Provision of Independent Review Consultancy Services Decommissioning

Murchison Decommissioning Comparative Assessment – Final IRC Report

CNR International (U.K.) Ltd

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Asset Support

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LIST OF ABBREVIATIONS

AGCC	Aberdeen & Grampian Chamber of Commerce
BTAs	Buoyancy tank assemblies
CA	Comparative assessment
CNRI	CNR International (UK) Ltd
CoP	Cessation of Production
CP	Cathodic protection
CRI	Cuttings re-injection
DECC	Department of Energy and Climate Change
DP	Drilling platform
EC	Environment Council
EIA	Environmental impact assessment
EMT	Environment management team
ENVID	Environmental issues identification
ERA	Environmental risk assessment
ES	Environmental statement
FAR	Fatal activity rate
FLAGS	Far North Liquids and Gas System
FLTC	U.K. Fisheries Offshore Oil & Gas Legacy Trust Fund Limited
GPS	Global positioning system
HLV	Heavy lift vessel(s)
IRC	Independent review consultant
JIP	Joint Industry Programme
JNCC	Joint Nature Conservation Committee
MBES	Multi-beam echo-sounder
MOM	Minutes of Meetings
MUR	Murchison platform
NLGP	Northern Leg Gas Pipeline
NNP	Ninian Northern Platform
OBM	Oil-based muds
OGUK	Oil and Gas UK
OSPAR	Oslo Paris Convention for the Protection of the Marine Environment of the North East Atlantic
PILOT	Oil and Gas Taskforce that facilitates the partnership between the UK oil and gas industry and Government
PL	Pipeline
PLL	Potential loss of life

PSD	Particle size distribution
QRA	Quantitative risk assessment
RSPB	Royal Society for the Protection of Birds
SFF	Scottish Fishermen's Federation
SHE	Safety, health and environment
SLV	Single lift vessel(s)
SSCV	Semi-submersible crane vessel(s)
SSIV	Subsea isolation value
UEA	University of East-Anglia
UKCS	UK Continental Shelf
UKOOA	UK Offshore Operators Association (now Oil and Gas UK (OGUK))

EXECUTIVE SUMMARY

1. The Murchison (MUR) jacket has a total weight of 27,584 tonnes, and therefore as it exceeds 10,000 tonnes it is a candidate for derogation from the base case of full removal under The Oslo Paris Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR) Decision 98/3, and that the option of leaving the jacket footings in place may be considered.
2. If CNR International (UK) Ltd (CNRI) wish to seek a derogation from the general rule of total removal for Murchison, they are required to demonstrate that there are significant reasons why leaving the 'footings' or part of the 'footings' in place is preferable to returning them to shore for reuse or recycling or final disposal on land. To achieve this, they must conduct an assessment in accordance with Annex 2 to the OSPAR Decision 98/3, and within the Framework described by the Department of Energy and Climate Change (DECC) in Annex A of the DECC Guidance Notes for Decommissioning Under the Petroleum Act 1998 [REF 1].
3. In the context of an assessment for derogation under OSPAR 98/3, DECC recommend that the studies and the assessment process that supports the chosen decommissioning option are subject to independent verification.
4. CNRI have appointed Xodus Group Ltd (Xodus) as Independent Review Consultants (IRC) for the comparative assessment (CA) of options for the Murchison jacket decommissioning. In addition, CNRI have requested the IRC to provide verification for the CA process for the management options for the Murchison drill cuttings pile (under OSPAR 2006/5) and the Murchison oil export pipeline which is a large diameter inter-field pipeline which is buried along 50% of its length and is a candidate for in-situ decommissioning (under the Petroleum Act 1998, DECC Guidance Notes for Decommissioning).
5. This report provides the findings of the IRC review to evaluate the scope, quality and application of the CNRI assessments of the decommissioning options for the Murchison jacket, drill cuttings pile and oil export pipeline.
6. The scope of work addressed in this document is the final summary report following the review of over 30 studies produced or commissioned by CNRI in support of the CA process for the Murchison jacket and footings, drill cuttings and oil export pipeline.
7. Phases 1 and 2 of the scope comprised review of externally commissioned studies to inform the CA process, This was followed, in Phases 3 to 5, by review of the CA methodology and procedures, and their subsequent application (including through CA workshops and preparation of a Draft CA report).
8. This summary report is supported by detailed interim reports, covering:
   - Phase 1 studies
   - Phase 2 studies
   - Review of CNRI CA Methods and Procedures [MURDECOM-XDS-PM-PRO-00059]
   - Review of CA Workshops and Draft CA Report [MURDECOM-XDS-PM-REP-00002]
9. It is important to note that under the DECC Guidance Notes the purpose of verification is to confirm that the assessments are reliable and there is no requirement to verify the final means of weighting and balancing the options but the process must be transparent.
10. The IRC considers that for the subjects covered in reports from Phase 1 and 2 studies, there was sufficient information in place for CNRI to support a CA, and the associated environmental impact assessment (EIA), for Murchison decommissioning.
11. As stated in Section 4, and confirmed in the formal IRC Verification Certificates, the IRC considers that for the CA as described in the CA Report (with the support from earlier informing reports) there is sufficient information in place for CNRI to support the development of a Murchison Decommissioning Plan.

