1.3 Jacket Decommissioning Options

Two options for decommissioning the Murchison Jacket were taken through a formal comparative assessment process:

a) Full removal of the jacket (removal weight 27,584 te), with foundation piles cut 3m below mud line level;
b) Partial removal of the jacket down to the top of footings (removal weight 14,854 te) at -112m below Lowest Astronomical Tide (LAT). The jacket footings, weighing 12,730 te, would be left in place and subject to periodic survey and monitoring.

For each jacket removal option a series of decommissioning methods[1] were assessed utilising both established and developing technologies. None of the decommissioning methods assessed could remove the jacket in a single piece. All methods could remove the jacket down to the top of footings in large sections and then remove the remaining footings in smaller sections.

1.4 Drill Cuttings Pile

The drill cuttings pile at Murchison lies predominately within the area of the jacket footings, covering a total area of approximately 6840 m^2 and with a volume of approximately 22,545 m^3. As a consequence:

a) Full removal of the jacket would necessitate the removal or dispersal of the existing drill cuttings pile that covers the jacket bottom framing levels;

[1] Further details are reported in the document Murchison Platform Removal Technology Study. DECOM-GLND-PM-STU-00042

b) Partial removal of the jacket down to the top of footings would facilitate leaving the cuttings pile in situ and undisturbed to degrade naturally over time.

The cuttings pile was assessed against the OSPAR Management Regime for Offshore Cuttings Piles – Recommendation 2006/5. The assessment showed the Murchison values to be significantly below the OSPAR thresholds and hence the option to leave the cuttings pile *in situ* and undisturbed to degrade and to allow the seabed to recover naturally over time was taken through the comparative assessment process.

1.5 Comparative Assessment of Decommissioning Options

OSPAR Decision 98/3 recognises that there may be difficulty in removing the footings of the large steel jackets weighing more than 10,000 te that were installed before 1999. As a result there is a provision for derogation from the requirement of total removal for such jackets. Nevertheless, there is a presumption that the jacket will be removed entirely and derogation granted only if a detailed comparative assessment of options and consultation with stakeholders demonstrates that there is no better alternative disposal option.

The Murchison Platform Owners developed a comparative assessment framework for conducting a detailed evaluation of the full and partial removal options for the jacket. The framework is based on the high-level framework outlined in OSPAR Decision 98/3 and the UK Department of Energy and Climate Change (DECC) Guidance Notes. It adopts the five main assessment criteria prescribed in these sources – Safety, Environment, Technical, Societal and Economic – and appropriate sub-criteria chosen in light of the specific Murchison facilities.[2]

DECC's Decommissioning Guidance Notes also define requirements for independent verification of the comparative assessment process. The purpose of such verification is to confirm that data used are sound and appropriate, the assessment reliable, the comparative assessment process is both rigorous and transparent and the chosen decommissioning option supported by credible and verifiable data. A review of the Murchison Comparative Assessment process and procedure was conducted by Independent Review Consultants (IRC) during 2011/2012 and their verification report has since been published online at http://www.cnri-northsea-decom.com.[3]

In summary, the comparative assessment for jacket removal options found there is a significant increase in operational safety risk, technical complexity and cost associated with full jacket removal of the Murchison jacket, compared to partial jacket removal.

The equipment and techniques required for removing and recovering the Murchison jacket footings do not have a demonstrable track record, giving rise to significant uncertainties. There is therefore a higher probability of project failure for full jacket removal compared to partial jacket removal.

While partial removal of the Murchison jacket creates a physical obstruction for fishing activity, however, Murchison is not a major fishing ground compared with other areas of the North Sea. The fishing effort in the Murchison area is contained within the ICES rectangle 51F1, approximately 900 nm^2 or 3,091 km^2. The obstruction caused by the Murchison footings with a footprint of less than 0.01 km^2 is small compared with the size of 51F1.

The increase in snagging risk to fishermen would be mitigated by supporting the programmes set up by the UK Fisheries Offshore Oil and Gas Legacy Trust Fund (FLTC). FLTC sponsors the FishSafe system that provides up-to-date electronic mapping of oil and gas subsea and surface infrastructure in UK waters which may be a potential hazard to fishing vessels or their equipment. The jacket footings would

[2] Details of the Comparative Assessment Process criteria and sub criteria are given in Appendix 1
[3] Copies of the IRC Expert Verification Statements are given in Appendix 3

also be marked on Admiralty Charts and subject to a continuing programme of inspection and monitoring through a regime to be agreed with DECC.

Whilst both full removal and partial removal options cause some environmental disturbance this is localised and of short duration. There is no significant difference in the energy and emissions between options when implications of replacing the material left on the seabed are factored in.

The Murchison Platform Owners consider the difference between full and partial removal of the Murchison jacket to be material and significant and therefore recommend that the jacket is removed down to the top of the footings (-112m LAT) with the top section(s) recovered and returned to shore for reuse, recycling or disposal.

1.6 Stakeholder Engagement

The recommendation to remove the jacket down to the top of footings was tested in consultation with stakeholders both during extensive pre-engagement as well as during the statutory consultation period required by the Petroleum Act 1998.

In addition to the tailored approaches and bilateral discussions held with stakeholders, a website www.cnri-northsea-decom.com was set up as a means of communicating with a wider audience as well as to facilitate the sharing of information and dialogue. Reports of stakeholder engagement workshops held for multiple participants were also published on the website to assist with this. It was also an important vehicle for the statutory consultation on the Murchison decommissioning programmes which took place from May to July 2013.

The programme reflected the commitment of the Murchison Owners to meaningful and transparent engagement with the full spectrum of stakeholders. There were no significant objections to the proposals that form the basis of this derogation application.

1.7 Programme Management

Following completion of decommissioning activities a post decommissioning environmental survey will be executed alongside a programme of debris recovery and independent verification of seabed state. The results from these post decommissioning surveys will be used to agree, with DECC, the future decommissioning monitoring and survey regime.

The Murchison footings which are proposed to be left in place remain the property of the Murchison owners who will retain responsibility for the subsequent management of on-going residual liabilities including managing and reporting the results of the agreed post-decommissioning monitoring evaluation and remedial programme.

CNRI will manage the decommissioning programme for and on behalf of the Murchison Platform Owners.

The Murchison decommissioning programme will commence with well plug and abandonment starting in late 2013, with removal operations commencing in 2016 and running through to 2019/20 depending on operating windows agreed with the appointed contractors.

2.0 Description of the Murchison Field

The Murchison Field lies within UK Block 211/19 and extends into the Norwegian Block 33/9 in the Northern North Sea. The Field is approximately 240 km north east of Shetland and the platform stands in 156m of water.

Murchison was discovered in 1975 and received development approval in 1978 for a single drilling production and accommodation facility. The platform was installed and production started in 1980, initially from three subsea wells tied back to the main platform. Subsea tie-backs to the three remote wells were used to support early production until the platform wells were brought on stream. Oil is exported to the Dunlin platform and then onto Cormorant A and finally to Sullom Voe. Fuel gas is imported from a tie in into the NLGP network.

A Cessation of Production (CoP) application was submitted to DECC in 2011 and approved in 2012 with actual cessation of production expected during the first quarter of 2014.

The Playfair Field lies approximately 5km north of the Murchison Field and is 100% owned by CNRI. Playfair was developed as an extended reach well drilled from the Murchison platform. The Murchison platform also supports production from the Norwegian Delta reservoir which is 100% owned by Wintershall Norge AS (Wintershall) through a single well drilled from the Murchison platform.

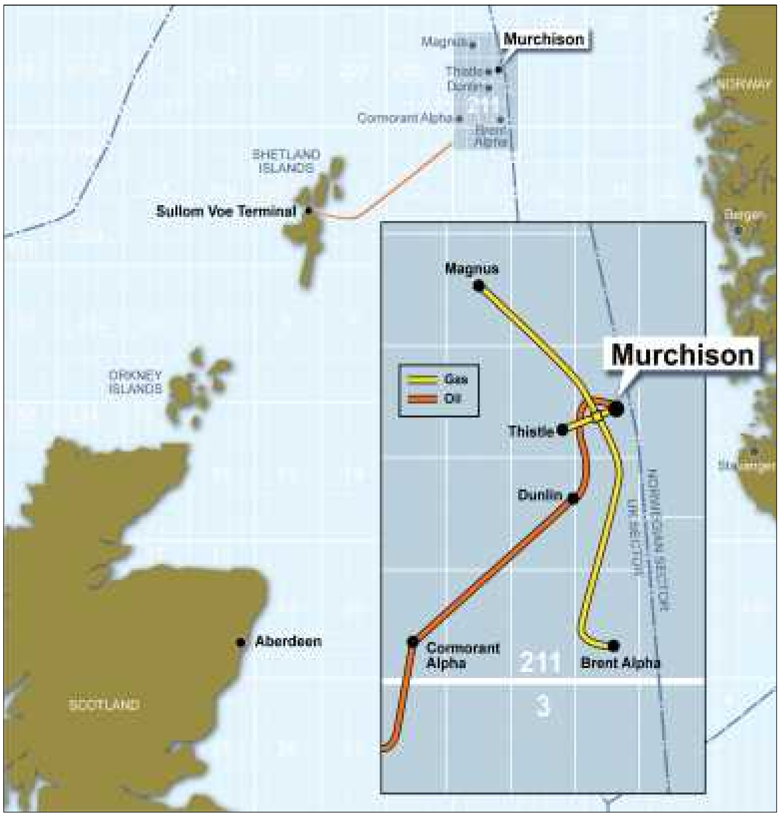

Figure 1: Murchison Field Location

The Murchison Field infrastructure and tie into adjacent facilities is shown in Figure 2 below.

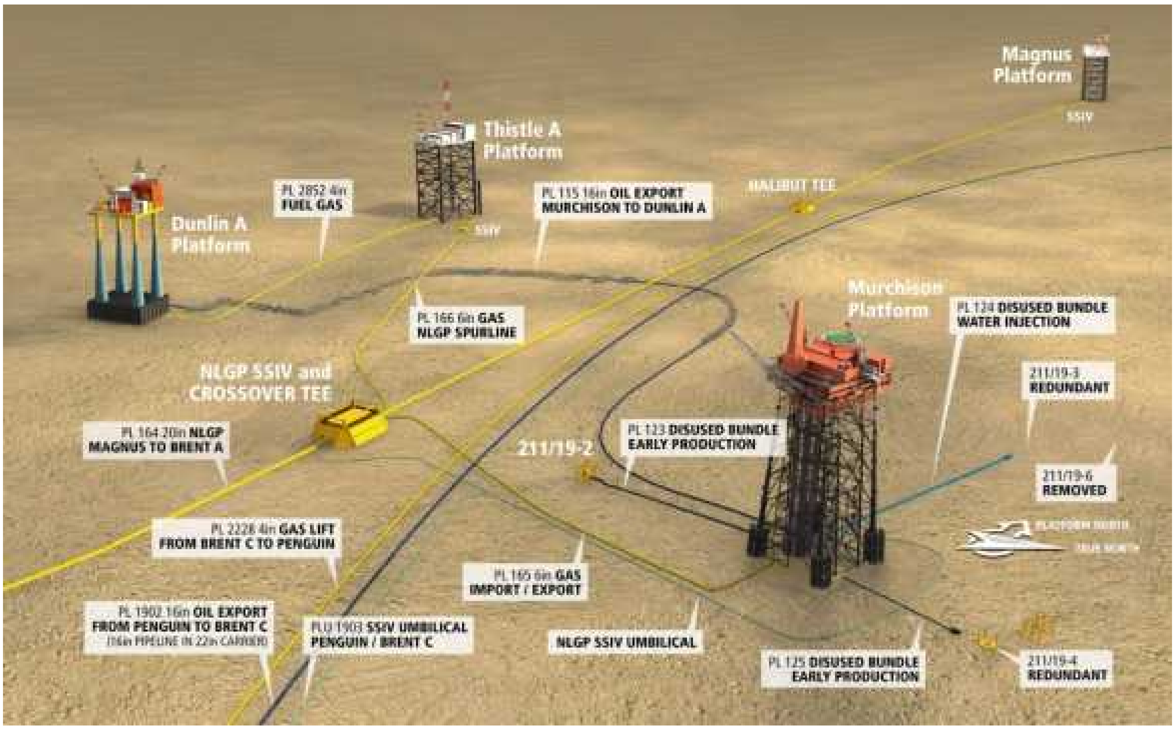

Figure 2: Murchison Infrastructure Layout

2.1 Decommissioning Recommendations

The Murchison Field decommissioning programmes, submitted to DECC in 2013, describes the proposed activities, namely that:

1. All platform and subsea wells will be plugged and abandoned in accordance with Oil & Gas UK Guidelines.
2. The platform topside modules will be removed and returned to shore for reuse, recycling or disposal.
3. The recommendation that the jacket be removed down to the top of footings at 44 m above the seabed (EL -112m LAT) and returned to shore for reuse, recycling or disposal. The jacket footings would then be left in place.
4. The drill cuttings pile located within the jacket footings will be left *in situ* to degrade naturally with time.
5. The short early production pipeline bundles and associated subsea equipment will be removed and returned to shore for recycling or disposal.
6. The main oil export line (PL115) which is surface laid will be left *in situ* with remedial rock placement over exposed sections. The main pipeline tie in spools, at either end, will be removed and returned to shore for recycling or disposal.
7. The Murchison gas export/import pipeline (PL165) which forms part of the NLGP system will be isolated at the Murchison subsea riser tie-in spool as part of the Murchison decommissioning programmes. The pipeline (PL165) is owned by the NLGP parties and does not form part of the Murchison decommissioning programmes.

8. On completion of the decommissioning programmes a seabed survey will be undertaken to identify oilfield related debris within the platform 500 m zones and a 200 m wide corridor along each pipeline. All items of oilfield debris will be categorised and in consultation with DECC a management and recovery plan will be agreed. Following completion of the recovery plan, verification of seabed clearance by an independent organisation will be carried out.
9. On completion of the decommissioning operations a post decommissioning environmental and pipeline seabed survey will be undertaken the results from which will inform requirements for the subsequent monitoring and survey regimes. This will include monitoring of the footings if the recommendation to leave *in situ* is granted.

Figure 3 illustrates the infrastructure which will be left in place in the Murchison Field post-decommissioning on the basis of the recommendations outlined above.

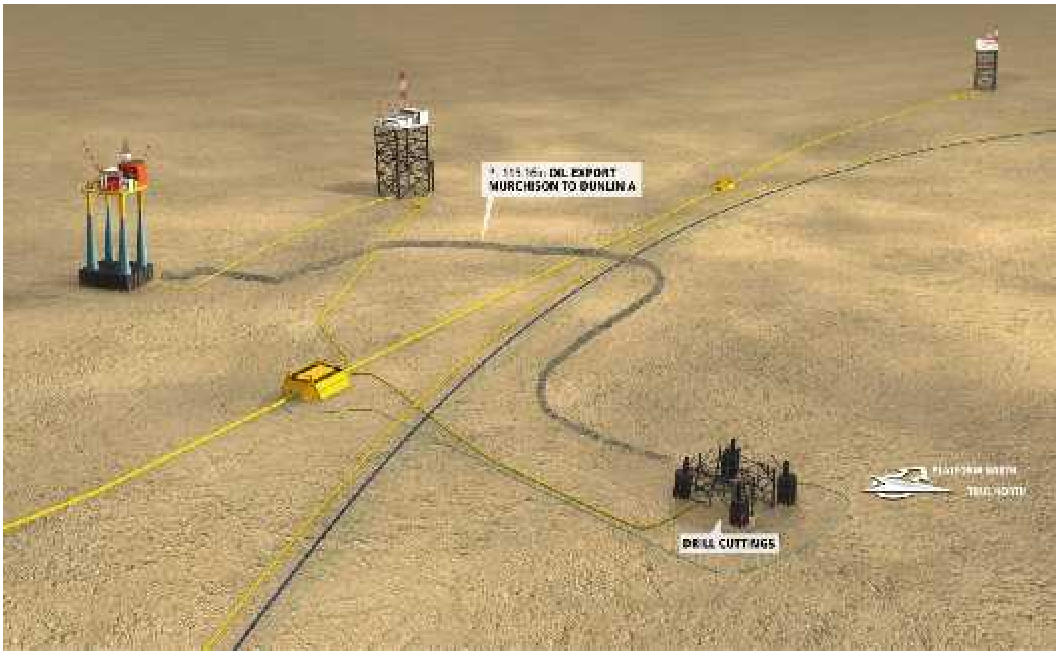

Figure 3: Murchison Infrastructure Post Decommissioning

3.0 Description of the Murchison Jacket

This section describes the characteristics of the Murchison steel jacket including its related parts, material inventories and condition survey data.

3.1 Jacket Structure Description

The jacket is an eight leg structure of welded steel construction, measuring 75 m by 75 m at the base and 52.8 m by 62.5 m at the top. The overall height of the jacket is 162 m.

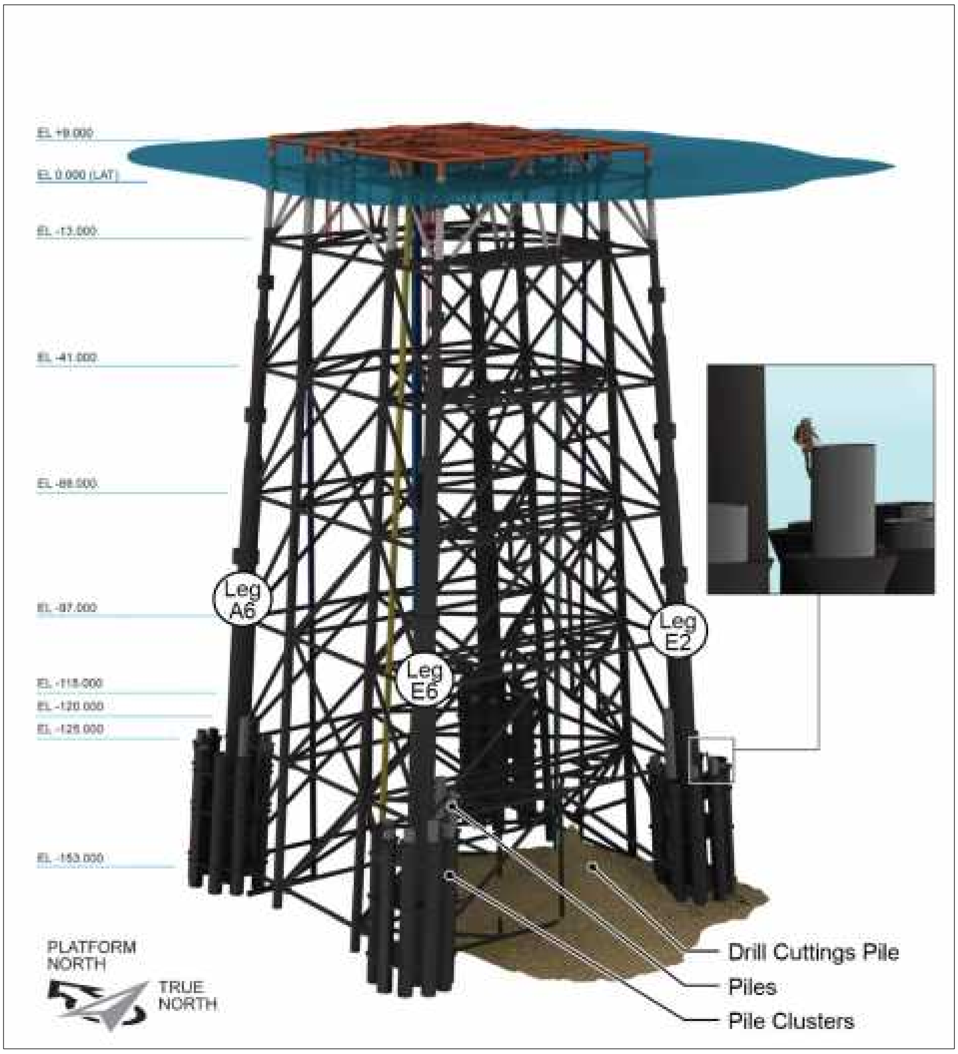

Figure 4: Jacket Elevation

The main jacket legs have a diameter of 2 m at the water line increasing to 6 m diameter at the seabed. Two of the corner legs (the north east leg E2 and the south east leg A2, not labelled in Figure 4 but visible between legs E6 and E2) are currently used for diesel storage. The storage area extends from the underside of the module support frame down to a waterproof diaphragm at -81 m. The diesel will be removed prior to decommissioning as part of the engineering-down and clean programme. The weight of the jacket during installation was 25,000 te. The weight of the jacket to be removed, assuming foundation piles are cut 3m below the mud line is 27,584 te. The weight of the jacket to be removed down to the top of the footings is approximately 14,854 te.

The jacket foundations consist of 32 piles in pile clusters of eight[4] around the four corner legs of the jacket. Each pile is 82 inches (2.08 m) in diameter and 80 m in length and was designed to be driven some 50 m into the seabed. The piles are thick-walled, hollow steel-tube construction.

The piles were driven through pile sleeves and connected to the jacket by shear plates. Steel mud mats were attached to the base of the jacket and pile sleeves to provide temporary foundations after the jacket had been installed and before the piles had been driven to the required depth.

The piles, sleeves, mud mats and jacket leg sections are collectively referred to as the 'bottle assemblies'. The 'footings' are those parts of jacket which are below the highest point of the piles which connect the jacket to the sea bed. On Murchison, the highest point of the piles is -112 m below LAT or 44 m above the seabed.[5]

3.2 Inventory of Material

Table 2 gives details of the estimated material in the jacket.

Table 2: Jacket Material Inventory

Component	Weight (te)
Structural steel Jacket	14,439
Jacket appurtenances	4,858
Timber in launch runners	40
Piles	4,243
Sacrificial anodes (zinc –aluminium alloy)	501
Grout	1,109
Densitometers	Negligible
Bundle towheads	18
Marine Growth	2,394
Total (Full removal to -3m below mud line)	27,584

3.3 Installation of Jacket

The Murchison jacket was fabricated in the McDermott yard at Ardersier on the east coast of Scotland in 1978.

The individual frames of the jacket were assembled horizontally at ground level. The inner two jacket frames were strengthened to provide the launch trusses that take the whole jacket load during loadout of the jacket over the quay edge onto the cargo barge and the launch of the jacket when at the offshore location.

[4] The eight piles per leg are inserted into eight of the nine pile sleeves clustered around each leg. The ninth pile sleeve is designated a 'spare'

[5] The height of the piles was measured during a survey in 2010, see document reference MUR-ISS-SU-REP-15406

The four bottle leg assemblies (see Figure 5) each comprising part of a jacket leg, pile sleeves, connecting plates and ring stiffeners were fabricated in Japan and transported to Ardersier for assembly into the main jacket framework. The great size and weight of the bottle legs proved problematic during jacket assembly, resulting in the failure of one crane and the need to erect a purpose designed portal frame utilising strand jacks to lift and finally position the bottle leg assemblies within the jacket structure.

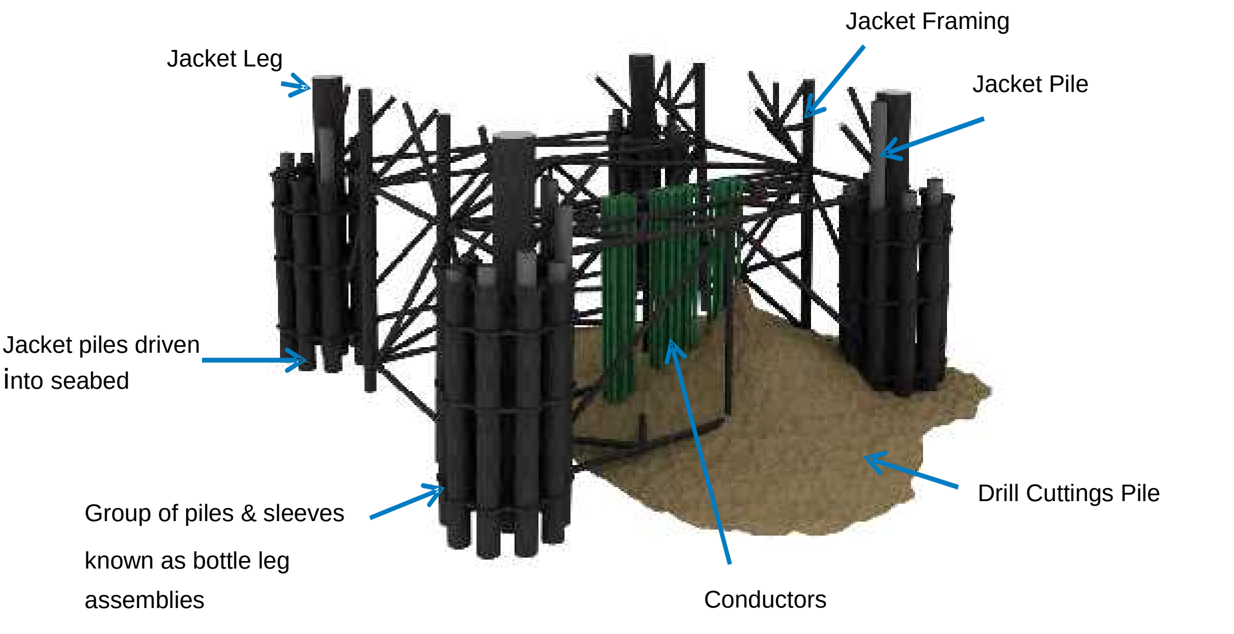

Figure 5: Jacket Footings

The jacket was fabricated to facilitate loadout onto a sea-going cargo barge. Before loadout, temporary buoyancy tubes were located in the jacket pile guides[6] and the ballast control system was installed and commissioned.

After loadout and transportation to the Murchison location the jacket was launched, upended using a system of ballast control lines to execute a controlled flooding of the jacket legs. Once confirmed in its correct position, final ballasting was undertaken to position the jacket on the seabed.

Each of the 32 piles was driven using a steam hammer and pile followers to a design penetration of 50 m beneath the seabed. The actual penetrations achieved varied from 40m to 50m. After the piling was completed the piles were connected to the jacket by injecting grout between the pile and the pile sleeve.

The grouting process was monitored using two grout densitometers fitted to each pile sleeve. The grout densitometers contain the radiation source Caesium 137 and a detector attenuated by the material flowing in the pile/sleeve annulus. The degree of attenuation is calibrated with grout density and hence strength. The densitometers were located on the face between the pile sleeve and jacket leg to provide protection during jacket launch.

[6] Most of the upper jacket pile guides were removed after installation of the jacket

3.4 Jacket Survey

Jacket condition surveys were completed in 2011 and 2013.[7] The General Visual Inspection (GVI) reported the jacket structure to be in a good condition with no gross damage or significant distortions apart from damage to a horizontal brace on failure of the produced water caisson in 2013. Key conclusions of the survey for the comparative assessment process were noted as follows:

a) All 32 piles in four clusters of eight per leg were inspected. 25 piles have internal access for excavating the soil plugs and cutting the piles below seabed level but seven were found to have debris located within the pile which would have to be removed before a cutting tool could be run inside the pile;

   The height of each of the 32 piles protruding above the pile sleeves in which they are located was measured. The level of the highest pile (A2/7) was at an elevation of approximately 112 m below sea level (LAT). This level sets the datum for the top of footings;

b) The 72 grout densitometers fitted to the pile sleeves were found to be in good condition although access was severely restricted by extensive *Lophelia pertusa* marine growth;[8]

c) Flooded member checks were completed, the inner jacket legs being flooded, whilst the corner legs were dry with the exception of the top compartments in legs A2 and E2 which are used for diesel storage;

d) The jacket launch truss timber runners were found to be in good condition with no visible damage;

e) A debris survey within the 500 m safety zone identified 345 targets in excess of 1 m in length by 1 m in width and/or height. The debris comprised a mixture of 164 oilfield related objects and 181 naturally occurring boulders. A final debris survey will be undertaken post decommissioning;

f) Periodic surveys have confirmed details of the extent and type of marine growth on the jacket structure and related parts.

During 2013 a produced water caisson failed, coming away from its attachment stubs and severely damaging some of the conductor guide frame bracing at the -13 m LAT elevation. The caisson lodged within the jacket footings. The resulting damage presents a hazard to ROV and diving operations in the immediate area.[9] Periodic surveys are planned through 2013 and 2014 to detect any major spread of damage. Detailed assessment reports on any impairment of structural integrity are currently being compiled.

3.5 Drill Cuttings Pile Description

During the life of the platform drill cuttings have been discharged to the sea. Of the 33 well slots drilled in this field, oil based mud (OBM) was used and discharged with drill cuttings at half of the wells. A proportion of these discharged drill cuttings and drilling mud now exists as a pile on the seabed immediately below the jacket, covering the bottom bracing. Mapping of the drill cuttings pile at Murchison using Multibeam Echo Sounder indicate that the pile covers a seabed area of 6,840 m^2 and has an estimated volume of 22,545 m^3

OSPAR recommendation 2006/5 indicates that if the oil release rate from a cuttings pile is less than 10 te/yr and the area of persistence is less than 500 Km^2years then the best environmental option for the management of the pile is to leave it in place undisturbed to degrade naturally.

[7] For details see Murchison Platform 2010 ROV Structural Inspection Report document reference. MUR-ISS-SU-REP-15406
[8] For the implications of restricted access see Application for Assessing the Removal of the Murchison Densitometers. MURDECOM-CNR-EN-REP-002 (application presented to Scottish Environmental Protection Agency (SEPA)
[9] ISS Structural Inspection Field Report UK-P936 - 2013

Total annual oil loss from the Murchison Pile is predicted to be 1.2 te/year (this value includes both loss to the water column and loss by biodegradation); the persistence is predicted to be 25 km^2years. These Murchison results are significantly below the OSPAR thresholds of 10 te/year and 500 km2years.

It is also important to recognise the interaction between the cuttings pile and jacket removal options. If the jacket is removed fully then 22,545 m^3 of drill cuttings would have to be removed to expose the jacket's lower framing. If the jacket is removed down to the top of footings at -112 m LAT and the conductors cut down to -124 m LAT, then the cuttings pile would be left undisturbed. (The conductors would be cut just above the conductor guide frame which is at -125 m, i.e. lower than the cut height of the jacket, to provide additional long term support to the conductors.)

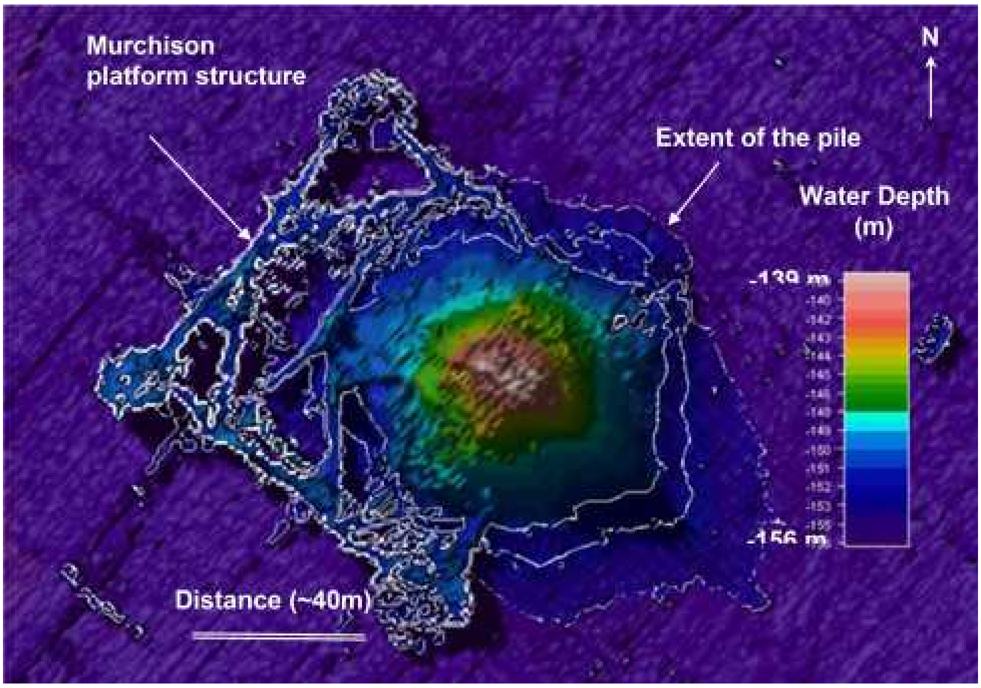

Figure 6: Murchison Drill Cuttings Pile

4.0 Jacket Decommissioning Options

This section of the report describes the practical availability of reuse, recycling and disposal options for all or part of the Murchison platform.

4.1 Re-use

In line with the waste hierarchy, the Murchison Owners considered the re-use of the installation (or parts thereof) as the first in the order of preferred decommissioning options.

Options were assessed for extending the producing life of the platform, utilising it as an infrastructure hub for third party tie backs and enhanced recovery programmes. However, none proved commercially viable and a Cessation of Production application was ultimately submitted to DECC in 2011 and approved in 2012.

Options were also assessed for the relocation of the platform as a producing asset but concluded that due to its ageing process technology (1978 design), high cost of maintaining the fabric and structural integrity of the 35 year old platform, there was no technically viable reuse option available.

Alternate uses for the Murchison facilities for power generation using wind energy, wave and tidal energy and reuse for carbon capture and storage were all considered but no alternative use option was economically viable.

Studies into alternative use opportunities outside the energy sector were carried out including:

- Marine research
- Diver training centre
- Fish farm
- Offshore infrastructure hub

None of the alternative use options was found to be commercially viable and hence were not taken forward into the comparative assessment process.[10]

4.2 Leave *in situ*

Notwithstanding the requirements of OSPAR Decision 98/3, following suggestions from key stakeholders during the formal consultation process the Murchison Owners considered the advantages and disadvantages of leaving the entire jacket *in situ* after removing the topside facilities and returning them to shore.

[10] For further details of all re-use options see Murchison-Post CoP Alternate Use Appraisal. DECOM-GLND-PM-STU-00048

Figure 7: Jacket left in situ after removing topsides

The advantage claimed by stakeholders of leaving the entire jacket *in situ* with navigation aids above the surface of the sea, was as an aid to navigation particularly to those fishing vessels not equipped with the FishSafe marine plotter. The FishSafe system is designed to provide audible and visual warnings of surface and subsurface hazards.

The disadvantages identified by the Murchison Owners were the effect of accelerated corrosion and structural failure of the jacket members in the splash zone. Corrosion protection for the jacket is largely provided by an impressed current system supplied by the topside facilities. After the topsides are removed, the corrosion protection will be lost and corrosion rates will accelerate leading to progressive structural failure of those members subject to high wave slam loading in the splash zone. The resulting progressive collapse of the jacket to below the sea surface will lead to an increasing hazard to passing surface shipping.

The Murchison Owners concluded that the disadvantages of leaving the jacket *in situ* significantly outweighed the advantages and hence this option was not taken forward into the comparative assessment process.

4.3 Full Removal

Full removal of the Murchison jacket entails recovery of the 27,584 te of jacket and piles, with the piles cut 3 m below mudline. After removal from the original location the jacket, or jacket sections, would be transported to an onshore reception facility to be offloaded, ready for final demolition and recycling of material.

4.4 Partial Removal to Top of Footings

Partial removal of the Murchison jacket entails recovery of 14,853 te of jacket steelwork down to the top of the footings at an elevation of -112 m below LAT. After removal from the original location the jacket top sections would be transported to an onshore reception facility where they are offloaded ready for final demolition and recycling of material.

The height of the remaining jacket footings would be 44 m above the seabed with 112 m clear water above the footings.

4.5 Jacket Removal Methods Summary

The Murchison Owners commissioned an independent Platform Removal Technology Study from its experts. The purpose of the report was to summarise the oil industry's decommissioning experience, both in the Gulf of Mexico and the North Sea, and to identify the methods and equipment used. The report also identified new technology that may have an application in future decommissioning and the timeframe for its development. New technology was only considered when there was a high probability of its delivery within the Murchison project programme timeframe.

The results of the study were used to identify four potential methods for full and partial decommissioning of the Murchison Platform:

1. Removal using a large semi-submersible crane vessel (SSCV – see Figure 8), previously used to partially remove jackets of a similar configuration to Murchison;
2. Removal using a small heavy lift vessel (HLV) previously used to remove smaller unmanned platforms;
3. Removal using a new single lift vessel (SLV – see Figure 9) concept;
4. Removals using an increased capacity buoyancy tank assembly (BTA – see Figure 10) refloat method, previously used to remove a 10,000 te jacket.

A series of studies was then commissioned from specialist marine contractors to assess the feasibility of full and partial removal for each of the removal methods described below.

In the North Sea decommissioning activities have been dominated by Heavy Lift Vessels (HLVs) with a capacity up to 5,000 te and the larger Semi-Submersible Crane Vessels (SSCVs) with a capacity of up to 14,000 te.

Figure 8: Jacket Removal using SSCV

Figure 9: Jacket Removal using SLV

A number of new design Single Lift Vessels (SLVs) have been proposed over the years, many of which have not left the design stage or the developer went into liquidation before delivery of the vessel. There is only one SLV being built at present with any realistic prospect of being commercially available in a time frame that meets the Murchison schedule. This is the Allseas vessel the Pieter Schelte due for delivery in 2014 and therefore, with a jacket lift capacity of 25,000 te was considered further in the Murchison CA process.

Although not a vessel, Aker Kvaerner has developed a jacket removal method which uses external Buoyancy Tank Assemblies (BTAs) to refloat the jacket at a predetermined draft.

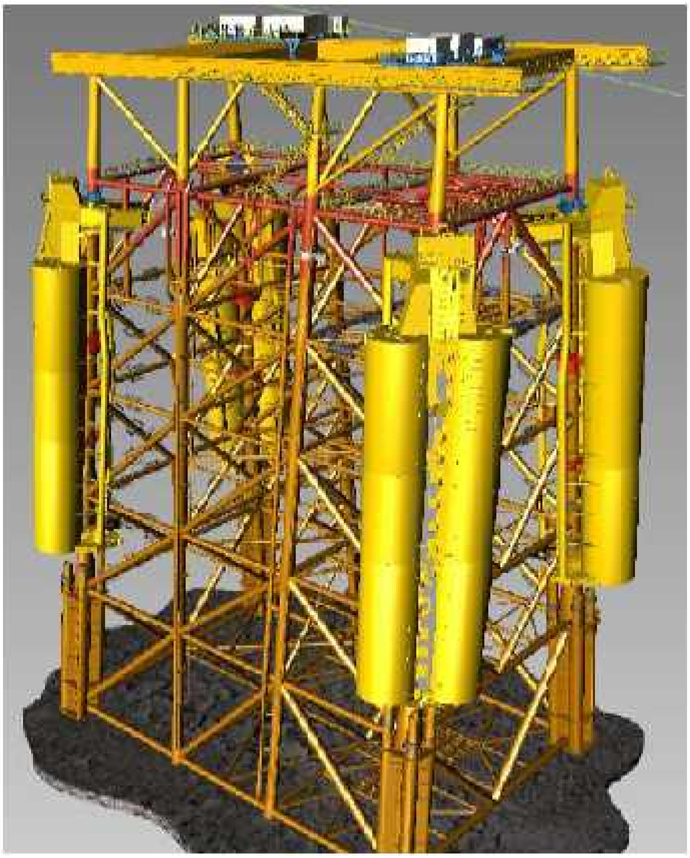

Figure 10: Jacket Removal using BTAs

The BTAs were successfully used during the summer of 2008 to remove the 12,000 te Frigg DP2 jacket. With some modification the BTAs potentially could provide an alternate decommissioning option for the Murchison jacket and were therefore considered further in the comparative assessment process.