12. This IRC final report reviews stakeholder consultation up to and including the second stakeholder workshop in November 2012. CNRI has covered such consultation in a thorough and transparent manner and must be applauded for the efforts undertaken.

1 INTRODUCTION

1.1 Background

The Murchison Platform (MUR) is located in 156m of water on the UK Continental Shelf (UKCS), in Block 211/19 approximately 550km (330miles) NE of Aberdeen. Oil is exported onshore to Sullom Voe, Shetland, while gas export / import is available via the Far North Liquids and Gas System (FLAGS) line.

The Murchison jacket has a total weight of 27,584 tonnes, and therefore as it exceeds 10,000 tonnes it is a candidate for derogation from the base case of full removal under The Oslo Paris Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR) Decision 98/3, and that the option of leaving the jacket footings in place may be considered (see Section 1.2).

If CNR International (UK) Ltd (CNRI) wish to seek a derogation from the general rule of total removal for Murchison, they are required demonstrate that there are significant reasons why leaving the 'footings' or part of the 'footings' in place is preferable to returning them to shore for reuse or recycling or final disposal on land. To achieve this, they must conduct an assessment in accordance with Annex 2 to the OSPAR Decision 98/3, and within the Framework described by the Department of Energy & Climate Change (DECC) in Annex A of the DECC Guidance Notes for Decommissioning Under the Petroleum Act 1998 [1].