4.6 Interaction of the Jacket Removal Options and Drill Cuttings

Some or all of the drill cuttings pile described in section 3.5 would have to be removed in order to undertake the full removal of the jacket if this option were adopted. Accordingly, different options for the management of the Murchison drill cuttings pile were assessed in order to understand the implications of having to remove the cuttings pile to facilitate full removal of the jacket structure.

The options considered included:[11]

For partial removal of the jacket:

Option 1: Leave the cuttings pile *in situ* to decay naturally over time if the jacket footings remain *in situ*

For full removal of the jacket:

Option 2: Recover the whole pile to a surface vessel for transportation to shore for separation and treatment and final disposal, or treat on the platform;

Option 3: Recover the whole pile to the platform with cuttings reinjected into one or more wells;

[11] For further details see Environmental Assessment of Options for the Management of the Murchison Drill Cuttings Pile. MURDECOM-BMT-EN-STU-00132

Option 4: Excavate and redistribute the drill cuttings pile offshore in the area immediately adjacent to the Murchison jacket.

Decommissioning of the jacket and drill cuttings pile were evaluated separately to ensure each was considered on its own merits. The interrelationship between the jacket and the cuttings pile options was assessed in the final comparative assessment workshop.

4.7 Degradation Mechanisms for the Jacket Footings

The Murchison Platform Owners commissioned specialist studies to estimate the long term degradation rates for the footings left in place in the derogation case. The jacket footing components will be subject to very low levels of loading such that corrosion will be the most significant degradation mechanism. The study assumed an upper bound corrosion rate of 0.1 mm/year and initial failure of member commencing at 50% of wall thickness loss and global failure occurring above 70% of wall thickness loss.

The estimate time to initiation of failure is shown in Figure 11.

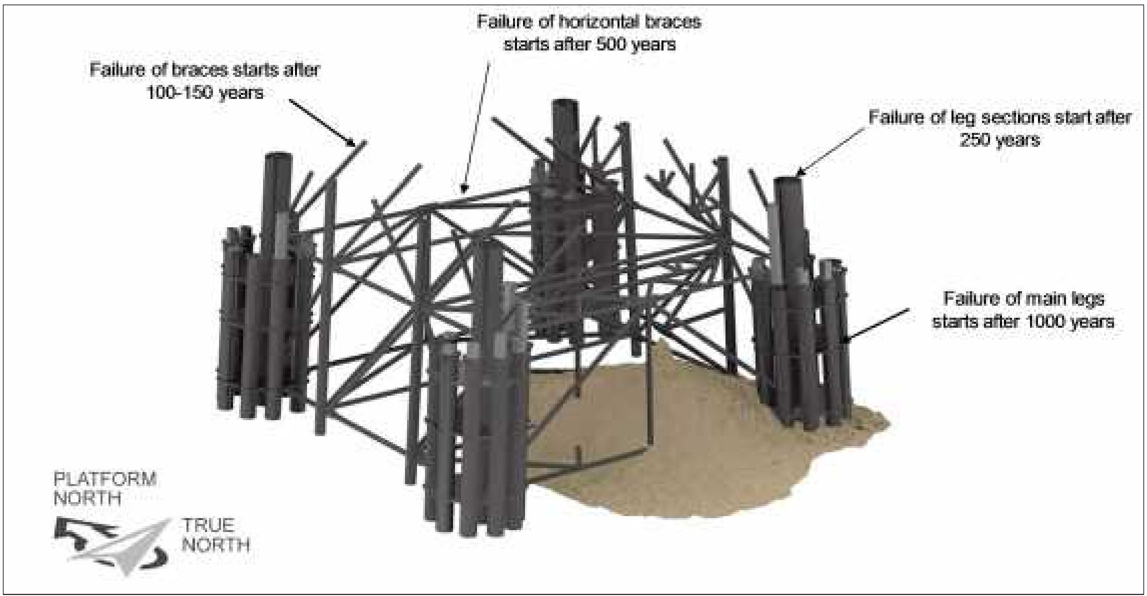

Figure 11: Jacket Footings - Degradation Rates

Due to the incline of the vertical jacket members, the failure mechanism will tend to be inboard of the current jacket footprint.

During the stakeholder consultation process, the question was raised as to whether it was feasible to accelerate the corrosion rate of the remaining structure to mitigate any long term snagging risk to fishing.

Two options were considered. The first entailed installing a cathodic protection (CP) system whereby the footings acted as the sacrificial anode. This was concluded as being unviable due to the significant amount of new cathodic material required.

The second option was to utilise the potential impact of microbial induced corrosion (MIC). MIC is typically localised and patchy in distribution, forming under marine growth e.g. barnacles, or under biofilms, and results in areas of pitting. It was concluded that bacteria tend to be active in warmer environments and that a decommissioned structure that is no longer producing heated fluids through the sub-sea infrastructure may present a colder environment and perhaps reduced bacterial growth. It was concluded that MIC could increase the overall corrosion of the footings above the predicted electrochemical corrosion rates but the effects may not be significant and hence were not considered further.

5.0 Jacket Decommissioning

This section describes the principal technical and engineering activities associated with removal of the Murchison jacket, noting that while removal methods have been considered, the actual method to be adopted has not yet been decided.

5.1 Preparation for Removal

Removal of the jacket will require a spread of marine vessels and heavy equipment, with coordination between marine operations involving surface and subsea activities in a harsh, open sea environment.

It is planned that the removal of the jacket could be undertaken a full 12 months after removal of the topside facilities. Temporary navigation lights will therefore be fitted to the jacket in any interim period in accordance with the requirements of the Northern Lighthouse Board.

Detailed engineering will be undertaken to determine the size and configuration of each section of the jacket to be removed and the structural appurtenances required to suit the selected removal method described in section 4.5. The position and timing of each cut will be determined to ensure both the integrity of the remaining jacket sections and of the section being removed whilst subject to dynamic loads imposed during lifting and backloading onto the removal vessel.

5.2 Jacket Cutting Sequence and Tools

Lifting of a Murchison jacket section, similar to that shown in Figure 12 will require the cutting of a large number of legs and brace sections of variable size. Removal of the Murchison jacket down to top of the footings will require between 65 and 120 cuts depending on the removal method deployed. Full removal will require considerably more.

Figure 12: Removal of Jacket Section

It is expected that the jacket legs would be cut using diamond wire cutters (DWC). Frame bracing could be cut using abrasive water jet cutting (AWJ) tools or upgraded hydraulic shears.[12]

The 6 m diameter leg sections at the interface between the jacket and the top of the jacket footings are beyond the capacity of existing cutting tools. New or modified cutting tools will need to be developed for the Murchison jacket.

[12] For a full description of cutting tools see "Technology for subsea cutting of Jacket members." DECOM-GLD-ST-REP-00045

Details of each of the main cutting tools available are described below.

Figure 13: Diamond Wire Cutting Tool

The diamond wire cutting tool uses a wire impregnated with diamond beads. The wire runs around a series of pulleys and is rotated as it cuts through steel sections much like a chain saw.

The larger cutting tools can weigh up to 3.5 te in air and have to be deployed subsea using rigging and remotely operated vehicles (ROVs).

Figure 14: Abrasive Water Jet Tool

The abrasive water jet cutting tools use high pressure water with entrained abrasive material to cut through structural steel.

The larger cutting tools weigh up to 2.3 te in air and are deployed using a work class ROV with a high pressure slurry hose feed from the surface.

For both the DWC and AWJ tools the main risks are associated with the reliability and verification of the cut and the safe handling and use of rigging equipment.

Figure 15: Hydraulic Shears

Hydraulic shear cutters have been used in the North Sea for jacket cutting. The shears crush the structural member between a clevis and static blade, with the shearing action developed as the blade enters the clevis. Figure 15 illustrates the use of a hydraulic shear tool.

The size and weight of the cutting equipment described above presents three main challenges:

I. Deployment and recovery of the tools from a vessel in open sea conditions;

II. Achieving safe access in and around the jacket structure while operating in water depths down to 112 m below LAT;

III. Positioning and holding the cutting tool to accurately cut the structural member in open sea conditions and at depths down to 112 m below sea level.

Operating all three cutting tools described above is subject to operational difficulties that could result in incomplete cuts. For preparatory cuts this would result in delays to reset and recut. For the final cuts during which the jacket section is rigged to the crane vessel, failure to complete a cut could result in severe risk of damage to the vessel caused by snagging or loss of control of the lift.

Contingencies to mitigate the consequences of a failed cutting operation include:

I. Detailed engineering to define cut positions and operational risk assessment;

II. Final cuts would be undertaken only in calm weather within a weather window long enough to undertake the cut and any remedial action in the event of mechanical failure or failure to complete the cut;

III. Spare cutting tools will be carried on the vessel;

IV. Alternate cut locations will be identified and prepared in the event of mechanical failure or failure to complete a cut.

V. Removal of marine growth at cut locations to allow fit of cutting tools.

Figure 16: Section of Jacket Lifted Using Clamps

Rigging sets will be designed for each of the sections of the Murchison jacket to be lifted, and installed prior to the final cuts being made.

Each rigging set would comprise rigging and hydraulic clamps, internal lifting tools or mechanical grippers as shown in Figure 16.

The rigging sets would have to be deployed positioned and attached subsea with some uncertainty on weight to be lifted and section profile caused by marine growth and the possibility of flooded members.

The failure of any part of the rigging sets could impact the lifting operation causing the jacket section being dropped back onto the remainder of the jacket, thereby making subsequent removal operations more complex. Of greater significance is the case where the jacket section being lifted is dropped onto the deck of the crane vessel causing injury to personnel on-board.

5.3 Contingent Measures

In preparing the jacket for removal, two key contingent measures have been identified, these being the use of explosives for cutting where other cutting tools have failed, or the use of divers where remote operations have failed.

5.3.1 Use of Explosives

The use of explosives for cutting jacket members is not a planned option within the Murchison decommissioning programme. However, because of the technical challenges described in section 5.2 above, the contractors nominated for the Murchison jacket removal may propose that an explosive cutting solution be considered as a contingency measure. In this event, the Murchison owners would, together with the nominated contractor, refer this contingency to DECC and the Joint Nature Conservation Committee (JNCC) prior to the deployment of any explosives offshore. All mitigation methods and procedures agreed with DECC and JNCC would be implemented and reported as part of the decommissioning programme.

5.3.2 Use of Divers

Diver intervention is not a planned option within the decommissioning programme. However because of the technical challenges described in section 5.2 above, the contractors nominated for the jacket removal may propose that diver intervention be considered as a contingency method to prepare for cutting, repair or handling of cutting or gripper tools required in order to complete the cut and recover to surface the cut section.

If divers are required for such contingencies a rigorous risk assessment would be completed prior to mobilisation of diving spreads offshore.

5.4 Removal from Field

On cutting free from the seabed, the jacket will be transported back to an onshore reception facility. If removal is undertaken using a heavy lift vessel (HLV) or semi-submersible crane vessel (SSCV), the jacket sections may be lifted, backloaded and secured onto the crane vessel or cargo barge for transport back to shore.

Figure 17: Backloading Jacket Sections onto Barge

If removal is undertaken using a single lift vessel (SLV) (as shown in Figure 9) the jacket top section, down to -112 m, would be lifted in a single piece onto the vessel jacket lift beams, rotated through to the horizontal, pulled onto the vessel deck and secured for transportation. A single lift would not be possible for the entire jacket including footings. Should an SLV be used for full removal, in addition to the main lift for the jacket, the lower portion of the jacket would need to be recovered in four lifts, each of which would incorporate one of the jacket legs – i.e. a total of five lifts.

If removal is undertaken using buoyancy tank assemblies (BTAs) to refloat a large segment of the jacket, tow bridles would be fitted to the jacket and the floating segment of jacket towed to a deep water location in Norway. The jacket would then be grounded at the deep water location and cut into smaller components and sections using cutting equipment operated from a shear leg crane.

Figure 18: Refloating the DP2 Jacket using BTA's

For full removal, the lower sections of the jacket would be recovered in small sections in a similar way to that for the HLV or SSCV methods.

5.5 Onshore Disposal

The recovered sections of the Murchison jacket will be returned to an onshore reception site for final demolition treatment and disposal. The Murchison project will enact the waste hierarchy by which material will be reused and recycled in preference to disposal.

Figure 19: Typical Jacket Sections in Yard

The onshore reception facility will be managed by licensed contractors at licensed sites with all the necessary permits, consents and licenses in place. The reception yard will be audited as part of the contract award process and a duty of care will be exercised throughout the decommissioning programmes using the appropriate assurance process.

The Murchison Platform Owners have declared an aspiration to reuse or recycle in excess of 95% of the jacket material recovered to shore. This will be achieved through contractual arrangements and other incentives with the selected reception site operator.

On completion of the decommissioning programme a material reconciliation report will be compiled identifying the quantities of material landed compared with the quantities and end points of material reused, recycled and disposed to landfill or hazardous waste treatment plants.

The different jacket removal methods described in section 4.5 will impose different requirements of the reception yard, whether this is yard capacity, water depth, quay strength or the method of offloading from the removal vessel. For this reason the Murchison Platform Owners have requested that each contractor bidding for the jacket removal contract nominates a reception yard that is compatible with his removal method and equipment and meets the environmental requirements and targets listed above.

6.0 Comparative Assessment

This section of the report describes the comparative assessment (CA) process carried out by the Murchison owners in order to reach reasoned conclusions for the jacket removal options.

6.1 Options considered in the Comparative Assessment

Two options were carried through the formal consultation process, these being:

a) Full removal of the jacket down to 3 m below the mudline, with the recovered structure returned to shore, for recycling and disposal;

b) Partial removal down to the top of footings at -112 m LAT. The top section of the jacket would be recovered to shore for recycling and disposal, whilst the footings would be left *in situ* to degrade naturally over time.

Each option was assessed using the four removal methods described in section 4, i.e.:

a) Removal of the jacket in large sections using a SSCV, which represents current practice using the capacity of existing large crane barges to lift and recover large sections of the jacket;

b) Removal of the jacket in small sections using a HLV, which represents the capacity of the existing small crane barges to lift and recover jacket in small pieces;

c) Removal of the jacket in a SLV, which represents new emerging technology yet to be proven;

d) Removal of the jacket in a single lift using BTAs, which represents a significant development of existing technology.

6.2 Comparative Assessment Methodology

A method statement was developed to outline a framework for conducting detailed comparative assessment for the evaluation of alternative disposal options during the decommissioning planning process. The framework is based on the high-level framework outlined in OSPAR Decision 98/3 and the DECC Guidance Notes. It adopts the five main assessment criteria prescribed in these guidelines:

a) Safety

b) Environment

c) Technical

d) Societal

e) Economic

Appropriate sub-criteria were chosen in light of the specific Murchison jacket attributes, described in more detail in Appendix 1.

Independent Review Consultants (IRC) were appointed to review the Murchison CA process and to verify that the process would deliver robust scientifically based conclusions based on the five assessment criteria described above. The IRC expert verification certificate is included at Appendix 3.

6.3 Studies Undertaken[13]

Study contracts were awarded to four specialist marine contractors with equipment as described in section 6.1 above. The contractors were required to review existing data on the Murchison structure including as-built and as-installed historic records from which they identified data gaps that were subsequently resolved during offshore surveys of the Murchison platform. Each of the marine contractors

[13] A list of all the studies undertaken is given in section 11

was required to develop operational procedures for both full and partial removal of the Murchison jacket, identifying the marine equipment and personnel needed, and to develop a schedule of operation and identify risks involved in the proposed operations.

An Independent Safety Consultant was appointed to facilitate a series of HAZIDs covering the marine contactors' proposed procedures for full and partial removal of the Murchison jacket. The HAZIDs were attended by the specialist marine contractors, specialist external consultants, CNRI's internal technical authorities (TAs) and members of the Murchison decommissioning project team. The HAZID results informed the identification of the major accident events appropriate to each decommissioning option from which quantitative risk assessments (QRA) were undertaken to derive Potential Loss of Life (PLL) figures.

Other specialist consultants were appointed to assess the impact of the jacket decommissioning options on fishing in the Murchison area and to assess the probability and consequences of snagging risks to fishermen for the jacket partial removal option.

Following an initial environmental baseline survey and the marine contractors' studies, a series of specialist environmental studies were undertaken to assess the related impact on seabed disturbance, energy use and emissions resulting from the different jacket options, the effect of noise and socioeconomic impacts to other users of the sea. A summary of the environmental studies impact assessment undertaken is given in section 7.

6.4 Independent Review

The IRC, in addition to reviewing the CA process and procedures, also reviewed all the studies undertaken that would inform the CA process. The review was to ensure the adequacy of scope and methodology, clarity, completeness, relevance and objectivity of conclusions.[14]

An experienced independent Marine Warranty Consultant (MWC) was also appointed to review the removal contractors' method statements to ensure they were complete in scope and utilised good marine practice.[15] This review also assessed the level of maturity of new technology systems using the DNV Recommended Practice for the Qualification of New Technology (DNV-RP-A203).

6.5 Specialist Review Workshops

Results from the detailed studies were reviewed and assessed in a series of specialist workshops.[16] The workshops were attended by qualified members of the Murchison decommissioning project team, members of the contractors who originated the study reports, company technical authorities and specialist external advisors. Each workshop was run by an independent chairperson and secretary. The objective of each workshop was to evaluate the conclusions from the studies and to score the options accordingly.

6.5.1 Safety Workshops

A Quantitative Risk Assessment (QRA)[17] was used to establish the Potential Loss of Life (PLL) for each of the four removal methods described in section 4.5, each covering the options for full removal and partial removal down to top of footings. The individual marine contractors provided estimates of the number of personnel involved in each work task, the associated marine spread and the task duration.

[14] The IRC report can be seen in Murchison Decommissioning Comparative Assessment – Final IRC Report. MURDECOM-XDS-PM-REP-00062
[15] The MWC report Evaluation of Removal Options for the Murchison Jacket. MURDECOM-GLND-PM-REP-00008
[16] For detailed records of each of the workshops see the list of Comparative Assessment & Stakeholder Workshops listed under the Reference Documents of this document
[17] Murchison Jacket Decommissioning Options – QRA Report DECOM-WHF-SA-REP-00113

The boundary for the QRA analysis included the preparation of the jacket for removal, removal, tow and transport to onshore reception facility and offloading over the quay edge into the facility yard and final demolition. The risk figures have not taken into account the potential use of divers (see section 5.3.2) which would be likely to increase the PLL figures. This is more likely to impact the full removal options due to the greater potential for technical risks requiring diver intervention (see section 6.5.3 below).

The principal risks associated with the different removal options result from the following hazards:[18]

- Structural failure of jacket sections, leading to jacket instability, problems with securing seafastening in preparation for transport to shore, failure of rigging and or attachments leading to dropped objects impacting remaining jacket removal operations. As there will be an increased number and complexity of lifts for full removal, the risk of failures will increase;
- Dropped objects or swinging loads during lifting operations, falling debris, and failure to set down safely on the deck of the lift vessel. Full removal will entail a greater number of lift operations than partial removal and hence greater risk exposure to operational personnel;
- Occupational risk exposure such as working at heights, basket transfers between vessels, trips and falls, lifting, cutting and material handling. Because full removal takes longer than partial removal the occupational risks to operating personnel increases in proportion;
- Severe weather impacting lifting, backloading and transportation operations. Full removal of the jacket has a longer offshore work programme than partial removal to top of footings and hence an increase risk from weather;
- Fire and explosion being associated with support activities on the heavy lift vessel. Full removal of the jacket has a longer work programme than partial removal and hence an increased risk from fire and explosion;
- Helicopter transport during crew change from the heavy lift vessels during removal operations. As full removal of the jacket takes longer than partial removal, the number of crew changes by helicopter will be greater for the full removal operation and hence carry additional risk;
- Ship/vessel collision involving one or more vessels in the marine fleet required for jacket removal, leading to vessel damage, potential injuries and aborted operations. More offshore operations or trips are required for full removal compared to partial removal of the jacket and hence a greater risk of ship /vessel collisions.

Fatal Accident Rates (FARs),[19] for each of the identified hazards, are applied to the work tasks to calculate PLL and the average individual risk per annum (IRPA). The QRA results are dependent on the number of personnel involved in the removal operation including standby and support crews, and the duration of the individual activity.

The Murchison QRA studies[20] indicated that full jacket removal has a PLL double that of partial jacket removal: 0.04 for full removal compared to a PLL of 0.02 for partial removal down to top of footings.

The increase in safety risk for full jacket removal, as measured by the PLL figure, is in part due to the longer operational durations and the increased number and complexity of heavy lifts required. The added complexity in removing the jacket footings, as described in section 6.5.3 below, increases the probability of needing to use additional contingent measures as described in section 5.3 with a corresponding increase in safety risk above the current PLL of 0.04.

Full jacket removal requires the complete removal of the drill cuttings pile (see section 3.6) to expose the jacket lower bracing members. The risk to personnel involved in recovering, treating and disposal of the

[18] For further details see Major Accident Hazard Workshop DECOM-WHF-SA-REP-00106
[19] See Joint Industry Project – Risk Analysis of Decommissioning Activities ST-20447_-RA-1-Rev03
[20] Murchison Jacket Decommissioning Options – QRA Report DECOM-WHF-SA-REP-00113

drill cuttings has not been included in the PLL for full jacket removal in order to permit a direct comparison with the partial removal option. Drill cuttings are classified as hazardous waste and require special precautions and procedures onshore and offshore in order to manage the additional safety risks to operational personnel.

The increased risk to personnel in removing and recovering the drill cuttings pile arises from a number of related activities:

- Activities aboard the Murchison platform or attendant vessel to recover the drill cuttings to surface and store with handling and deployment of suction dredging equipment, pumps and hoses. There is no prior experience in removing subsea drill cuttings piles of the size of Murchison (25,454 m^3) nor from water depths of 156 m;
- Recovery of the Murchison drill cuttings pile to the surface has been estimated to take significantly more than 12 months[21] which would increase the occupational risks to offshore personnel, increase the support logistics such as helicopter flights and attendant marine vessels;
- Offshore storage and handling of up to 500,000[22] te of recovered hazardous drill cuttings slurry, including the cleaning of slurry residues on dredging equipment;
- Personnel exposed to hazardous slurry waste and the related safety issues both onshore and offshore;
- Management and cleaning of jacket sections contaminated with drill cuttings waste and the risk of cross contamination on board support vessels;
- Onshore management and treatment of the recovered hazardous waste material.

The resulting safety risk arising from the activities listed above will further increase the full jacket removal PLL above 0.04.

Leaving the jacket footings *in situ* constitutes a seabed obstacle which is a potential snagging hazard to fishermen.

A QRA assessment of the snagging risk to fishermen[23] was completed based on the level and type of fishing activity in the vicinity of the Murchison platform. The analysis estimated the annual PLL for fishermen to be 1.5×10^{-5} pa (equivalent to 1 in 65,000 years).

As described in section 4.7, the Murchison jacket footings, especially the pile foundations, could be expected to last for 1,000 years. It is anticipated that future developments in fishing gear, vessel design and fishing practice will reduce the annual PLL below the 1 in 65,000 figure over time.

The snagging risk figures over the 1000 year life of the jacket footings are particularly conservative considering the low levels of fishing in the area and the modern developments in fishing vessel sonar and positioning technology.

If the Murchison jacket footings are left in place their position will be inputted to the FLTC FishSafe System. The FishSafe marine plotter provides an audible and visual warning of the approach onto subsea hazards allowing appropriate action to be taken by the vessel to minimise the snagging risk.

It is concluded that the additional resources required and risks created to remove the jacket footings cannot be justified when compared to the fishing snagging risk.

[21] For details see CNRI Technical Note on Murchison Drill Cuttings Pile Removal Method. DECOM-CNR-EN-ETN-00102
[22] Based on a 20:1 water to drill cuttings ratio realised in current suction dredging operations
[23] Murchison Pipeline & Jacket Fishing Risk Analysis – A2710-CNR-F1-6

To summarise, the full removal PLL of 0.04 is 100% greater than the partial removal PLL of 0.02. On this basis the Murchison Platform Owners having a duty of care to reduce safety risks so far as is reasonably practicable concluded that the preferred option from a safety perspective is to partially remove the jacket down to the top of footings.

6.5.2 Environmental Workshop

Environmental impacts were considered in terms of operational impacts and long-term end point impacts associated with any infrastructure decommissioned *in situ*. The full jacket removal option scored slightly better in terms of environmental impacts of end-points as the entire infrastructure and potential contaminants would be removed, although this advantage was only considered to be of low significance.

The full removal of the jacket would also mean that the steel and concrete within the footings could be recycled, which is preferable to new manufacture of this material and is reflected in the lower energy and emissions calculated for the full removal option, despite the increased duration and level of vessel activity. However, the total energy use and atmospheric emissions estimated for all removal options were well below the energy emissions arising from one year's operation of the Murchison platform and were consequently considered to be of low significance. They therefore did not act as a decision driver.

The level of underwater noise created by vessels and cutting operations was found to be similar for both full and partial removal options. While the duration of the noise would be shorter for the partial removal options and hence these options were scored slightly better than the full removal options, this was not considered to be of significance as a decision driver between removal options.

The Murchison Owners concluded that environmental impacts associated with the different removal options did not differ significantly and that this criterion did not act as a significant driver between jacket options.

The jacket removal options were initially considered independently of the cuttings pile. However, full removal of the jacket requires the removal of the cuttings pile to gain access to lower jacket framing members. The options for drill cuttings have been summarised as:

- Leave the cuttings pile *in situ* to decay naturally over time if the jacket footings remain *in situ*
- Recover the cuttings to surface with treatment either on the platform or onshore
- Recover the cuttings to surface for reinjection down a well
- Excavate and relocate the cuttings pile away from the jacket footprint

As discussed in section 6.5.3 below there are serious questions related to the technical ability to recover the drill cuttings to surface. Of the remaining cuttings removal options relocation was considered to result in significant environmental impacts and therefore the recommended option is to leave the footings in place without disturbing the cuttings pile, allowing it to degrade naturally over time.

6.5.3 Technical Workshop

The technical workshop examined each of the removal methods ability to fully remove the Murchison jacket compared to partial removal down to top of footings.

The main criterion which separated the full and partial removal options was technical feasibility. Two principal technical drivers were identified:

I. The technical feasibility of full removal for each of the methods assessed;

II. The technical complexity of cutting piled foundations for full removal.

I. Technical Feasibility

Technical feasibility was assessed for each of the four removal methods described in section 4.5 for the full and partial removal options.

a) Using a conventional semi-submersible crane vessel (SSCV), full jacket removal in sections is within the vessel lifting capacity, albeit with complex practical issues of cutting free the foundation pile assemblies whilst maintaining structural integrity (as described below);

b) The new single lift vessel (SLV) could not remove the jacket down to the mudline in a single lift as the full weight of the jacket exceeds the capacity of the vessel systems (maximum weight of jacket at 27,584 te against a SLV capacity of 25,000 te). Further studies were undertaken[24] to assess the feasibility of changing the operating mode of the vessel, firstly, to separate and remove the top half of the jacket in a single lift and then to change the jacket lift beams into a shear leg configuration to remove the footings of the jacket. These studies were inconclusive being dependent on the final design of the vessel's jacket lift beams and the capacity of the auxiliary blocks when rated for deep water application which has not currently been determined. Alternatively the footings could be removed in sections using a SSCV as described above albeit with the same complex practical issues of cutting free the foundation pile assemblies whilst maintaining structural integrity (as described below);

c) The smaller heavy lift vessels (HLV) could remove the jacket down to the top of footings but cannot remove the footings of the jacket because of insufficient crane block lifting capacity when re-rigged for deep-water operation. The nominal 5000 te capacity main blocks are rated for less than 2,500 te when operating in 156 m of water. The weight of a single Murchison bottle leg is in excess of 3,000 te and consequently would need to be cut into smaller components. Cutting of the bottle legs into smaller sections was not considered viable due to their complex configuration. Alternately the footings could be removed in sections using a larger SSCV as described above;

d) The buoyancy tank assembly (BTA) option would be operating at close to its absolute lifting capacity and would require the reinstatement of the jacket ballast control system in the four corner legs. The maximum buoyancy capacity of the BTAs and Murchison jacket ballast system is 23,660 te which is not sufficient to refloat the full 27,584 te jacket. Even with further modifications to the existing BTAs the risk of failure for the full removal case was considered to be unacceptably high due to uncertain structural stability when towing the complete jacket in an upright position over a long tow route (160 nm or 297km) which would take three days to reach the Norwegian fjord. For partial jacket removal the top portion of the jacket (weighing 14,853 te) could be refloated and towed to a Norwegian deep water location where the jacket would be grounded and cut into small sections using a shear leg crane or a HLV.

Based on the capacities of the removal methods described above, all four methods are capable of removing the Murchison jacket down to the top of footings in one or more sections, but all four methods would require the footings to be cut and removed in sections. The total number of cuts for partial removal would be between 65 and 120 depending on the method employed, compared to 115 to 200 cuts for full removal of the jacket.[25]

The subsea cutting requires the jacket legs, braces and piles to be severed using the variety of tools described in section 5.2. Each of the cutting tools will be deployed by crane with assistance from ROVs.

Removal of the footings would require the use of much larger tools and equipment due to the configuration of the footings.

[24] See MURDECOM-ALS-ST-PRO-00024
[25] The actual number of cuts will be finalised during detailed engineering of the nominated removal method

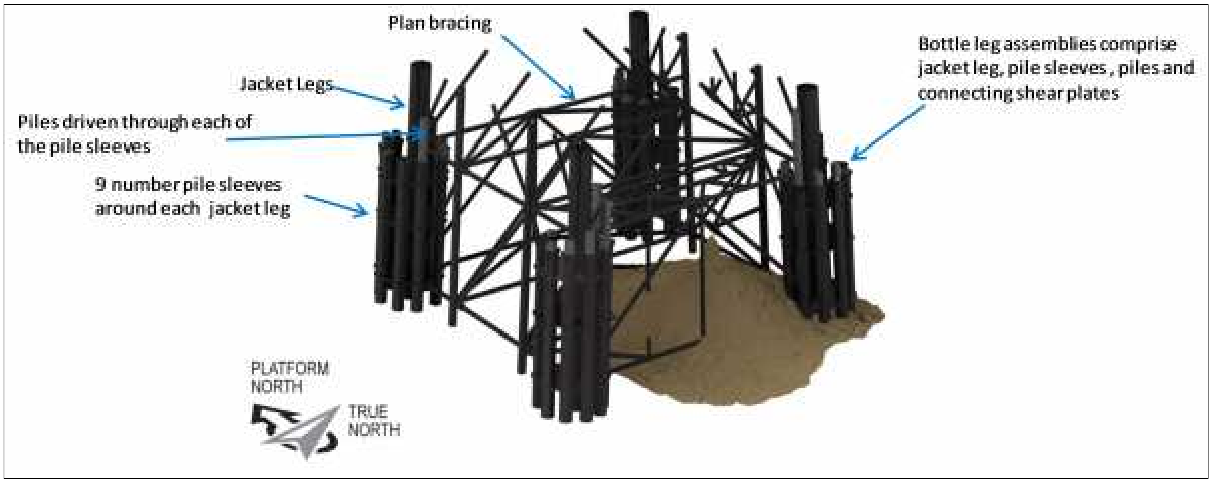

Figure 20: Murchison Jacket Footings – Components

The major items of the footings are the four bottle leg assemblies, each comprising a main leg surrounded by nine[26] pile sleeves which are connected to the legs by steel plates and a mud mat at the base of the pile assemblies. Each bottle leg has a combined diameter of more than 15 m and weighs approximately 3,000 te excluding marine growth and the effect of frictional drag and suction/adhesion loads when pulling footings free from seabed.

To date there been no industry experience of cutting free and removing bottle leg assemblies of this size and in this water depth. Although it may be theoretically feasible, there is a very high level of uncertainty due to the novel methods and equipment required.

The uncertainty arises from the limited or lack of direct experience and knowledge of the specific operation that makes it impossible to exactly describe the future outcome of the operation and/or the consequences of failure.

To lift the isolated bottle assemblies will require supports to aid stability when they are free standing after the plan bracing and the piles have been cut. If the piles can be cut internally then the bottle leg mud mats may provide some stability but, if the piles can only be cut externally, this would introduce significant stability problems.

[26] Of the nine pile sleeves per leg, one is nominated a spare, leaving eight sleeves for eight piles.

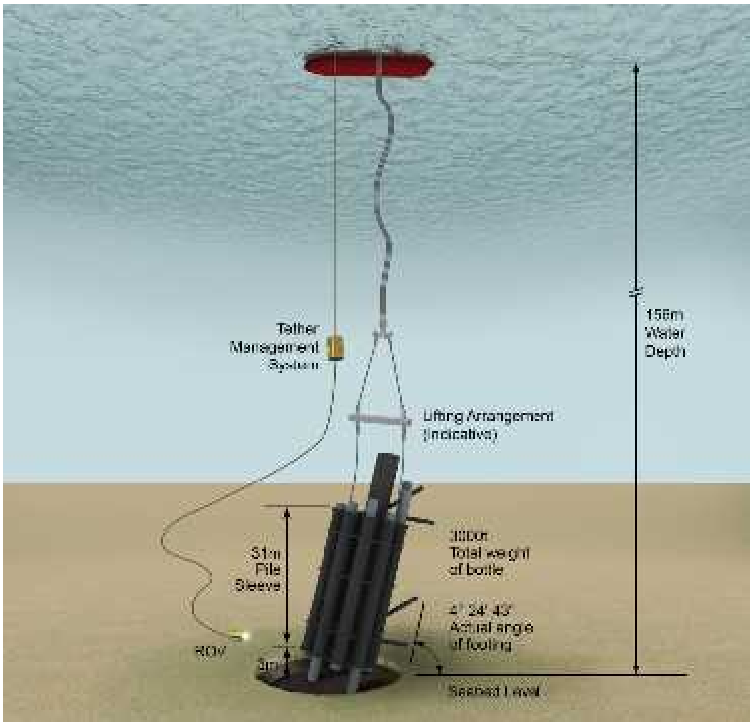

Figure 21: Lifting Configuration for Jacket Bottle Legs

Figure 21 illustrates the potential challenges in cutting and removing each bottle leg assembly.

Each bottle leg stands on a slight (4 degree) inclination and consequently the removal vessel would be required to provide support to the bottle leg as the final two piles are cut on each leg.

In the open conditions of the North Sea the removal vessel will experience both vertical wave and swell motions which will have to be compensated for by leaving slack in the lift rigging. This could result in a sudden shock load on the rigging if the bottle leg moves suddenly as the final cuts are made.

At 3,000 te total weight and in 156 m water depth, lifting the bottle legs is close to the lift capacity of some of the largest lift vessels. The total lift weight would be increased taking into account the break out loads and the potential for substantial amounts of seabed material to adhere to the underside of the mud matts and between the piles. The lifting operation could be compromised should any of the loose material adhering to the underside of the bottle legs suddenly drop away resulting in a change to the centre of gravity and potential loss of control of the lift. Lifts of this nature and in this water depth have not been previously performed and therefore carry a number of uncertainties and risks which increase the probability of failure.

II. The Technical Complexity Involved in Cutting the Foundation Piles.

Full removal of the jacket will require the cutting of the footings below the seabed surface.

This could be achieved with two options:

a) Internal pile cutting as the preferred method;

b) External pile cutting as a contingency in the event of inability or failure to complete internal pile cutting.

(a) Internal Pile Cutting

To achieve internal pile cutting, debris inside the piles would have to be removed to allow access for a dredging tool to remove the soil plug inside the pile down to 5 m below seabed before the cutting tool could be run in. At least six of the 32 piles are known to contain substantial oil field debris, consisting of scaffold poles, caisson sections, ladders and wire rope. Specialist fishing tools would be required to be run into the piles, grab onto the debris whilst avoiding the added risk of dropping objects as the grab is recovered to surface. Although the piles are 84 inches in diameter, they extend between 35m to 44m above the seabed and hence diver access into the piles to recover the debris is not possible[27,28] as the depth from the top of the pile to the seabed exceeds the excursion limit from the diving bell (see Figure 22).

Neither is it feasible to run a work class ROV down the pile to recover the residual debris, as the physical size of the ROV is greater that the opening of the pile.

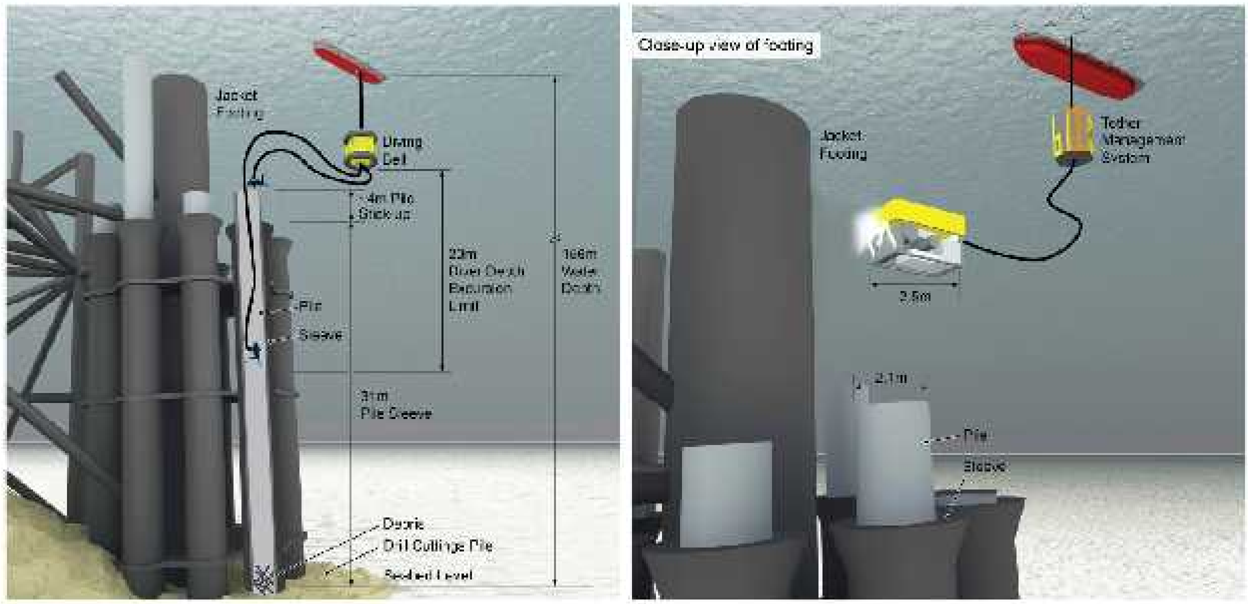

Figure 22: Restraints on Access into Piles to Recover Debris

(b) External Pile Cutting

As there are significant challenges and uncertainties associated with removing the debris from inside the piles or the soil plug excavated down to 5 m[29] below seabed, external cutting would therefore be required. This would involve the excavation of a large volume of stiff seabed sediment to gain access to the footings. Tools exist in the industry to excavate large volumes of soft seabed sediment, but there are significant challenges associated with excavating the stiff boulder clays between each pile at Murchison and within the centre of the pile clusters to allow access for the pile cutting tool around each pile.