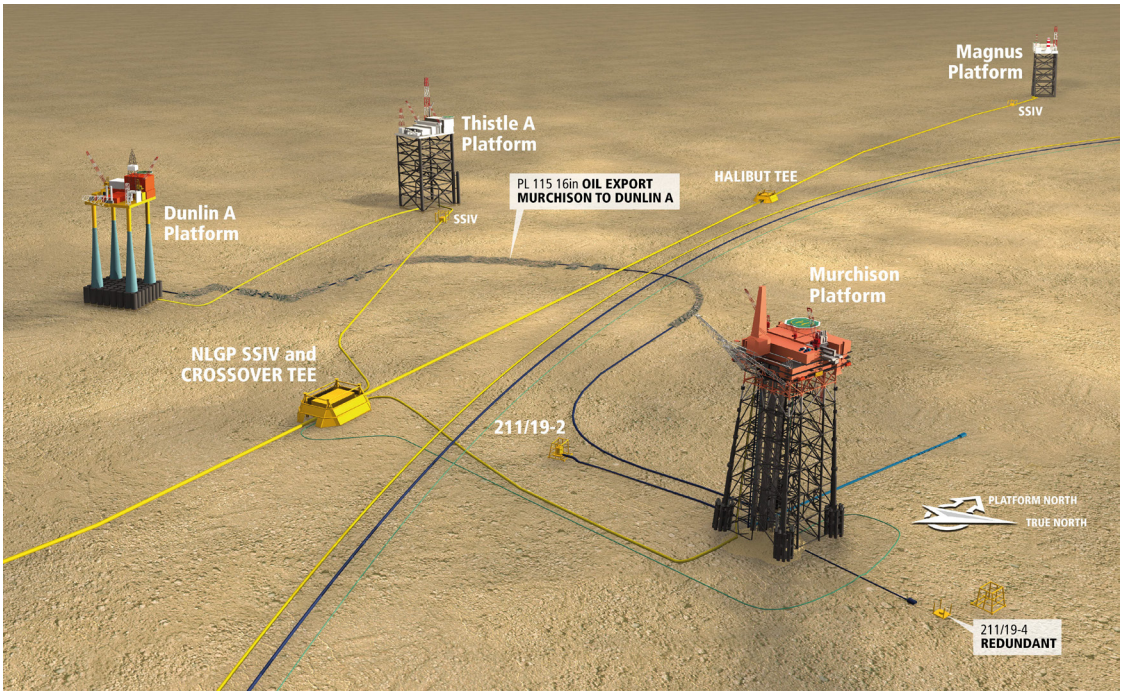

Figure 1.1 Artists Impression of Murchison Platform

1.2 Legislative Context

The decommissioning of disused offshore installations is governed under UK law by the Petroleum Act of 1998 as amended by the Energy Act of 2008. The Petroleum Act also incorporates the UK Government's international obligations relating to the decommissioning of offshore installations that arise from the OSPAR convention. The OSPAR Decision 98/3 entered into force in 1999. OSPAR Decision 98/3 requires that the topsides of all installations and jackets weighing less than 10,000 tonnes are removed and returned to shore for reuse, recycling or disposal.

DECC Guidance Notes [Ref 1] states:

"Under the terms of (OSPAR) Decision 98/3, there is a prohibition on the dumping and leaving wholly or partly in place of offshore installations. The topsides of all installations must be returned to shore. All installations with a jacket weight less than 10,000 tonnes must be completely removed for re-use, recycling or final disposal on land. The Decision recognises that there may be difficulty in removing the 'footings' of large steel jackets weighing more than 10,000 tonnes and in removing concrete installations. As a result there is a facility for derogation from the main rule for such installations. It has been agreed that these cases should be considered individually to see whether it may be appropriate to leave the footings of large steel installations or concrete structures in place. Nevertheless, there is a presumption that they will all be removed entirely and exceptions to that rule will be granted only if the assessment and consultation procedure, which forms part of the OSPAR Decision, shows that there are significant reasons why an alternative disposal option is preferable to re-use or recycling or final disposal on land".

The Murchison jacket has a maximum gross weight of 27,584 tonnes and was installed in 1979 and as such is a potential derogation candidate. Nevertheless, there is a presumption that the jacket will be removed entirely and derogation granted only if a detailed comparative assessment (CA) of options and consultation with stakeholders demonstrates that an alternate disposal option is preferable.

There are no international guidelines covering the decommissioning of disused pipelines. The DECC Guidance Notes [REF 1] have therefore been followed. In particular, the requirement that small diameter early production pipeline bundles will be removed completely and returned to shore for recycling or disposal. The main oil export pipeline which is intermittently stabilised by rock placement was subject to a CA process.

The Petroleum Act enables the Secretary of State to make regulations as required, and advice on complying with the regulations are published as the DECC Guidance Notes.

1.3 Role of the IRC

In the DECC Guidance Notes [REF 1] it is stated that "*it is important that the studies and the assessment process that supports the chosen decommissioning option are subject to independent expert verification. The purpose of this verification is to confirm that the assessments are reliable and there is no requirement to verify the final means of weighting and balancing the options but the process must be transparent. This may involve the establishment of an independent review process to evaluate the scope, quality and application of the work undertaken."*

CNRI have appointed Xodus Group Ltd (Xodus) as Independent Review Consultants (IRC) for the CA of options for the Murchison jacket decommissioning. In addition, CNRI has requested the IRC to provide verification for the CA process for the management options for the Murchison drill cuttings pile (under OSPAR 2006/5) and the Murchison oil export pipeline which is a large diameter inter-field pipeline which is buried along 50% of its length and is a candidate for in-situ decommissioning (under the Petroleum Act 1998, DECC Guidance Notes for Decommissioning).

Although the IRC has been expected to comment on specific technical aspects of the project, particularly when reviewing supporting technical documents, it has always stressed that final 'ownership' of decisions on decommissioning options remain with CNRI.

This was achieved by ensuring that the IRC maintained an independence from CNRI's CA decision making process.

At the conclusion of the CA process, the IRC undertook to provide a summary report (this report), on their findings for individual studies used to inform the CA and an overview statement on the process that CNRI employed to manage the CA process.