The spatial arrangement of piles within each pile cluster also presents access issues for ROV based dredge systems (Figure 23). The gap between the piles below the mud mat is only 1.9 m, therefore even the smallest suitable work class ROV on the market at 2.5 m long, would not be able to physically enter

[27] See Diver Excursion Limit Tables
[28] See Excursion Tables in Saturation Diving – HSE - Research Report 44
[29] Soil plug is removed to -5m below seabed to allow cutting tool to be run into the pile to make a cut at -3m below seabed

the gap between the piles and manipulate the dredge system to effectively excavate within the pile cluster. Thus, a manual diver operated dredge system would be required to dredge under the pile cluster. This would present a significant additional safety risk of confined space working within a severely restricted visibility from suspended sediments for the diver. There are additional risks for divers operating in these conditions of undercutting the sediment during excavation within the pile cluster which could cause a collapse of overlying sediments and partial burial of the divers. This was considered to pose a significant and unacceptable safety risk and was consequently not considered further.

Based on currently available excavation techniques, if this operation were possible, it is likely to be a lengthy operation. If excavation is successful the jacket piles would then need to be severed. However, while cutting technologies do exist, once again they do not have a consistent track record for successfully cutting pile groups with restricted access. Both the excavation and cutting tools would represent proven technology being used in a new way and as such would require extensive engineering and testing to prove.

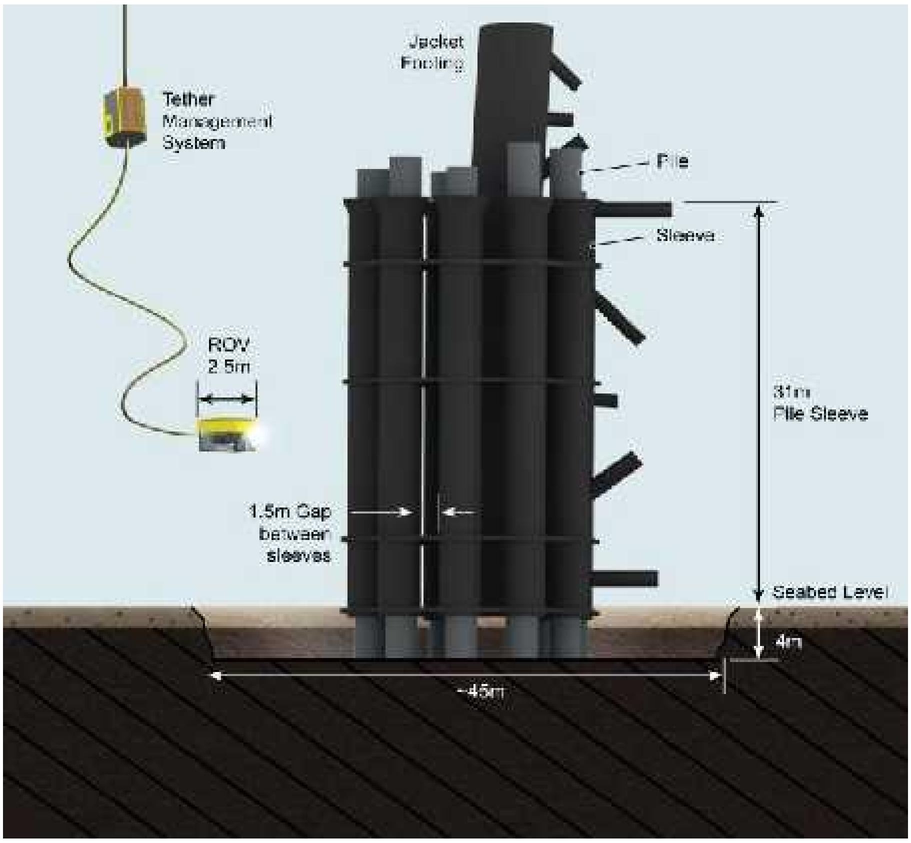

Figure 23: Excavation under Footings

Based on the capacities of the equipment and vessels currently available, full removal of the jacket footings would require multiple cutting and lift operations, the heaviest components being the four bottle leg assemblies each weighing in excess of 3,000 te. The feasibility of the excavation, cutting and lifting operations has not been proved and is likely to require significant engineering development before work could commence.

The technical assessment workshop concluded that the probability of a major or catastrophic technical failure during full removal was significantly and materially greater than for partial removal down to the top of footings. The main contributions to the technical risk are cutting, lifting and backloading of the major jacket footing components including the bottle leg assemblies, potentially resulting in an inability to recover from any a technical failure.

With significant concerns regarding the probability of technical failure and the consequences of this, the technical assessment workshop concluded the preferred option to be to remove the top section of the jacket and to leave the footings *in situ*.

6.5.4 Societal Workshop

Societal considerations were not found to be a great differentiator between options.

There was considered to be a limited impact to onshore amenities and communities because recovered items would be returned to existing specialist onshore facilities for processing under the necessary management and control procedures. The one exception was the BTA option where the refloated jacket would be towed to and grounded at a near-shore location in a Norwegian fjord for final demolition. This was considered to impact the amenity value of the local area, albeit at a low level and for a temporary duration.

The societal impact on fishing was assessed both for loss of access in the partial removal case and the loss of fishing time due to snagged or damaged nets. As a consequence full removal was found to result in no risk to fishermen and partial removal was considered to have a moderate snagging risk to fishermen. However the proposed mitigation of Notification to Mariners, marking the remains on Admiralty charts and on the FLTC FishSafe system were considered to reduce the snagging risk to an acceptable level.

6.5.5 Economic Workshop

Costs were assessed for both full and partial removal of the Murchison jacket. Costs included the direct operational costs for each option and the long term residual costs arising from future survey and remedial work commitments, discounted to today's money.

The full removal options cost approximately 75% more than the partial removal options, the cost driver being the increased schedule for the full removal options.

6.6 Stakeholder Engagement

The Murchison owners recognised that a purely scientific assessment of the impacts arising from the different jacket decommissioning options was unlikely to resolve the real or perceived risks of the various stakeholder groups.

An on-going and transparent consultation process with stakeholders was agreed as an effective way of reaching a balanced consensus of the best decommissioning option for the Murchison jacket. The consultation process commenced early in the project to identify stakeholder interests and concerns and how these might be addressed in the various studies described in section 5.3 above. Results of the stakeholder engagement were reported back to the main comparative assessment workshop described below.

Documents relating to the stakeholder engagement process were posted on the website http://www.cnri-northsea-decom.com. Further details on the stakeholder engagement process are reported in section 8.

6.7 Jacket Removal Comparative Assessment Recommendations

Results from the specialist workshops described above were reported back to a full comparative assessment workshop comprising members of the technical sessions, specialist external consultants, internal technical authorities and Murchison field partners. This full CA workshop was, again, run by an independent chairman and secretary, with the IRC as observers.

The table overleaf illustrates the main decision drivers identified in the CA workshop and is followed by discussion of each of these.

Table 3: Comparative Assessment Summary Results

Jacket Decommissioning Options CA Summary			
Criteria	**Metric**	**Full Removal**	**Partial Removal**
Safety	Risk to Personnel (offshore and onshore) Potential Loss of Life (PLL)	0.04 PLL	0.02 PLL
	Risk to other users of the sea Potential Loss of Life per annum (PLL_{pa})	0	1.5×10^{-5} PLL_{pa}
Environmental	Energy Consumption Total Energy (GJ)	487,750 GJ	570,818 GJ
	Emissions to the Atmosphere CO_2 Equivalent (Tonne)	40,416	45,266
	Marine Impacts (including noise, seabed disturbance, waste disposal)	100%	100%
Technical	Technical Feasibility Qualitative Score *[Note: the percentage score reflects the level reached in the Technology Qualification Process as described in the Qualification of New Technology recommended practice DNV-RP-A203-July 2011]*	50%	100%
	Ease of Recovery From Excursion	87%	100%
	Use of Proven Technology & Equipment	55%	100%
Societal	Commercial impact on fisheries	100%	66%
	Socio-economic impact - amenities	100%	100%
	Socio-economic impact - communities	100%	100%
Economic	Total Project Cost (%)	100%	57%

(Red indicates the key decision drivers in the comparative assessment)[30]

Table 3 identifies the key decision drivers to be:

a) **Safety is the key significant driver in Murchison comparative assessment.** The Health and Safety Executive (HSE) sets a safety individual risk per annum (IRPA) baseline of 1 in 1,000 above which the safety risk is classified as intolerable. CNRI has a more stringent approach as part of its corporate policy: a baseline of 1 in 1,000,000. Between these two baseline risks it is required to demonstrate that the level of risk is as low as reasonably practicable (ALARP). The

[30] For a more detailed description of the CA criteria and sub criteria metrics, see Appendix 1

IRPA safety rates for both full removal and partial removal are less than the HSE intolerable region of 1 in 1,000.

The PLL for full removal of the jacket is 100% higher than the PLL for the partial removal option. This increase in risk is unjustifiable as it violates the principle of reducing risks to as low as reasonably practical.

b) **Full jacket removal is technically more challenging than partial jacket removal in the 156 m water depth around Murchison.** The equipment and techniques required to isolate, remove and recover the Murchison jacket footings, in particular the 3,000 te bottle leg assemblies, have significant uncertainties because they do not have a demonstrable track record. There is therefore a higher probability of project failure for full jacket removal compared to partial jacket removal.

Table 3 identifies significant decision drivers to be:

c) Partial removal creates a long term and persistent risk to fishermen from the potential snagging of their fishing gear on the remaining footings. The PLL for fishermen, directly attributable to fishing over the Murchison remains is 1.5×10^{-5} per annum or 1 in 65,000 years.

d) Partial removal of the Murchison jacket creates a physical obstruction for fishing activity. However, Murchison is not a major fishing ground compared with other areas of the North Sea. The fishing effort in the Murchison area is contained within the ICES rectangle 51F1 (approximately 900 nm^2 or 3,091 km^2) The obstruction caused by the Murchison footings with a footprint of less than 0.01 km^2 is small compared with the size of 51F1.

The following criteria were not considered to result in significant decision drivers for either full or partial removal, as the scores for each method were not found to differ significantly:

e) Whilst both full removal and partial removal options cause some environmental disturbance this is localised and of short duration.

f) There is no significant difference in the energy and emissions between options when implications of replacing the material left on the seabed are factored in. When put into context of the emissions currently generated by the Murchison platform during operation the emissions generated during decommissioning operations were lower and hence not considered to be a significant impact.

g) The cost of full jacket removal is 75% higher than that for partial removal, whilst this is a significant difference in cost, it has not been considered a main driver in comparing the full and partial removal options.

DECC state that cost should not be considered the main driver in selecting a decommissioning option; therefore, an evaluation of the results of the comparative assessment, firstly with cost excluded, then with cost included was made.

In summary, there is a significant increase in operational safety risk, technical complexity and cost associated with the full jacket removal compared to partial jacket removal.

For the partial removal option there will be an increase in snagging risk to fishermen which will be mitigated by supporting the FishSafe system and other programmes set up by the FLTC.

The difference between full and partial removal of the Murchison jacket is material and significant in terms of the increased risk to the safety profile and the technical challenges that would arise from full removal. The Murchison Owners therefore recommend that the jacket is removed down to the top of the footings (-112 m LAT) with recovered top section(s) returned to shore for reuse, recycling or disposal. The jacket footings left in place will be marked on Admiralty charts and entered into the FishSafe System and will be subject to a continuing programme of inspection and monitoring as described in section 9.4 and 9.7.

7.0 Environmental Impact Assessment

As part of the comparative assessment study work in support the decommissioning programme for the Murchison Field, an Environmental Impact Assessment (EIA) was undertaken. The EIA considered all of the activities required to fully decommission the entire Murchison Field including well plug and abandonment, topsides and jacket removal, pipeline decommissioning and post decommissioning debris clearance and survey. The results of the EIA for the Murchison Field decommissioning options selected during the comparative assessment are presented in the Murchison Environmental Statement.[31]

This section presents a brief summary of the environmental impact assessment process and Murchison Environmental Statement which are relevant to the options of jacket decommissioning and support the application for derogation from full removal of the Murchison jacket under OSPAR Decision 98/3.

7.1 EIA Process

The EIA was an iterative process that commenced with a scoping study[32] at the project's inception which identified potential environmental impacts arising from the decommissioning activities and the requirement for specific independent studies to inform the impact assessment. A list of the independent environmental studies conducted in support of the Murchison EIA is given in the Reference Documents section.

The results of the independent environmental studies were formally evaluated in an environmental impact identification and assessment workshop which formed the basis of the environmental and societal component for the comparative assessment.

The Environmental Impact Assessment (EIA) for the options of decommissioning the Murchison jacket followed a systematic process to consider how the different project options could change existing environmental conditions and subsequently assessed and compared the consequence and significance of these changes.

Potential environmental impacts were evaluated in terms of the magnitude of the environmental impact or risk of the activity and the sensitivity of the receiving environment or environmental receptor. Stakeholder views were sought and incorporated throughout the EIA process, as described in section 7, and contributed to identify areas of concern and evaluation of technical data.

7.2 Environmental Description

This section provides a summary of the environmental conditions in the Murchison Field. Further detailed descriptions are available in the following reports and references therein:

- Murchison Pre-Decommissioning Environmental Baseline Survey (Fugro ERT, 2013)
- Murchison Decommissioning Environmental Statement MURDECOM-BMT-EN-REP-00198 (BMT Cordah, 2011).

7.2.1 Hydrography and Meteorology

The Murchison Field is located in a water depth of 156 m in an area influenced by the northern North Sea water mass.[33] Throughout the year the residual current speed range from 0.0 m/s to 0.01 m/s and prevailing seabed currents in the Murchison area run in a northwest to southeast direction. Mean sea surface temperature is approximately 12.5°C in summer and 8°C in winter. Mean bottom water temperature is less variable, and is approximately 9°C in summer and 7°C in winter. Winds in the

[31] Environmental Statement for the Decommissioning of the Murchison Facilities. MURDECOM-BMT-EN-REP-00198
[32] Murchison Decommissioning EIA Scoping Report. MURDECOM-BMT-EN-REP-00036 Rev C
[33] Cited in: Murchison Decommissioning Environmental Statement. MURDECOM-BMT-EN-REP-00198

Murchison area originate from all directions, although winds from the south southwest and south are most dominant (Meteorological Office, 1998).

7.2.2 Murchison Baseline Survey

The Murchison Owners conducted a pre-decommissioning environmental baseline survey and drill cuttings pile assessment for the Murchison platform in April/May 2011[36] with the objective of measuring the footprint, dimensions, topography and volume of the Murchison drill cuttings pile and characterising the physico-chemical and biological status of the pile and surrounding sediments. Prior to the 2011 survey, the Murchison Field had been surveyed on ten separate occasions, comprising nine environmental surveys by Conoco UK between 1978 and 1993[34] and a further monitoring survey by CNRI in 2006.[35] The results of the pre-decommissioning environmental baseline survey are described in more detail in the following sections.

7.2.3 Description of the Murchison Drill Cuttings Pile

Multi-Beam Echo Sounder (MBES) mapping the topography of the drill cuttings pile indicates that the pile is located under, and to the south-east, of the Murchison jacket extending in a south-easterly direction following the main residual current.[36] The Murchison cuttings pile was found to have a measured footprint area and volume of 6,840 m^2 and 22,545 m^3 respectively and a maximum height of 15.4 m.[36]

A plot of the MBES survey is shown in Figure 6 in section 3.5.

7.2.4 Physical and Chemical Analysis

The seabed in the vicinity of the Murchison platform is generally flat with water depths ranging from 152 m in the south-east to 162 m in the south-west, and average water depths of 156 m at the platform location. Physical and chemical analysis of the Murchison drill cuttings pile and wider Murchison area indicated decreasing zones of contamination with increasing distance from the Murchison platform:

- The drill cuttings pile contained the most heavily contaminated sediments;
- Station 4, located 250 m south east of Murchison along the residual current, was found to have highly contaminated sediment almost comparable to levels found within the drill cuttings pile and two orders of magnitude greater than all other stations from the wider Murchison area. It is likely that this station was directly impacted by drill cuttings discharge.
- Sediments from the wider Murchison area were considered to be within background concentrations.

Sediments from the drill cuttings pile had high silt/clay contents (33.5% - 57.7%) and were classified as coarse silt to fine sand on the Wentworth scale. Station 4 had elevated silt/clay content (27.9%) and was classified as very fine sand. The sediment samples taken from the wider Murchison area had low silt/clay contents (<0.1% to 8.5%) and were classified as medium sand on the Wentworth scale.

Chemical analysis indicated that concentrations of Total Hydrocarbon Concentration (THC), Polycyclic aromatic hydrocarbons (PAH), Polychlorinated Biphenyls (PCBs), Alkylphenol Ethoxylates (APE), Tributyl tin (TBT) and heavy metals of material from the Murchison drill cuttings pile and at Station 4 were elevated in comparison to mean concentrations of sediments in the wider Murchison area and levels typical of background marine sediments. The chemical constituents recorded in elevated levels in at these stations are consistent with those expected to be associated with drilling discharges, such as those that occurred during the development of the Field.

[34] UK Benthos database UKOOA. http://www.oilandgasuk.co.uk/knowledgecentre/uk_benthos_database.cfm

[35] Hartley Anderson Ltd, 2007. 2005/2006 Platform Specific Surveys Murchison Field; Data Report; Government/Industry Offshore Environmental Monitoring Committee. Oil and Gas UK

Results from the pre-decommissioning survey and other historical surveys indicate that at distances greater than 250 m from the Murchison platform total hydrocarbon concentrations (THC) are within the limits of typical background concentrations (9.41-40.10 µg/g; UKOOA, 2001) for this area of the North Sea, and that at distances less than 250 m from the Murchison platform THC values were elevated above background levels.

Results from the pre-decommissioning survey in 2011[36] indicated that the "effect footprint" of the Murchison cuttings pile, defined as the region within which sediment hydrocarbon concentrations are greater than 50 mg/kg, extends to less than 500 m from the platform.

Concentrations of metals within wider Murchison samples were considered to be similar to natural background concentrations typical of the Northern North Sea (NNS). In general, a pattern of decreasing metal concentration with distance from the platform was observed.

7.2.5 Faunal Analysis

Analysis of samples taken during surveys between 1979 and 2011 has indicated that the macrofaunal community of the Murchison Field is typical of the wider northern North Sea but shows evidence of a modified community structure within 500 m of the platform.[36]

In the 2011 pre-decommissioning survey,[36] faunal analysis of the drill cuttings pile indicated a highly modified community comprising low numbers of hydrocarbon-tolerant and opportunistic species. Faunal variation between samples ranged from virtually abiotic sediments, with only five individuals of the hydrocarbon-tolerant polychaete *Capitella capitata* present, to sediments with greater abundance and species diversity, but where most species were only present as single individuals. Station 4 also exhibited a highly modified benthic community with low species diversity but with the highest number of individuals (1078 individuals) of any station within the Murchison area (maximum of 417 individuals).

An intermediate community,[36] considered to be transitory between the background community and the highly modified community at Station 4, was observed at 250 m and up to 500 m along the residual current. These stations exhibited high diversity similar to background communities, increased numbers of indicator species and reduced numbers of hydrocarbon tolerant polychaetes.

Within the wider Murchison sediments there was a high degree of similarity in faunal composition at stations between 500 m and up to 2000 m along the residual current, characterised by both high numbers of background species and increased numbers of mobile predator/scavengers. The community present between 2000 m and 5000 m were broadly similar to those between 500 m and 2000 m, but with reduced numbers of background species. The outer references stations (5000 m to 10,000 m) were characterised by low numbers of taxa and low numbers of individuals.

7.2.6 Plankton and Primary Production

The most common phytoplankton groups responsible for a majority of the primary production in the North Sea are the diatoms, dinoflagellates and the smaller flagellates. In the northern North Sea, where the Murchison Field is located, the phytoplankton community is dominated by the dinoflagellate genus Ceratium[33].

The most abundant zooplankton group in the North Sea is the copepods, which are dominated by *Calanus* spp.[33] Other zooplanktonic organisms of the North Sea include Euphausiids (krill), *Thaliacea* (salps and doliolids), siphonophores, medusae (jellyfish) and the larval stages of starfish and sea urchins (echinoderms), crabs and lobsters (decapods) and fish. The zooplankton communities across the North Sea are broadly similar.

[36] Pre-Decommissioning Environmental Survey Report for the Murchison Field MURDECOM-ERT-EN-REP-00056

7.2.7 Commercial Fish Spawning and Nursery Areas

The main commercial fish species in the northern North Sea in the vicinity of Murchison are mackerel, herring, cod, haddock, whiting, ling, megrim, pollack, monkfish, and saithe.[37] The Murchison Field lies within spawning grounds for cod (*Gadus morhua*; January to April), whiting (*Merlangius merlangus*; February to June), saithe (*Pollachius virens*; January to April), haddock (*Melanogram musaeglefinus*; February to May) and Norway pout (*Trisopterus esmarkii*; January to April), and nursery grounds throughout the year for herring (*Clupea harengus*), ling (*Molva molva*), mackerel (*Scomber scombus*), spurdog (*Squalus acanthias*), and blue whiting (*Micromesistius poutassou*).

7.2.8 Commercial Fishing

Commercial fishing effort (days spent fishing) in the area around the Murchison Field (which is located in International Council for the Exploration of the Seas (ICES) Statistical Rectangles 51F1) is considered to be moderate in comparison with other areas of the North Sea.[37] The majority of fishing effort (>75%) is associated with demersal fisheries operating single and pair bottom otter trawls to target haddock, cod and whiting stocks.[37] UK vessels, and specifically Scottish vessels, account for the majority of demersal fishing effort in ICES Rectangle 51F1, although there are a number of non-UK vessels, such as Norwegian, French and Danish, which also operate in the area.

The relative value of the fishing catch originating from ICES Rectangle 51F1 is considered to be “moderate” in comparison with other areas of the North Sea.[37] The Murchison platform is location within a region of an internationally important pelagic fishery, which is targeted by a number of countries including the UK, Norway, the Netherlands, Denmark and France.[37] Pelagic fishing is a seasonal activity, and in a given area is restricted to a relatively short period of time as the fishing fleet targets migrating species, such as mackerel, which pass through the Murchison area during October, November and December. This is reflected in the high landings values but relatively low level of effort recorded. Mackerel represents the highest UK landings values in Rectangle 51F1 (79% of the total), with the remainder comprising principally haddock (5%), cod (4%), saithe (3%), monkfish (3%) and whiting (2%).

7.2.9 Marine Mammals

The main cetacean (whale and dolphin) species occurring in the Murchison area are minke whale (*Balaenoptera acutorostrata*), long-finned pilot whale (*Globicephala melas*), killer whale (*Orcinus orca*), white-beaked dolphin (*Lagenorhynchus albirostris*), white-sided dolphin (*Lagenorhynchus acutus*) and harbour porpoise (*Phocoena phocoena*); most sightings occur in the summer months[33]. In addition, sperm whales have occasionally been sighted in the vicinity of Block 211 between May and October.

The grey seal (*Halichoerus grypus*) and the harbour or common seal (*Phoca vitulina*), are both resident in UK waters and occur regularly over large parts of the North Sea. As the Murchison Field is 150 km from the nearest coastline it is unlikely that significant numbers of grey or common seals would be found in the vicinity of the field.

7.2.10 Inshore Areas Adjacent to Reception Facilities

The inshore and onshore destination for the Murchison Facilities is currently unknown, and therefore it is not possible to define the specific areas of interest for these locations. Decommissioning will occur within an existing facility, with operations compliant with local permitting and legislative requirements.

---

[37] Murchison Decommissioning Commercial Fisheries - Socioeconomic Impact Study SFF. MURDECOM-SFF-EN-STU-00131

7.2.11 Conservation Sites and Species

The European Habitats Directive (92/43/EEC) identifies habitats, listed in Annex I, and species, listed in Annex II, which require protection through the designation of Special Areas of Conservation. There are no known Annex I habitats of the European Union Habitats Directive (92/43/EEC) in the vicinity of the Murchison Field. The only Annex II species sighted within the Murchison area is the harbour porpoise, sighted in very high numbers in February and July and in low numbers in May, June, August and September.

Annex IV of the Habitats Directive identifies particularly threatened species which require strict protection from killing, disturbance or the destruction of them or their habitat. No Annex IV species have been sighted within the same block or quadrant where Murchison is located; however, a number of cetacean species have been sighted within the adjacent quadrants, they include: minke whale, long-finned pilot whale, Atlantic white-sided dolphin, white beaked dolphin, killer whale and sperm whale.

In consideration of the OSPAR List of Threatened and/or Declining Species and Habitats[38] the harbour porpoise and Atlantic cod are known to be present in the Murchison area, whilst none of the listed habitats have been recorded in the area.

7.3 Offshore Impacts and Mitigation

This section describes the offshore impacts from the decommissioning operations and the mitigation measures proposed.

7.3.1 Energy Use and Atmospheric Emissions

The Murchison owners commissioned a study, based on the life cycle assessment approach,[39] to assess the energy use and the atmospheric emissions that could arise as a result of the decommissioning options considered for the Murchison Facilities.[40]

In all removal methods partial removal is predicted to use more energy than the full removal options as a result of the large theoretical cost of re-manufacture to replace the steel contained within the jacket footings that would be left *in situ.* However, the difference in emissions between full and partial removal is relatively small when put into context of the emissions generated by Murchison during normal operations in 2011 which range from 22% for full removal to 20% for partial removal for Methods A&B; and 45% for full removal to 43% for partial removal for flotation. On this basis the energy use and emissions were considered to be a low environmental risk for both full and partial removal, and were not considered to be a key decision driver between full and partial removal.

[38] OSPAR List of Threatened and/or Declining Species and Habitats (Reference number: 2008-6)
[39] Guidelines for the Calculation of Estimates of Energy Use and Gaseous Emissions in the Decommissioning of Offshore Structures (Institute of Petroleum, 2000)
[40] Energy and Emissions Report for the Decommissioning of Murchison. MURDECOM-BMT-EN-REP-00125

Table 4: Energy and Emissions Arising from Full or Partial Removal of the Murchison Jacket

Decommissioning Methods		Energy(GJ)	CO2 (t)	NOx (t)	SO2 (t)	CH4 (t)
Full removal	Cut and lift Method A	487,750	40,415	416	99	1,666
	Cut and lift Method B	488,043	40,437	416	99	1,668
	Flotation	1,095,423	85,582	1,201	157	5,244
Partial removal	Cut and lift Method A	570,817	45,264	301	119	897
	Cut and lift Method B	553,957	44,013	278	118	792
	Cut and lift Method C	690,544	54,154	465	131	1,647
	Flotation	1,162,271	89,227	1,064	176	4,374
Normal Operations Murchison in 2011		**-**	**198,510**	**-**	**-**	**-**

As the Murchison facilities are located approximately 2 km from the UK/Norwegian median line, there is potential for transboundary transport of atmospheric contaminants. However, under the open conditions that prevail offshore, the quantity of additional air emissions produced is unlikely to create any measurable transboundary impact.

The potential cumulative effects associated with atmospheric emissions produced by the decommissioning activities include a contribution to climate change by emission of greenhouse gases, acidification (acid rain) and local air pollution. The emissions from the proposed decommissioning operations (155,796 te CO_2) represent a reduction in CO_2 emissions when compared to the total CO_2 emissions generated by Murchison during normal operations in 2011 (198,510 te; CNRI, 2012a), and represent 1% of the total annual CO_2 offshore emissions from the UKCS (16,393,119 te CO_2, Oil and Gas UK (2012).

Mitigation

The Murchison Owners will minimise energy use by developing work programmes to optimise vessel time in the field, and fuel consumption will be minimised by operational practices and power management systems for engines, generators and other combustion plant and maintenance systems. Vessels will be required to use ultra-low sulphur fuel in line with MARPOL requirements. All mitigation measures will be incorporated into contractual documents of sub-contractors.

7.3.2 Underwater Noise Assessment

The potential impact of underwater sound to marine mammal species, in particular those species on the list of European Protected Species[41] (EPS), was assessed[42] following JNCC[43] guidance on the protection of marine EPS from injury and disturbance as required under the Habitats Directive and UK Offshore Marine Conservations Regulations.

[41] Annex IV of the EU Habitats Directive (92/43/ECC) and the UK Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (amended 2009 and 2010)
[42] Underwater Noise Impact Assessment for the Murchison Field Decommissioning. MURDECOM-BMT-EN-REP-00122
[43] JNCC 2010 The Protection of Marine European Protected Species from Injury and Disturbance. Guidance for the marine area in England and Wales and the UK offshore marine area

Underwater cutting was predicted to have the highest Sound Pressure Level (SPL) associated with the jacket decommissioning options. However as cutting activities are expected to be short in duration, vessels will be the main source of sound throughout offshore decommissioning.

The decommissioning activities (including the underwater cutting) would not be predicted to exceed the precautionary noise exposure criteria for injury to cetacean species (230 dB re 1 µPa at 1 m recommended by JNCC[43]). The precautionary injury threshold[43] for harbour porpoise (200 dB re 1 µPa at 1 m) would be exceeded during cutting activities but only within the immediate vicinity of operations, up to 0.19 m from source.

Thresholds for behavioural disturbance to cetacean species are predicted to be exceeded for all decommissioning operations. During underwater cutting operations, it is estimated that the threshold for disturbance behaviour for low and mid-frequency hearing type may be exceeded up to 41 km from the sound source; and up to 1.9 km for high-frequency hearing type (harbour porpoise). Consequently, between 58 and 500 individual low and mid-frequency cetaceans, and only two harbour porpoise individuals may be disturbed by noise from these activities. Cetacean species in UK waters are generally wide ranging, their distribution and abundance varies considerably spatially and temporally, and is influenced by both natural and anthropogenic factors. As the cutting operations are expected to be short in duration, lasting a few hours each over a period of days to weeks it is not expected that the disturbance would result in a significant deviation from the natural variability for these species population. Additionally, as the range of impact would be limited to 41 km it is expected that cetaceans would be displaced to adjacent areas of the northern North Sea which would be within the natural range of their populations and would compensate for the displacement from a particular area of habitat.

For the majority of the time, vessels will be the main sound source and it is estimated that behavioural disturbance may be exhibited by low and mid-frequency hearing cetaceans within at most 3 km and high-frequency hearing cetaceans within 0.1 km of the activities. This suggests that very few (<7) individuals will be disturbed by noise from these activities. Decommissioning operations are expected to last at most a few months and will be intermittent over this period, with overall sound generation expected to be similar in nature to existing/general vessel activity in the area.

Despite the differing operational durations, it was not possible to distinguish between the options for full or partial jacket removal based on the level of underwater noise as both removal options would require underwater cutting and a similar vessel spread. Overall the generation of underwater noise is considered to be a low environmental risk for both full and partial removal, and consequently was not considered to be a key decision driver between full and partial removal.

It is not currently known whether any of the Murchison operations will coincide or whether other nearby operations may be conducted at the same time to estimate potential cumulative impacts. The Murchison field is adjacent to, and the Murchison platform is approximately 2 km from, the UK/Norway median line. The assessment predicted that the thresholds for disturbance may be exceeded up to 41 km from decommissioning operations during underwater cutting and up to 4.8 km during other operations. Therefore, it is predicted that the zone of potential disturbance may extend into Norwegian waters at times during the Murchison decommissioning operations.

Mitigation

Impacts associated with noise disturbances will be minimised during decommissioning operations, by ensuring that the number of vessels travelling to, or standing by, Murchison will be kept to a minimum, and that equipment is well-maintained to keep the noise of operating machinery as low as possible. Offshore vessels will avoid concentrations of marine mammals and maintain a steady course and speed when possible. A minimum operational altitude will be set for helicopter transits and approaches. These mitigation measures will be implemented through the contracting process and within the major removals contracts.

7.3.3 Seabed Disturbance

Under the OSPAR Recommendation 2006/5[44] the Murchison drill cuttings pile is predicted to fall significantly below the OSPAR thresholds for both "total rate of oil release into the water column" (at 1.2 te/year compared to the OSPAR threshold of 10 te/year) and "persistence over the area of seabed contaminated"[45] (at 25 km^2yrs compared to the OSPAR threshold of 500 km^2yrs). The Murchison drill cuttings pile is therefore considered to present a low environmental impact, and in this context natural degradation is considered the Best Environmental Strategy.

If both the cuttings pile and jacket footings were left *in situ*, the eventual collapse of the derogated jacket footings could disturb the cuttings pile some 300-1000 years in the future. The eventual collapse of the jacket footings[46] is predicted to disturb and re-suspended a relatively small proportion of the cuttings pile (7%) with the majority of the material re-settling on the existing accumulation of drill cuttings pile material and currently contaminated sediments, and is therefore considered to present a low environmental impact.

However, if the Murchison jacket were to be completely removed, the entire drill cuttings pile would have to be excavated and removed, or displaced to allow the jacket footings to be cut and the lower bracings to be released. Consequently, CNRI examined the options for the removal of the Murchison drill cuttings pile by means of a comprehensive comparative assessment.

Modelling studies were conducted to give high level predictions of the nature, extent and duration of impacts to the seabed and water column as a result of physical disturbance to the drill cuttings pile associated with the options to remove the pile.[47] Results of the modelling studies were used to inform the environmental impact assessment[48] for each of the removal options in support of the full comparative assessment.

From an environmental perspective, recovering the pile to the surface either for subsequent treatment and disposal or for reinjection, involves the complete removal of the pile and are the only options that effectively remove long-term contamination liability issues associated with the accumulation of cuttings pile material. There is predicted to be a moderate environmental impact to the water column by re-suspension of cuttings during removal operations and elevated hydrocarbons in surrounding sediments would be measurable for several decades. This option would only remove the physical accumulation of cuttings, whilst the sediments contaminated from the original drilling discharges extending 500 m from the physical accumulation cuttings would still remain.

Redistribution of the pile would result in high operational environmental impacts to the water column during sediment redistribution and leave high long-term legacy impacts from the redistributed contaminated sediments, which would persist for hundreds to thousands years.

Excavation of the drill cuttings pile, recovery to the surface and reinjection of the cuttings material into a disposal well, gives a favourable balance between moderate short-term environmental impacts to the water column during removal operations and low long-term environmental risks from removal of the

[44] OSPAR Recommendation 2006/5 on a Management Regime for Offshore Cuttings Piles
[45] Murchison Drill Cuttings Pile Long-Term Cuttings Pile Characteristics Report. MURDECOM-GEN-EN-REP-00133
[46] Murchison Drill Cuttings Pile Modelling Disturbance of Drill Cuttings from the Collapse of the Structural Piles. MURDECOM-GEN-EN-REP-00240
[47] Murchison Drill Cuttings Pile Modelling the Effects of Human Disturbance of the Cuttings Pile. MURDECOM-GEN-EN-REP-00135
[48] Environmental Assessment of Options for the Management of the Murchison Drill Cuttings Pile. MURDECOM-BMT-EN-STU-00132

accumulation of cuttings pile material. However, recovered historic cuttings would be considered waste and their injection into the formation would not be permissible under the OSPAR Convention and London Protocol which prohibits the disposal of industrial wastes in this manner.

The environmental assessment supports the recommendation of OSPAR 2005/6 that the drill cuttings pile is considered to present a low environmental impact and that in this context natural degradation is considered the Best Environmental Strategy.

7.3.4 Socioeconomic Impacts

The Scottish Fishermen's Federation assessed the socioeconomic impacts to commercial fishermen for the full and partial removal options of decommissioning the Murchison jacket.[49]

For both full and partial jacket removal there will be the potential for navigational conflicts arising between fishing vessels and decommissioning vessels transiting to and from the site. This could include towed gear vessels being required to alter towing direction, or the fouling of fixed gear markers. The majority of fishing activity in the vicinity of the Murchison platform is by vessels towing mobile gear. It is therefore considered that any interaction with vessels would result in changes in fishing patterns rather than damage to fishing gears and any loss of income would not be significant. Additionally, the 500 m safety zone will remain around the Murchison installation throughout the decommissioning operation and the majority of decommissioning vessels will be located within this zone. Consequently, their effect on fishing vessels is considered to be of minor significance.

Full removal of the Murchison jacket would leave a clean seabed without any subsea obstructions which could cause a long-term snagging hazard to fishermen. Full jacket removal is therefore not considered to pose a long-term socioeconomic impact to commercial fisheries.

Conversely, partial removal of the Murchison jacket would leave the jacket footings covering a relatively small area of seabed (0.0018 nm^2 or 0.006 km^2) and extending 44 m above the seabed. The drill cuttings pile would be left *in situ* underneath the jacket footings, which would physically exclude vessels from operating within the boundaries of the platform and prevent commercial fisheries from interacting with the cuttings pile. However, following partial jacket removal the mandatory 500 m safety zone would no longer apply thus allowing fishing activities to be undertaken in close vicinity to the footings, which at 44 m above the seabed are likely to pose snagging risks to fishing nets. Demersal towed fishing gears carry the greatest risk of snagging the jacket footings due to their contact with the seabed, and combined with the high fishing effort recorded in the Murchison area, partial removal is considered to have a moderate risk to commercial fishermen.

Partial removal of the jacket is considered to present a higher risk to commercial fishermen compared to full removal, as a result of the long-term legacy risks associated with the presence of the jacket footings over the next 1000 years.

Mitigation

The presence of the jacket footings remaining on the seabed will be widely published through UK Hydrographic Office for inclusion on Admiralty Charts; Kingfisher Information Service for inclusion on the Fishing Plotter Files, Awareness Charts and Kingfisher bulletins; and through the FLTC FishSafe system. CNRI will establish lines of communication to inform other sea users, including fishermen, of vessel operations during decommissioning activities.

The number of vessels travelling to, or standing by, Murchison will be kept to the minimum and the UK Northern Lighthouse Board would be notified of the movement of specialist vessels involved in decommissioning activities.

[49] Commercial Fisheries - Socioeconomic Impact Study. MURDECOM-SFF-EN-STU-00131

7.4 Post Decommissioning Environmental Survey

A post decommissioning environmental seabed survey, centred on sites of the Murchison platform and the subsea wellheads will be carried out. The survey will focus on chemical and physical disturbances of the completed decommissioning operations and compared with the pre-decommissioning survey.

All pipeline routes and subsea structure sites, including the jacket footings, will be the subject of surveys when decommissioning activity has concluded. A survey of the condition of the footings and the adjacent seabed will also be undertaken at the end of the removal activities. The footings which are proposed to be left in place will be subject to a documented monitoring programme. The survey frequency will be discussed and agreed with DECC.

Results from both surveys will be available once the work is complete, with a copy forwarded to DECC. After the surveys have been sent to DECC and reviewed, a post monitoring survey regime will be agreed by both parties. This is discussed further in section 9.4.

7.5 Environmental Compensation Options and Opportunities

The Murchison Owners have considered the impacts of their decommissioning programme in the context of the EU Environmental Liability Directive (ELD) which holds operators legally and financially responsible for environmental damage caused by their operations. Under the terms of the ELD, environmental damage is defined as direct or indirect damage to species and natural habitats protected under the EU Wild Birds Directive and the EU Habitats Directive; and direct or indirect contamination of the land which creates a significant risk to human health. There are no protected sites within the vicinity of the Murchison Field, and the Murchison decommissioning operations are not predicted to cause significant environmental harm, therefore, environmental compensation as described is not considered to apply.