1.4 Scope of Work and Terms of Reference

The overall scope of work comprised five phases, which can be summarised as:

For Phase 1 and 2 studies, the IRC was required to:

- Review studies commissioned by CNRI covering the potential options for decommissioning the platform jacket, drill cuttings and pipelines;
- Identify any notable omissions in the content of these studies and provide an overall written review of each study assessing the validity of the technical content and resulting conclusions;
- If necessary, provide CNRI with a list of topics and key points requiring particular follow-up action, with accompanying technical justifications and appropriate regulatory context (with particular reference to the DECC Guidance Notes);
- Assist CNRI in developing additional study work scopes or reviews to rectify omissions in the quality or scope of the original studies data and the resulting outcomes/conclusions that can be drawn from these data; and
- Maintain records of all review activities and a comprehensive register of the documents reviewed and the resulting outcomes.

For the wider CA process (i.e. Phases 3 to 5), the IRC verification role included:

- Reviewing and commenting on the CNRI's CA Method Statement, including submission of Verification Certification relating to the methodology to be applied in the CA process;
- Attending the pre-assessment workshop to witness the briefing of the CA participants;
- Reviewing the Minutes of Meeting (MOM) from the pre-assessment workshop and technical (specialist) scoring meetings;
- Attending as observers at the pre-CA open session stakeholder workshop (March 2012) to witness the briefing and handling of questions from stakeholders; and review of minutes/report from that workshop;
- Attendance, as observers, at the main CA workshop, including first follow-up session; reviewing the MOM, notes, findings and conclusions from the CA main workshop, including follow-up sessions;
- Review of overall CA process;
- Reviewing the draft and final draft CA report produced by CNRI (for pre-read by all stakeholders, in time for second open session workshop);
- Reviewing the means by which the results from the first stakeholder workshop (March) were reported back to stakeholders, notably attendance as observers at post-CA report stakeholder workshop (November 2012); followed by review of minutes/report from that workshop;
- Submission of a final report to CNRI on the full CA review undertaken by the IRC, to be followed by submission of Verification Certification relating to the full CA process undertaken by CNRI.

1.5 Documents Reviewed

1.5.1 Specialist Studies Reviewed in Phases 1 and 2

1.5.1.1 Project Engineering Studies

- Preliminary footings life assessment. Atkins Ltd DECOM-ATK-ST-REP-00080 Issue 3
- NNP/MUR - Limitations to Marine Operations during Platform Removal. GL Noble Denton DECOM-GLND-MA-REP-00044 Rev B1
- NNP/MUR - Platform Removal Technology Study. GL Noble Denton DECOM-GLND-PM-STU-00042 Rev B1
- Murchison Topsides and Jacket Removal Study – Method Statement. Heerema Marine Contractors MURDECOM-HMC-ST-PRO-00033 Rev A

- Murchison Jacket BTA Removal Study. Aker Solutions. Doc No MURDECOM-AKER-ST-REP-00025 Rev 01
- Method Statement Murchison Jacket Removal. Excalibur Marine Contractors MURDECOM-ALS-ST-PRO-00024 Rev B
- Decommissioning of the Murchison Platform (HLV Option). Seaway Heavy Lifting Engineering BV MURDECOM-SHL-PM-REP-00067 Rev B
- Murchison Subsea and Pipeline Assets. Atkins Ltd MURDECOM-ATK-PI-REP-00027 Rev 2
- 2011 Pipeline Inspection & Environmental Survey Phase 2 Reports. Integrated Subsea Services Ltd PLS-ISS-SU-REP-15430 Rev 1
- Murchison Platform – 2010 ROV Structural Inspection Report MURDECOM-ISS-SU-REP-15406
- Murchison – Post Cessation of Production (CoP) Alternate Use Appraisal DECOM-GLND-PM-STU-00048
- MUR - Evaluation of Removal Options for Murchison Jacket. GL Noble Denton. Doc No MURDECOM-GLND-PM-REP-00008 Rev A1
- Murchison Platform Linear and Non-Linear Strength Assessment. Atkins Ltd. Doc No MUR-ATK-ST-ER-0224 Rev A1
- Murchison Decommissioning Project – CNRI Technical Note on Anchor Pile Cutting MURDECOM-CNR-PM-GTN-00137

1.5.1.2 Safety Studies

- Murchison Pipelines and Platform Fishing Risk Analysis. Anatec Ltd. Doc No A2710-CNR-FI-6 Rev 06
- QRA Report Murchison Jacket Decommissioning Options. Woodhill Frontier Caledonia Ltd MURDECOM-WHF-SA-REP-00115 Rev C.
- Decommissioning Project- QRA Report – Murchison Pipeline Decommissioning Option MURDECOM-WHF-SA-REP-00082

1.5.1.3 Environment / Societal Studies

- EIA Scoping Document. BMT Cordah Limited. Doc No MURDECOM-BMT-EN-REP-00036. Rev C2 (plus earlier revisions)
- Pre-Decommissioning Environmental Baseline Survey MURDECOM-ERT-EN-REP-00056
- Environmental Statement for the Decommissioning of the Murchison Facilities – (Draft) Project Description MURDECOM-BMT-EN-REP-00124 Rev 02
- Environmental Statement for the Decommissioning of the Murchison Facilities – (Draft) Environmental Description MURDECOM-BMT-EN-REP-00126
- Energy and Emissions Report for the Decommissioning of Murchison MURDECOM-BMT-EN-REP-00125
- Underwater Noise Impact Assessment for the Murchison Field Decommissioning MURDECOM-BMT-EN-REP-00122; including earlier draft
- Environmental Statement for the Decommissioning of the Murchison Facilities – Risk Assessment and ENVID Results MURDECOM-BMT-EN-REP-00127; including earlier ENVID report drafts
- Murchison Drill Cuttings Pile Long-Term Cuttings Pile Characteristics. Genesis MURDECOM-GEN-EN-REP-00133 Rev B4

- Murchison Drill Cuttings Pile Modelling the Effects of Human Disturbance of the Cuttings Pile. Genesis MURDECOM-GEN-EN-REP-00135 Rev B6
- Environmental Assessment of Options for the Management of the Murchison Drill Cuttings Pile. BMT Cordah MURDECOM-BMT-EN-STU-00132 Version 2
- Murchison Drill Cuttings Pile Modelling Disturbance of Drill Cuttings from the Collapse of the Structural Piles MURDECOM-GEN-EN-REP-00240
- Commercial Fisheries – Socioeconomic Impact Study. SSF Services Ltd MURDECOM-SFF-EN-STU-00131; including initial draft
- Environmental Statement for the Decommissioning of the Murchison Facilities MURDECOM-BMT-EN-REP-00198 (draft)

1.5.2 Documents Reviewed within Phases 3 to 5

1.5.2.1 Comparative Assessment Reports

- Comparative Assessment Method Statement DECOM-CNR-PM-PRO-00081
- Comparative Assessment Procedure MURDECOM-CNR-PM-PRO-00136
- Murchison Decommissioning Draft Comparative Assessment Report - Draft Issued as pre-read for Stakeholder Workshop, 8 Nov 2012 MURDECOM-CNR-PM-REP-00225

1.5.2.2 Comparative Assessment & Stakeholder Workshop Minutes

- Pre-Assessment Introduction Workshop MURDECOM-CNR-PM-MOM-00151
- Technical Assessment Murchison Jacket MURDECOM-CNR-PM-MOM-00156
- Economic Assessment Murchison Jacket & Pipelines MURDECOM-CNR-PM-MOM-00161
- Technical Assessment Murchison Pipelines MURDECOM-CNR-PM-MOM-00162
- Safety Assessment Murchison Jacket & Pipelines MURDECOM-CNR-PM-MOM-00176
- Societal Assessment Murchison Jacket & Pipelines MURDECOM-CNR-PM-MOM-00179
- CA Stakeholder Workshop – Transcript Report (March 2012) MURDECOM-TEC-PM-REP-00184
- Environmental Assessment Murchison Jacket & Pipelines MURDECOM-CNR-PM-MOM-00185
- Drill Cuttings Pile Assessment MURDECOM-CNR-PM-MOM-00186
- CA Main Workshop – Murchison 10th May 2012 MURDECOM-CNR-PM-MOM-00204
- CA Workshop – Follow up Murchison Workshop June 2012 MURDECOM-CNR-PM-MOM-00203; plus pre-read documents (dated 4/6/2012, pdf - no ref number)
- CA Workshop – Follow up Murchison Workshop, July 2012 MURDECOM-CNR-PM-MOM-00213; plus pre-read documents MURDECOM-CNR-PM-GTN-00210
- CA Stakeholder Workshop – Summary Report and Transcript (by The Environment Council (EC)) November 2012 MURDECOM-CNR-PM-REP-00236 and MURDECOM-CNR-PM-REP-00237