However, it is considered that leaving the Murchison jacket footings in place may have societal impacts to commercial fishermen through the loss of fishing grounds (albeit a relatively small area) and through the potential snagging risk resulting in loss of or damage to fishing gear. This will be mitigated by financially supporting the programmes set up by the FLTC.

8.0 Stakeholder Engagement

8.1 Publication of the Draft Decommissioning Programme for Consultation and Responses

The Draft Murchison Field Decommissioning Programme[50] was submitted to DECC in late May 2013, together with four key supporting documents: the Comparative Assessment Report[51], Environmental Statement[52], Stakeholder Report[53]and Independent Review Consultants' Final Report[54].

Submission of the Draft Decommissioning Programme in May 2013 triggered a statutory consultation as required under section 29 (3) of the Petroleum Act 1998. The statutory consultees comprised:

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

CNRI chose to extend the consultation to cover a six (rather than four) week period to ensure that all those with an interest had ample opportunity to comment. The Draft Decommissioning Programme and supporting documents were published online and made available in hard copy form as well as on CD. They were also available for inspection at CNRI's Aberdeen offices. Documents referenced within the five documents were made available on request to those who wished to follow up in more detail.

As well as the four statutory consultees, stakeholders with whom CNRI had previously engaged with were alerted in writing to the commencement of the consultation, its duration and availability of materials and calling for responses. A reminder email was sent two weeks before the close of the consultation.

Furthermore, announcement of the proposals was accompanied by the placing of public notices in four relevant publications (one national daily newspaper, one regional daily newspaper, one local weekly newspaper and an official journal, as advised by DECC), extending the opportunity in a wider, public consultation.

The heads of OSPAR delegations were also contacted with CD copies of the five documents given that the recommendations in the decommissioning programme suggested the likelihood of a derogation application. Early stage briefings were sought with the contracting parties to ensure that any areas of particular interest could be investigated prior to any recommendation by the UK government for a derogation application to be made to OSPAR Commission. Briefings have taken place with the French, German, Netherlands and Norwegian delegations, with an additional meeting with the Norwegian Ministry of Petroleum and Energy. CNRI would welcome the opportunity to meet with other delegations should they consider this would be of interest.

8.2 Statutory Consultation - Results

The results of the statutory consultation were subsequently reported in the post-consultation draft of the Decommissioning Programme which was submitted to DECC in September 2013. The statutory consultees were broadly in agreement with the recommendations.

[50] Murchison Field Decommissioning Programmes. MURDECOM-CNR-PM-REP-00232
[51] Murchison Decommissioning Comparative Assessment Report. MURDECOM-CNR-PM-REP-00225
[52] Environmental Statement for the Decommissioning of the Murchison Facilities. MURDECOM-BMT-EN-REP-00198
[53] Murchison Field Decommissioning Stakeholder Engagement Report. MURDECOM-CNR-PM-REP-00233
[54] Murchison Decommissioning Comparative Assessment – Final IRC Report. MURDECOM-XDS-PM-REP-00062

A summary of the responses from statutory and other consultees appears in Appendix 2. Other than from section 29 Notice Holders, no responses were received from stakeholders outside the UK, despite formal notification of the consultation.

There were no responses from the public following the appearance of the notices in The Times, Aberdeen Press & Journal, Shetland Times and Edinburgh Gazette.

Copies of the full correspondence between respondents and CNRI can be accessed in the updated Stakeholder Report, available on request and online at www.cnri-northsea-decom.com.

9.0 Programme Management

This section of the Report describes how the Murchison Decommissioning Programmes will be managed and the associated cost and programme timing.

9.1 Project Management

A CNRI project management team will be appointed to manage the operations of competent contractors selected for the decommissioning, removal and disposal scopes of the decommissioning work.

CNRI Safety, Health and Environmental Management Processes will be used to govern operational controls, hazard identification and risk management. The work will be coordinated with due regard to the interfaces with other operators' oil and gas assets and with other users of the sea.

CNRI will control and manage the progress of all permits, licences, authorisations, notices, consents and consultations required.

9.2 Project Schedule

The proposed schedule of activity for Murchison decommissioning is shown below. This provides indicative timings with long windows for offshore activities.

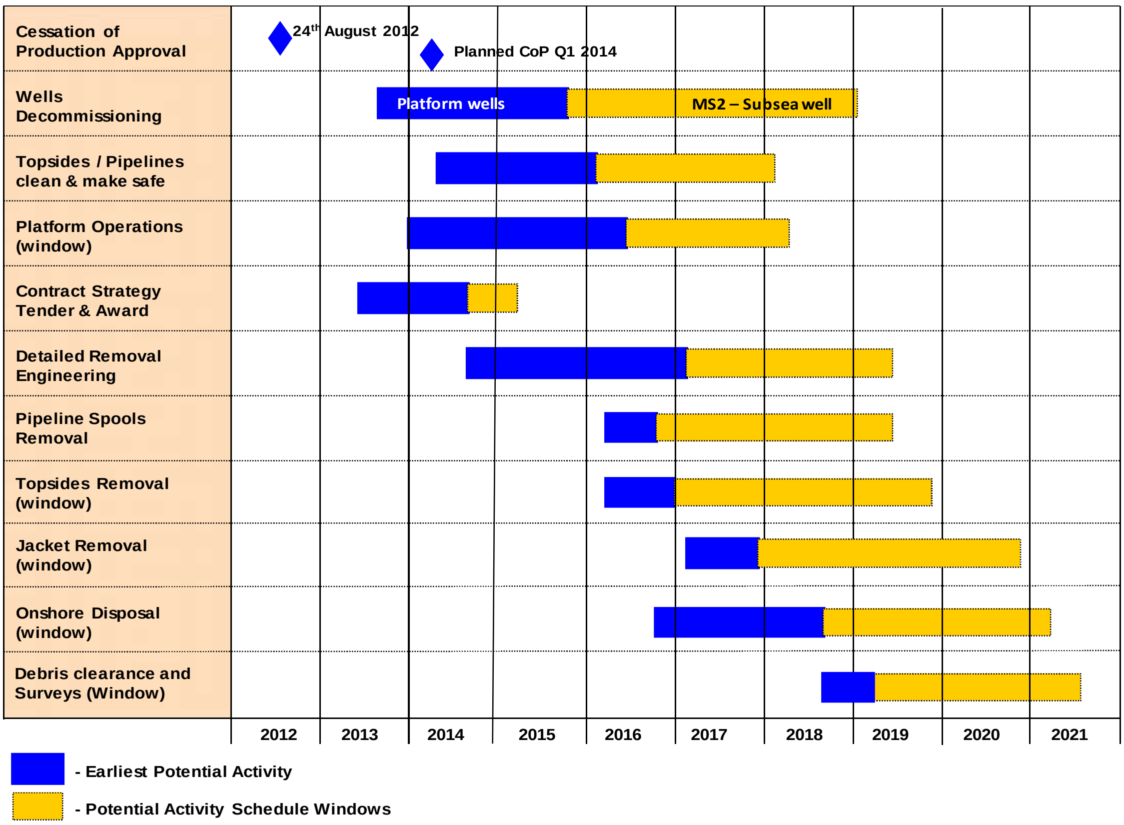

Figure 24: Murchison Decommissioning Indicative Schedule

9.3 Project Costs

An overall cost estimates (covering the items shown in table below) has been prepared following UK Oil and Gas Guidelines on Decommissioning Cost Estimation. Details of the cost estimate are commercially sensitive and have not been included in this derogation application. However, a detailed cost estimate was provided to DECC in support of the Murchison Decommissioning Programme.

Table 5: Provisional Decommissioning Programme Cost Structure

Provisional Decommissioning Programmes Costs	
Item	**Estimated Cost (£m)**
Preparation for Cessation of Production	Provided to DECC in confidence
Well Plug and Abandonment	
Decommissioning Services Contract (Engineer down & clean)	
Removal Services Contract (Topsides and Jacket)	
Pipelines and Subsea Services Contract	
Operational Support Contract (post CoP)	
Owner Costs including residual liabilities	
TOTAL	Provided to DECC

9.4 Post Decommissioning Surveys

The Murchison platform owners carried out a comprehensive sampling and survey scope in 2011 prior to commencing the decommissioning activities.

After completion of the decommissioning activities and debris clearance the area of the Murchison platform will be subject to a physical and environmental survey to establish a post decommissioning baseline.

The scope of the post decommissioning survey will be agreed with DECC and will be based on those transects and stations sampled in the 2011 survey. Samples will be analysed for hydrocarbons, metals and other trace elements. The morphology of the cuttings pile may be evaluated if it is believed to have been disturbed during the decommissioning activities.

The pre and post decommissioning survey results will be reviewed with DECC to mutually agree the scope and frequency of subsequent surveys to enable temporal recovery trends to be evaluated.

9.5 Debris Clearance and Verification

Following completion of the Murchison jacket decommissioning work, a seabed survey for oilfield related debris will be carried out within the platform 500 m zone.

Seabed debris located will be identified and catalogued in a survey report, the results from which will be used to inform the discussion with DECC on a remedial recovery programme for oilfield related debris.

Following the remedial recovery programme, independent verification of seabed state will be obtained by trawling the platform 500 m zones. The independent verification organisation will issue a statement of clearance.

9.6 Close Out Report

A close out report will be submitted to DECC within four months of the completion of the main offshore decommissioning scope, including debris removal and independent verification of seabed clearance, and the first post-decommissioning environmental survey.

Any variances from the approved decommissioning programmes will be explained in the close out report.

9.7 Post Decommissioning Monitoring of Remains

The post decommissioning survey scopes described in section 9.4 will also include monitoring the condition of the site, the jacket footings and any other material left *in situ* to ensure they remain as expected following completion of the Murchison Decommissioning Programme.

The post decommissioning survey results will be notified to the FLTC for inclusion in the FishSafe system, and for notification and marketing on Admiralty Charts and notices to Mariners.

9.8 Legacy Issues

In the close out report described in Section 9.6, the responsibility for the subsequent management of on-going residual liabilities including managing and reporting the results of the agreed post-decommissioning monitoring (described in Section 9.7), evaluation and remedial programme, will be confirmed.

The footings that are proposed to be left in place will remain the property and responsibility of the Murchison Platform Owners.

Should the Murchison owners, or reports from other stakeholders, raise or identify concerns with the footings left on the sea bed post decommissioning then the Murchison owners will assess such concerns and any potential remedial measures within a comparative assessment framework and discuss these with DECC.

The Murchison Owners will monitor future discussions and decisions under the OSPAR framework for their relevance to the management of the Murchison drill cuttings pile.

10.0 Reference Documents

This section of the report list all reference documents, studies and regulatory procedures that supports the Murchison Jacket derogation application

10.1 Regulations and Procedures

DECC Guidance Notes Version 6

OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations

OSPAR 2006. Recommendation 2006/5 on a Management Regime of Offshore Cuttings Piles

Comparative Assessment Method Statement
DECOM-CNR-PM-PRO-00081

Comparative Assessment Procedure
MURDECOM-CNR-PM-PRO-00136

Murchison Decommissioning Comparative Assessment – Final IRC Report
MURDECOM-XDS-PM-REP-00062

Murchison Field Decommissioning Programmes – Post Consultation Draft
MURDECOM-CNR-PM-REP-00232

10.2 Surveys

Murchison Pre-Decommissioning Environmental Baseline Survey
MURDECOM-ERT-EN-REP-00056

Murchison Asset Inventory Study Report
MURDECOM-PSN-PM-REP-00037

Murchison Platform – 2010 ROV Structural Inspection Report
MUR-ISS-SU-REP-15406

Murchison Shipping Traffic Survey
MURDECOM-ATC-EN-STU-00199

Facilities for Onshore Receipt of Decommissioning Structures Survey – 2011
DECOM-GLND-PM-REP-00043

Non Linear Structural Assessment of Post Damages to Braces at EL -13m
MUR-ATK-ST-REP-0288 rev A1

10.3 Removal Studies

Murchison – Post CoP Alternate Use Appraisal
DECOM-GLND-PM-STU-00048

Murchison Platform Removal Technology Study
DECOM-GLND-PM-STU-00042

Murchison Jacket Weight Report
MURDECOM-ATK-ST-REP-00253 revA2 July 2012

Murchison Jacket Weight Calculations
MURDECOM-ATK-ST-REP-00254

Murchison Field 2002 Decommissioning Study

Saipem Doc 979978/KMUK/Removal 2002-CNR096810

Murchison Topside & Jacket Removal Study-Method Statement
MURDECOM-HMC-ST-PRO-00033

Method Statement Murchison Jacket Removal
MURDECOM-ALS-ST-PRO-00024

Murchison Jacket Removal Method Statement
MURDECOM-ALS-ST-PRO-00219 – July 2012

Provision of Topside and Jacket Removal Studies decommissioning of the Murchison Platform
MURDECOM-SHL-PM-REP-00067

Murchison Jacket BTA Removal Study Report
MURDECOM-AKER-ST-REP- 00025

Evaluation of Removal Options for the Murchison Jacket
MURDECOM-GLND-PM-REP-00008

Limitation to Marine Operations during Platform Removal
DECOM-GLND-MA-REP-00044

Technology for Subsea Cutting of Jacket members
DECOM-GLND-ST-REP-00045

Technical Notes on Murchison Densitometers
MURDECOM-CNR-EN-ETN-00001

Murchison Preliminary Footings Life Assessment
DECOM-ATK-ST-REP-00080

CNRI Technical Note on Murchison Conductor String Removal
MURDECOM-CNR-WS-TFN-00001

10.4 Drill Cuttings

CNRI Technical Note on Murchison Drill Cuttings Pile Removal Methods
DECOM-CNR-EN-ETN-00102

Murchison Drill Cuttings Pile – Environmental Impact Study
MURDECOM-BMT-EN-STU-00132

Murchison Drill Cuttings Pile Long-Term Cuttings Pile Characteristics
MURDECOM-GEN-EN-REP-00133

Murchison Drill Cuttings Pile Modelling the Effects of Human Disturbance of the Cuttings Pile
MURDECOM-GEN-EN-REP-00135

Oil & Gas UK Cutting Study 2011
MURDECOM-FSS-PM-STU-00001

10.5 Environment

Environmental Statement for the Decommissioning of the Murchison Facilities
MURDECOM-BMT-EN-REP-00198

Underwater Noise Impact Assessment for the Murchison Field Decommissioning
MURDECOM-BMT-EN-REP-00122

Energy and Emissions Report for the Decommissioning of Murchison
MURDECOM-BMT-EN-REP-00125

Environmental Statement for the Decommissioning of the Murchison Facilities – Risk Assessment and Environmental Assessment Workshop Report
MURDECOM-BMT-EN-REP-00127

Murchison Decommissioning - Commercial Fisheries - Socioeconomic Impact Study
MURDECOM-SFF-EN-STU-00131

Evaluation of the Extent of Colonisation of *Lophilia pertusa* and Marine Growth on the Murchison Platform
A.INS.001/Murchison 2010-CNR0105209

Assessment of Marine Growth levels on Murchison
NNP-ATK-ST-TEC-0140

Application for Assessing the Removal of the Murchison Densitometers
MURDECOM-CNR-EN-REP-0002

10.6 Safety

Decommissioning Project - General Hazid Jacket Removal Report
DECOM-WHF-SA-HAZ-00094

Decommissioning Project - Major Hazard Workshop Identification Report – Woodhill Frontier
DECOM-WHF-SA-REP-00106

Murchison Platform - Perpetuity Liability Hazid – Hazid Report
MURDECOM-WHF-SA-HAZ-00103

Decommissioning Project – Safety Support – Murchison Topsides and Jacket Decommissioning Hazid - Heerema Option
MURDECOM-WHF-SA-REP- 00071

Decommissioning Project – Safety Support – Murchison Jacket Decommissioning Hazid – Aker Marine Option
MURDECOM-WHF-SA-REP-00074

Decommissioning Project – Safety Support – Murchison Topsides and Jacket

Decommissioning Hazid - Allseas Option
MURDECOM-WHF-SA-REP-00076

Decommissioning Project – Safety Support – Murchison Pipeline Decommissioning Hazid – Atkins Option
MURDECOM-WHF-SA-REP-00080

Decommissioning Project – Safety Support - Murchison – Topsides and Jacket Decommissioning Hazid – SHL Option
MURDECOM-WHF-SA-REP-00087

Decommissioning Project – Safety Support – Murchison Onshore Disposal – Hazid/Envid Report
MURDECOM-WHF-SA-REP-00113

Decommissioning Project - QRA Report – Murchison Jacket Decommissioning Options – Woodhill Frontier
MURDECOM-WHF-SA-REP- 00115

Murchison Decommissioning Study – Preliminary Footings Life Assessment
DECOM-ATK-ST-REP-00080

Ship Collision Risk – Management Review
A1204-CNR-TN-1

Assessment of Murchison Densitometer Sources HIRA
MURDECOM-CNR-EN-REP-00001

10.7 Comparative Assessment & Stakeholder Workshops

CA Workshop – Pre-Assessment Introduction Workshop
MURDECOM-CNR-PM-MOM-00151

CA Workshop – Technical Assessment Murchison Jacket
MURDECOM-CNR-PM-MOM-00156

CA Workshop – Economic Assessment Murchison Jacket
MURDECOM-CNR-PM-MOM-00161

CA Workshop – Safety Assessment Murchison Jacket
MURDECOM-CNR-PM-MOM-00176

CA Workshop – Societal Assessment Murchison Jacket
MURDECOM-CNR-PM-MOM-00179

CA Stakeholder Workshop – Transcript Report (March 2012)
MURDECOM-TEC-PM-REP-00184

CA Workshop – Environmental Assessment Murchison Jacket
MURDECOM-CNR-PM-MOM-00185

CA Workshop – Drill Cuttings Pile Assessment
MURDECOM-CNR-PM-MOM-00186

CA Workshop – Murchison 10th May 2012
MURDECOM-CNR-PM-MOM-00204

CA Workshop – Follow up Murchison Workshop 11th June 2012
MURDECOM-CNR-PM-MOM-00203

Technical Note – Murchison Comparative Assessment – Post Workshop Action
MURDECOM-CNR-PM-GTN-00210

Murchison Decommissioning Stakeholder Workshop 8th Nov 2012 – Summary Report
MURDECOM-CNR-PM-REP-00236

Murchison Decommissioning Stakeholder Workshop 8th Nov 2012 – Transcript Report
MURDECOM-CNR-PM-REP-00237

11.0 Appendices

Appendix 1: Comparative Assessment Criteria

Appendix 2: Summary of UK Stakeholder Responses to the Statutory Consultation

Appendix 3: The Independent Review Consultant (IRC)

Appendix 1: Comparative Assessment Criteria

CNRI acting on behalf of the Murchison Platform Owners developed a framework for conducting detailed CA's for the evaluation of alternative disposal options during the decommissioning planning process. The framework is based on the high-level framework outlined in the OSPAR Decision 98/3 and the DECC Guidance Notes. It adopts the five main assessment criteria prescribed in these guidelines – Safety, Environment, Technical, Societal and Economic – and appropriate sub-criteria chosen in light of the specific Murchison facilities and CNRI's SHE Policy and CNRI's mission statements.

The five main criteria, sub-criteria and the assessment method for each sub-criterion are described in the tables at the end of this section. Sub-criteria were assessed and then scored on a scale of 0-1, where 1 represents the best performance or outcome, using either quantitative or qualitative measures as described in.

A series of score guides were developed for the sub-criterion that was assessed on a qualitative basis. These score guides provided a framework for scoring the qualitative measures on a range of 0-1. Qualitative assessments were made by suitably experienced experts and based on the results of supporting decommissioning studies.

Quantitative estimates for sub-criteria were based on the data presented supporting decommissioning studies the values for each option within sub-criteria were transformed onto the 0-1 scale by proportional normalisation of the raw data.