1.5.2.3 HAZID Reports Provided For Information

- 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 - Comparative Assessment 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

1.6 Jacket & Footings Overview

The jacket is an eight leg structure of welded steel construction and measuring 75m by 75m at the base and 52.8m by 62.5m at the top. The jacket, standing in a water depth of 156m, has an overall height of 188m. The jacket foundations consist of 32 piles in groups of 8 around the four corner legs of the jacket. Each pile is 82” in diameter and 80m in length and was designed to be driven some 50m into the seabed.

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 -112m below LAT. The jacket main legs have a diameter of 2m at the water line increasing to 6m diameter at the seabed.

As already stated in Section 1.1, the presumption of total removal by OSPAR is the starting point for the comparative assessment (CA) process. By way of derogation a CA process has to be undertaken in accordance with OSPAR Annex 2 that requires there are significant reasons why a partial removal option is preferable to full removal for reuse, recycling or disposal on land.

For the Murchison jacket two decommissioning options were identified as being compliant with the OSPAR Decision 98/3 and DECC Guidelines and thereby assessed within a formal CA process.

- Full removal, with foundation piles cut 3m below the mudline. The total weight of jacket removed would be approximately 27,580te
- Partial removal of the jacket down to the top of footings, defined as the top of the highest Pile. The total weight of jacket removed would be approximately 14,850te.

Thus, decommissioning of the large, heavy Murchison jacket presents a major technical challenge of cutting at this depth/ steel thicknesses not undertaken elsewhere to date.

1.7 Drill Cuttings Overview

Drilling operations at the Murchison platform have taken place since the 1970s and up to 2008. There have been discharges of drill cuttings and drilling mud including oil-based muds (OBM) that have caused a drill cuttings pile to form beneath the platform jacket structure,. The pile has been measured using a multi-beam echo-sounder (MBES) and was found to have a measured height of 15.34m and a measured volume of 22,545m^3.

OSPAR Recommendation 2006/5 placed requirements around the management of such oily cuttings piles, depending largely on the rate of oil leaching from the pile and the area of seabed contaminated. An assessment submitted by CNRI to OSPAR in 2008 based on industry-wide data concluded that the Murchison pile did not exceed the relevant criteria and that it could be left to degrade by natural processes. However, it must be remembered that the OSPAR threshold criteria refer to undisturbed cuttings piles.

If undisturbed, the pile is expected to persist on the seabed physically for an indeterminate length of time. Its chemical and biological footprint is expected to diminish slowly and be detectable for many hundreds or possibly thousands of years.

However, the cuttings pile at Murchison sits on the seabed within the footprint of the base of the jacket, and partially covers part of the lower bracing and the footings. Therefore, Murchison decommissioning involving the full removal of the jacket, including the jacket footings, would require removal/relocation of all/most of the cuttings pile.

A detailed assessment of both the release rates/duration of hydrocarbons from both the undisturbed and deliberately disturbed/excavated cuttings pile requires a reliable definition of the internal structure of the pile.

1.8 Pipeline Overview

Pipelines are not covered by OSPAR Decision 98/3 and there are no international guidelines on the decommissioning of disused pipelines. The framework for decommissioning disused pipelines on the UKCS is provided by Part IV of the Petroleum Act 1998 and the Pipeline Safety Regulations 1996 provide requirements for the safe decommissioning of pipelines (as explained in the DECC Guidance Notes). As there is no pre-defined 'norm', the decommissioning of UKCS pipelines must be the subject of a CA process in which all feasible options are considered.

The Murchison Platform ties into a pipeline infrastructure that comprises three principal configurations:

- The Oil Export Pipeline (OEL) PL115 which exports produced oil to Dunlin (and then onto St Fergus terminal via the Cormorant Platform). PL 115 oil export line runs under a number of existing pipelines.

  This Murchison export pipeline is a candidate for *in-situ* decommissioning and therefore subject to comparative assessment.

- The pipeline bundles PL123, PL124 and PL125 which formed part of the early production facilities. The bundles will be removed as small diameter flexible pipelines and excluded from the detailed CA process.