CNRI developed a set of weightings for each of the five main selection criteria, which were subsequently split equally amongst the sub-criteria. The weightings were determined using Analytical Hierarchical Process (AHP) followed by an internal workshop to discuss the AHP results and ensure the weightings aligned with CNRI's SHE Policy, CNRI's vision and mission statements.

The scores for the option in each of the sub-criteria were then multiplied by the weightings that CNRI has determined for each sub-criterion, and the individual weighted scores summed to give a total weighted score for each option. The total weighted scores were then examined and discussed to determine the recommended option for that facility.

A sensitivity analysis was conducted to test whether the results of the Comparative Assessment would be any different if CNRI had selected different weightings. The results of the sensitivity analysis confirmed that CNRI CA results are robust and would not change with different weightings.

Criterion	Sub-criteria	Description of sub-criteria	Assessment of sub-criteria
SAFETY	Risk to project personnel offshore	Safety risk to project personnel working offshore.	Quantitative estimate of total PLL for project personnel.
	Risk to project personnel onshore	Safety risk to project personnel working onshore.	Quantitative estimate of total PLL for project personnel.
	Residual risk to other users of the sea	The combined safety risk to the crews of commercial fishing vessels, the crews of military vessels and the crew and passengers of commercial shipping vessels.	[55]Independent quantitative assessment of the snagging risk for commercial fisheries, and consequent risk to life and limb, as a result of the option's end-point. Provides values for likelihood of "serious injury" and "fatality".
ENVIRONMENT	Impacts of operations	The impacts of offshore and nearshore operations on any aspect of the marine environment. The impacts of onshore operations (e.g. dismantling, transporting, treating, recycling) on any ecological aspect of the terrestrial environment.	Qualitative assessment based on the results of the EIA process, where impacts are assessed and the significance categorised according to a pre-defined Risk Assessment Matrix.
	Impacts of end-points[56]	The impacts of offshore and nearshore end-points on any aspect of the marine environment. The impacts of onshore end-points (e.g. land filling, secondary use) on any ecological aspect of the terrestrial environment.	
	Total energy consumption and CO_2 emissions	Total energy consumption (GJ) and CO_2 emissions (te).	Quantitative estimate of total energy consumption (GJ) and CO_2 emissions (te) that would arise as a result of the successful completion of the option, including theoretical energy use and gaseous emissions that would arise if otherwise recyclable materials were left in the sea. Scores of both measures were averaged to provide an overall score for energy and emissions.

[55] The other users of the sea in the area of the project will be identified, and the potential for any project end points (e.g. jacket footings, or pipelines left in situ) to interact with other users will be identified. Only jacket footings and pipelines are candidates to remain in situ; therefore, it is highly unlikely that there will be any interactions with commercial shipping or the MOD. Consequently, the safety risk to other users of the sea shall be assessed by quantifying safety risk to fishermen.

[56] End Points addresses the consequence of an operation that describes the final condition of the material or components covered in the option

Criterion	Sub-criteria	Description of sub-criteria	Assessment of sub-criteria
TECHNICAL	Technical feasibility	Assessment of the technical feasibility of each option.	Qualitative assessment by expert judgement which was based on the range of engineering and technical studies carried out by the decommissioning team and their independent consultants.
	Ease of recovery from excursion	Assessment of the ability to recover from unplanned excursions and complete the planned decommissioning option.	
	Use of proven technology and equipment	Assessment of the extent to which the option requires the use of proven technology.	
SOCIETAL	Commercial impact on fisheries	Impacts of both the operations and the end-points on the present commercial fisheries in and around the Field. (NB Safety risks were considered under “safety” above).	Qualitative assessment based on information in the EIA process on the level of fishing activity in the area, the type of gear used, the value of the fishery, and the value of the ground that may or may not be available for fishing on completion of the options.
	Socio-economic impacts – amenities	The risks from any near-shore and onshore operations and end-points (dismantling, transporting, treating, recycling, land filling) on any aspect of the amenity or infrastructure of the environment.	Qualitative assessment based on the results of the EIA process, where impacts are assessed and the significance categorised according to a pre-defined Risk Assessment Matrix. Also informed by feedback from stakeholder dialogue.
	Socio-economic impacts – communities	The risks from any near-shore and onshore operations and end-points (dismantling, transporting, treating, recycling, land filling) on the health, well-being, standard of living, structure or coherence of communities.	Qualitative assessment based on the results of the EIA process, where impacts are assessed and the significance categorised according to a pre-defined Risk Assessment Matrix. Also informed by feedback from stakeholder dialogue.
ECONOMIC	Total project cost	The estimated total CAPEX cost plus a Net Present Value (NPV) estimate of the cost of any ongoing liability.	Quantitative estimate based on the programmes and schedules being prepared for the project.

Appendix 2: Summary of UK Stakeholder Responses to the Statutory Consultation

Summary of Consultation Responses	
Stakeholder Responses	**Comments made in response to Murchison consultation**
Statutory Consultees	
Global Marine Systems	1. No comments from GMS who note that no cables are expected to be directly affected in immediate vicinity, but that if in the unlikely event that any interaction were unexpectedly to be necessary in the course of engineering the project then liaison with specific cable owners would be needed. 2. Assumption that MoD would be consulted or aware of the project and of the operations for any military cables that may be in the region 3. Recommendation that when notice to mariners were arranged for the offshore works, then the Kingfisher Fortnightly Bulletin be updated to include details of the works to inform sea users.
National Federation of Fishermen's Organisations	1. Considers the information and rationale behind the project to be informative and comprehensive 2. Believes it imperative to get the correct balance between what is to remain on the seabed and its impact on future fishing operations. 3. The Federations both North and South of the border have expressed concerns on any part of the original structure remaining *in situ* but also understand the adverse environmental impact such complete removal would cause, e.g. disturbance of cuttings pile. 4. Restates preference for a structure that is visible (above surface) rather than one below sea level, despite understanding the restrictions on this matter, commenting that surface marker buoys or a fishing friendly structure could be placed over the remaining footings. 5. Feels that the decommissioning programme has been open, honest and informative and may well be the format for all other decommissioning programmes in the future.
Scottish Fishermen's Federation	1. Appreciation of engagement expressed. 2. Pleased to note P&A intentions, also bundle removal. 3. Notes derogation application plans, restating SFF preference for legs to be cut above sea surface level. 4. Recognises interrelationship between drill cuttings and footings. 5. Pleased to note that tie-in spools will be removed and are content given the circumstances for remedial rock. placement over exposed sections of PL115, and keen for overtrawlability trials to be undertaken on completion of latter.

	6. Notes plans to isolate gas export/import pipeline which forms part of NLGP and recognises that NLGP decommissioning does not form part of the Murchison decommissioning programme. 7. Reaffirmation of continued appreciation of the openness of dialogue to date and the wish to continue to work closely and positively with CNRI and the project team.
Core Stakeholders	
Aberdeen Grampian Chamber of Commerce	1. Advised that the Chamber had no further observations to make and acknowledging that comments made in November 2012 had been addressed and responded to by CNRI. 2. Considers that 'combined with the successful industry wide event held last month', the Chamber feels its input has run its course, though suggests that a further engagement in 2014 would be welcome to further explore the issues surrounding not just Murchison but other installations approaching decommissioning.
Greenpeace	1. Appreciate opportunity to comment and for these comments to be considered by DECC and OSPAR CPs 2. Express appreciation for the openness and transparency shown by CNRI during stakeholder consultation process and willingness to engage with Greenpeace on several occasions and at a detailed technical level, resulting in changes to documentation to make it clearer 3. Reiterates full support for Decision 98/3 4. Expresses concerns over certain areas, where despite discussion with CNRI no resolution has yet been found: i) stresses that Greenpeace does not support the approach taken by OSPAR to evaluate acceptability of 'leaving in place' of cuttings piles set out under recommendation 2006/5, nor the 'very limited and highly simplistic' threshold criteria on which Stage 1 of that approach depends, citing serious limitations which do not extend beyond consideration of estimated release rates for total hydrocarbons and area persistence in a similar context (whereas CNRI data shows cuttings sampled to date contain many more contaminants of concern); ii) expresses concern that the OSPAR rules mean there is no formal mechanism or guidance under which contaminants identified by CNRI will be taken into account when considering the acceptability of cuttings management options, particularly contaminants on the OSPAR List of Substances for Priority Action; iii) Notes high hydrocarbon content of drill cuttings pile, though acknowledges that according to CNRI's calculations this does not result in estimated oil leaching rates in excess of Stage 1 threshold criteria under OSPAR Recommendation 2006/5. Also notes presence in cuttings pile of other 'priority contaminants', listing these and by extrapolation proposing that total quantities of these would be 'very substantial'. 5. Appreciates that CNRI have presented all the available data on the

	presence of contaminants in the drill cuttings pile as part of the documentation submitted, also that CNRI have noted the toxicological significance of some of these priority substances within the ES and elsewhere, including persistence (also mentioned by the IRC), but are 'deeply concerned' that this has not had an influence on the consideration of acceptability of the proposed management options for the cuttings since CNRI has only been formally required to consider the two OSPAR threshold criteria of leaching rate of oil and area persistence in reaching its conclusions on the proposed management option for the cuttings. Adds that there is a danger that information on contaminants will be overlooked as a result and ignored in consideration of the proposed decommissioning programme – something which Greenpeace would find wholly unacceptable and therefore calls on the UK authorities to fully take it into account. 6. Recognises that by adherence to OSPAR Recommendation 2006/5, CNRI can claim to have fulfilled formal requirements relating to the assessment of the drill cuttings pile under that legislation, making clear that Greenpeace's concerns therefore related to the inadequacy of 2006/5 and its implementing legislation itself in this context, and of its ability thereby to ensure in and of itself the protection of the marine environment and the proper implementation of the OSPAR Hazardous Substances Strategy. 7. Two additional concerns expressed: i) that drill cuttings reinjection was considered within the comparative assessment when this would not be a permitted activity under current legislation governing the dumping of wastes at sea , making clear that this restriction should be clear in all considerations of the options evaluated; and ii) without deeper coring of the drill cuttings pile the possibility remains that other patterns of contamination could be detectable at different points in the pile, stressing there would be additional value in obtaining greater characterisation of the cuttings pile in the future (in order to inform management options for the wastes once recovered from the seabed) once that becomes a technical possibility. 8. States that Greenpeace has consistently reiterated that there should be a presumption to remove drill cuttings where it is technically feasible to do so and unless there are compelling reasons to justify a derogation.
International Marine Contractors Association	1. IMCA restated its position, as communicated to CNRI in 2012, that while it is relevant for IMCA to be kept abreast of progress on decommissioning, it should not be the conduit for discussions between operators and contractors regarding feasibility, planning for and carrying out such work and that industry should liaise direct with consultants on those issues directly without IMCA secretariat involvement.
Marine Conservation Society UK	1. MCS makes the assumption that for P&A, the Oil & Gas UK Guidelines for this are in line with OSPAR.

	2. Supports topsides proposals 3. Supports jacket removal and are disappointed that footings will be left in place, though accept providing it does not prevent access to the drill cuttings 4. Opposes drill cuttings being left in place and believes that efforts should be made to recover drill cuttings as far as is feasibly possible. 5. Supports proposals for removing short early production pipeline bundles and associated subsea equipment 6. Opposes the proposals to leave PL115 in situ and believes ‘such debris, especially oil contaminated debris’ should be removed. 7. Supports development and subsequent implementation of a recovery plan on completion of decommissioning and would like to be consulted on this.
Northern Lighthouse Board	1. Make clear that comments relate only to parts relating to Shipping and Navigational Safety. 2. No objection to the preferred option of removal to -112m below LAT with the remaining footings being properly identified on Admiralty Chart BA295 and recorded within the FishSafe information system. 3. Would require that Notice(s) to Mariners, Radio Navigation Warning(s) and publication in appropriate bulletins will be required stating the nature and timescale of any works carried out in the marine environment relating to the decommissioning project. 4. On final completion of the decommissioning operations would require position of any remaining sub-sea structure(s) and pipelines to be communicated to the UKHO in order that the admiralty chart BA295 can be correctly updated as stated above. 5. Marking and Lighting will be recommended for each stage of the decommissioning process through the formal DECC application and licensing process, recognising that suspension of decommissioning operations may be required due to seasonal weather and meteorological conditions and therefore request they are informed prior to any suspension to enable proposal of suitable Marking and Lighting regime to inform mariners of any remaining obstructions. 6. All vessel(s) deployed for the programme should be marked and lit as per the International Regulations for the Prevention of Colilsions at Sea. 7. Require that notifications of any movements regarding mobilisation and demobilisation of specialist vessels are sent to the NLB’s Edinburgh office.
North Sea Commission	1. Wrote to advise that ‘Unfortunately we are not able to give a formal comment within the deadline, as we did not adopt a common response within our political group.’ 2. Thanked CNRI for provision of information and ask to be kept updated on progress.

<table>
<tr><td>RSPB</td><td>1. Expresses appreciation for the level and nature of public engagement by CNRI
2. Reiterates that while RSPB's starting point for consideration of site clearance is that restoration should be to the state existing before development commenced, the Society recognises that such an aspiration may be more hazardous to the environment and to human safety than what is actually proposed, and that Murchison qualifies as a derogation candidate.
3. Asks that RSPB be kept informed of the progress of the project and particularly if any significant changes should arise as a result of this formal consultation.</td></tr>
<tr><td>S29 Notice Holders</td><td></td></tr>
<tr><td>Exxonmobil</td><td rowspan="2">Both companies replied in almost identical terms, namely that:
1. Based on their interpretations of the Petroleum Act 1988, section 29, and Agreement between the Norwegian and UK governments relating to the Exploitation of the Murchison Field Reservoir, the companies have no responsibilities.
2. As such, the companies abstain from commenting on the Murchison Field DP, requesting that it is made clear that it is not submitted on behalf of them.</td></tr>
<tr><td>Statoil</td></tr>
<tr><td>Maersk</td><td>Presentation made 8 August in response to invitation.</td></tr>
<tr><td>Commercially-linked Partners</td><td></td></tr>
<tr><td>Fairfield Energy</td><td>1. Table 1.6 of DP: preference for reference to 'operator' rather than 'owner' to be used as the heading to column 1 of table
2. Figure 2.2 of DP: consider annotations numbered 1 and 2 on schematic are unnecessary and potentially confusing; also, that text below the schematic differentiating 'operator, operations, primary emergency response and integrity' to be unnecessary in the context of the DP, suggesting it would be clearer if the annotations 1 and 2 were completely removed and that the descriptions of PL-115 Limits be simplified by removing the limit lines that describe 'operations, primary emergency response and integrity'.
3. Minor typos highlighted - p45: remove 'of' between 'review [of] materials' within table entry for Greenpeace; p47 where 'marketing on Admiralty Charts' should read 'marking on Admiralty Charts.'</td></tr>
<tr><td>Other Operators</td><td></td></tr>
<tr><td>ConocoPhillips
Marathon
Shell</td><td>Requests made for copies of various documents to help inform their own projects.</td></tr>
</table>

Appendix 3: The Independent Review Consultant (IRC)

The specific role of the IRC was to ensure that an appropriate range of decommissioning options was being assessed in sufficient depth and quality so that the resultant information available was adequate for a rational decision to be reached by CNRI in the CA.

Two verification statements from the IRC are attached:

I. Expert Verification Statement on the Comparative Assessment Procedure and Process used to determine the recommended decommissioning option for the Murchison Jacket.

II. Expert Verification Statement on the Murchison Jacket Decommissioning Comparative Assessment Results.

Xodus Group Ltd
Xodus House / 50 Huntly Street / Aberdeen / AB10 1RS / UK
T +44 (0)1224 628300 E info@xodusgroup.com
www.xodusgroup.com

26 June 2012

Expert Verification Statement

Murchison – Comparative Assessment Procedure

This statement has been prepared by Xodus Group Ltd (Xodus) in compliance with the UK Department of Energy and Climate Change (DECC) Decommissioning Guidance Notes on independent expert verification (Ref. 1).

Xodus has been appointed by CNR International (U.K.) Limited (CNRI), on behalf of the Murchison field partners CNRI and Wintershall Norge AS, to independently verify that a reliable Comparative Assessment (CA) procedure has been established in relation to the Murchison Asset for the following:-

> Jacket and footings
> Drill cuttings pile
> Pipelines and bundles

Xodus has reviewed the Comparative Assessment Method Statement (Ref. 2) and the Comparative Assessment Procedure (Ref.3). These reports are available for viewing at http://www.cnri-northsea-decom.com.

Xodus verifies that the processes described in the Method Statement and the Procedure will deliver robust, scientifically based CA's based on the five main criteria of:-

1. Safety
2. Environmental
3. Technical
4. Societal
5. Economic

Issued: MI Taylor
Checked: T Cairns
Approved: MI Taylor

1. DECC. Guidance Notes. Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998. Version 6 March 2011 (p64)
2. CNRI. Comparative Assessment Method Statement. Doc No DECOM-CNR-PM-PRO-00081 Rev B1.
3. CNRI. Comparative Assessment Procedure. Doc No MURDECOM-CNR-PM-PRO-00136 Rev A2.

Registered Office: Xodus House, 50 Huntly Street, Aberdeen, AB10 1RS. Registered Number: SC286421 (Scotland)
VAT Number: GB997341668

Xodus Group Ltd
Xodus House / 50 Huntly Street / Aberdeen / AB10 1RS / UK
T +44 (0)1224 628300 E info@xodusgroup.com
www.xodusgroup.com

3 May 2013

Expert Verification Statement

Murchison Decommissioning Comparative Assessment

This statement has been prepared by Xodus Group Ltd (Xodus) in compliance with the UK Department of Energy and Climate Change (DECC) Decommissioning Guidance Notes on independent expert verification (Ref 1).

As Independent Review Consultant (IRC), Xodus undertook a review of the Murchison Decommissioning Comparative Assessment comprising five phases, which can be summarised as:

- Phases 1 and 2 – review studies produced or commissioned by CNRI to inform the Comparative Assessment (CA) process;
- Phase 3 - review the approach to CA of Murchison facilities by CNRI, including review of CNRI CA Methods and Procedures (Ref 2 and Ref 3)*, and agree the level of participation as an independent review consultant;
- Phase 4 - review the CA process (pre-CA Report issue) and then review the Draft CA Report prepared by CNRI (Ref 4);
- Phase 5 – produce and publish the final IRC report involving collation of all IRC review work, including this issue of independent certification of CA process undertaken by CNRI for relevant Murchison facilities.

As summarised in its final report [MURDECOM-XDS-PM-REP-00062], Xodus verifies that:

1. For the subjects covered in reports from Phase 1 and 2 studies, there was sufficient information in place for CNRI to support a comparative assessment (CA), and the associated environmental impact assessment (EIA), for Murchison;
2. For the comparative assessment as described in the CNRI Draft CA Report (with the support of earlier informing reports) there is sufficient information in place for CNRI to support the development of a Murchison Decommissioning Programme;
3. CNRI has covered stakeholder consultation/engagement in a thorough and transparent manner throughout the project.

* *as already certified by the IRC (26 June 2012) (MURDECOM-XDS-PM-PRO-00206)*

Issued: 222 Gins

Checked:

Approved: 222 Gins

1. DECC, Guidance Notes, Decommissioning of Offshore Oil and Gas installations and Pipelines under the Petroleum Act 1998, Version 6 March 2011 (p64).
2. CNRI Comparative Assessment Method Statement. Doc No DECOM-CNR-PM-PRO-00081 Rev B1.
3. CNRI Comparative Assessment Procedure. Doc No MURDECOM-CNR-PM-PRO-00136 Rev A2.
4. CNRI Murchison Decommissioning Draft Comparative Assessment Report (issued for pre-read for Stakeholder Workshop 8 November 2012). MURDECOM-CNR-PM-REP-00225