- The Murchison Platform imports gas from the BP-operated Northern Leg Gas Pipeline (NLGP) network via PL165 and associated control umbilical. These lines will be decommissioned at a later date as part of the NLGP system and are therefore not part of the Murchison Programme. It will be necessary to disconnect PL165 riser and control umbilical in preparation for the future decommissioning of PL165 by the NLGP owners.

2 PHASE 1 AND PHASE 2 DOCUMENT REVIEWS

2.1 Approach to Reviews

This section of the report addresses Phases 1 and 2, in which over 30 studies were commissioned by CNRI. The IRC reviews were undertaken against a list of required criteria produced by Xodus and agreed with CNRI (MURDECOM-XDS-PM-TN-00075).

At the start of the review process the IRC reviewed the EIA Scoping Reports, initially version C1, which was re-issued in February 2012 with stakeholder comments [MURDECOM-BMT-EN-REP-00036. Rev C2]. The primary purpose of the Scoping Report was to ensure that CNRI would be adequately informed to conduct a full EIA, listing study requirements and outcomes expected. The outcome of proposed studies would inform the CA process, as well as the Environmental Statement (ES), for the final recommended decommissioning options.

In original project planning it was intended that Phase 2 would focus primarily on studies/reports informing the EIA process, thus contributing to the final ES for the recommended decommissioning options; however project scheduling and contributing study completions resulted in some re-allocation of report reviewing by the IRC between the two phases. For each of the reports reviewed, the IRC provided formal responses to CNRI, identifying key points of importance in informing the CA process, noting any omissions in the content of these studies, and assessing the validity of the technical content and resulting conclusions. Where necessary any requirements for particular follow-up action were identified, with accompanying technical justifications and appropriate regulatory context. CNRI addressed the comments either directly or through their subcontractors and reported to the IRC. As an example, there was significant discussion relating to the ENVID process which was central to the EIA process, which was informing both the CA process and the final ES for the recommended decommissioning option (the latter outwith the CA process). Discussions resulted in changes, including re-wording of the specialist report title, but retained some contractor opinions.

Within its formal role, the IRC ensured that each report review was formulated to assist CNRI in developing additional study work scopes and/or assist rectification of omissions in the quality or scope of the original studies data and the resulting outcomes/conclusions that can be drawn from these data.

In addition to the formal IRC reviews on each specialist study report, throughout Phases 1 and 2 there was extensive communication between the IRC and CNRI, including several hundred email exchanges supporting provision of interim supporting data/opinion, designed to inform the evolving CA process by CNRI.

Although the technical content of each report was reviewed by the IRC, the key role of IRC verification was to ensure that these reports provided sufficient content to inform the CA process and that it was utilised in a transparent manner by CNRI.

In this final report Xodus, having reviewed all documents provided by CNRI (see Section 1.5, above) and considered responses (including by email) from CNRI, the IRC has briefly summarised the contents herein, under the following facility categories:

- Jacket and footings;
- Drill cuttings pile;
- Pipeline (and umbilicals).

2.2 Jacket & Footings

2.2.1 Technical Issues

It is emphasised that the issues identified below are based on the review of the technical studies provided to the IRC in Phase 1.

Technically, there are no major problems in removing the jacket, either partially or fully, although there are additional project/safety risks in removing the jacket footings. Jacket removal involves the use of well-established offshore practices.

Removal of the jacket and footings can be achieved by several contractors although removal of the footings requires the removal of a substantial portion if not the whole of the drill cuttings mound.

CNRI advise that regular checks on corrosion levels are undertaken as part of standard operational maintenance and integrity checks. The most recent survey was March 2011 (covering bundles, trees, jacket, cathodic protection values, and conductors).

Typical project risks and mitigation measures have been identified by the various contractor studies.

It has been stated that cutting tools do not currently exist for the large diameter jacket legs, although time is being allowed for their development.

No insurmountable concerns are raised about the removal of the jacket footings, although excavation is required to remove both drill cuttings and soil to enable the cutting below the mud line.

No concerns have been raised regarding the stability and structural integrity of the jacket and footings during the removal process, although structural analyses have not yet been performed. These would be expected during more detailed assessments.

The schedules seen by the IRC indicate the jacket would be removed in a single season. However, the possibility of the removal spanning two summers should be considered, i.e. the stability of remaining sections will be checked.

2.2.2 Safety Issues

With the footings left in place the estimated annual societal risk increase to fishermen is 1.5×10^{-5} (1 fatality in 64,900 years). This is a low risk. The IRC also recognise that the future pattern of fishing activity over the next 1000 years of potential footings persistence is impossible to estimate. The fatality data are based on older historic data (e.g. Westhaven tragedy data) and there have been major technological advances with GPS and “Fishsafe” systems.

Robust potential loss of life (PLL) summary tables have been prepared by CNRI using industry-accepted fatal activity (FAR) rates for the jacket removal options.

As the additional risk associated with removal of the footings is similar to the estimated fishing risk from leaving the footings in place thus safety risk issues are neutral in the overall comparative assessment over the jacket and footings.

The risks associated with on-going footings surveys have not as far as can be established been included in any comparative risk assessments.

2.2.3 Environmental and Societal Issues

Should full removal of the jacket be considered it would require displacement/removal of a large proportion, or more probably the whole of the cuttings pile, as discussed above (2.2.1, technical items paragraph 2).

As identified in the ENVID [MURDECOM-BMT-EN-REP-00127], there could be some *moderate* potential issues if the full jacket is dismantled in inshore Norwegian waters, but since a likely site has been assessed by Norwegian regulatory authorities for wider industry use, it can be assumed that detailed procedures are in place to address and mitigate this.

The underwater noise impact assessment report [MURDECOM-BMT-EN-REP-00122] presented an assessment of the likelihood of both disturbance and injury to cetaceans as a result of noise due to decommissioning activities. This study indicated that the threshold for injury (as defined by Southall *et al*., 2007) [REF 2], is not exceeded by any of the proposed decommissioning activities. Underwater cutting is expected to be the highest source of sound associated with the decommissioning activities.

The ENVID also identifies the issue of inshore/onshore odour generation from decaying fouling growth on the jacket. Again, it will be important to have adequate regulatory/procedural control.

2.3 Drill Cuttings Pile

2.3.1 Technical Issues

Removal of the jacket and footings can be achieved by several contractors although removal of the footings requires the removal of a substantial portion of the drill cuttings mound.

Although Technical Note DECOM-CNR-EN-ETN-00102 considered data for cuttings recovery and potential treatment (in line with UK Offshore Operators Association (UKOOA) Joint Industry Project (JIP) reporting in 2002), should cuttings recovery be considered further a more detailed technology assessment would be prudent; see below and subsequent CA process discussions.

Initial assessment by CNRI reservoir engineers suggested that cuttings re-injection (CRI) of recovered cuttings could be a possible disposal option, even with the relatively large volumes involved; but see subsequent CA process discussions on regulatory constraints and viability cautions.

2.3.2 Safety Issues

Safety issues have not been addressed in the reports studied. The quantitative risk assessment (QRA) did not cover drill cuttings pile recovery and treatment due to a lack of actual accident statistics. The procedures were covered in the specific HAZID (MURDECOM-WHF-SA-HAZ-00165).

2.3.3 Environmental and Societal Issues

The rate of oil loss and persistence of the undisturbed drill cuttings pile are well within the OSPAR Stage 1 threshold values and indicate that within the OSPAR recommended management regime the cuttings pile may be left undisturbed.

It is recognised that, if the drill cuttings pile is to be disturbed in any way, a formal CA of drill cutting options would have to be made in accordance with Stage 2 of OSPAR Recommendation 2006/5 which in part at least was developed in the drill cuttings management report and its supporting modelling studies.

The definitive assessment of potential environmental risks from such cuttings pile disturbance requires a good understanding of the internal structure/chemistry of the pile. The physical dimensions of the cuttings pile are fully documented from direct field measurement. Currently, understanding of the internal structure is largely dependent on modelling outputs. Although such modelling has been robust, the lack of adequate ground truthing by direct sampling leaves significant uncertainties.

The uncertainty in the modelling could be quantified by conducting a survey of the cuttings pile to fully describe the particle size distribution and hydrocarbons at depth over the full extent of the pile. However, cuttings pile sampling methodology used to date only provides information on the surface/near surface samples. This does not provide chemical data for the deeper drill cuttings (i.e. most of the 15 metres height of the pile). Therefore, uncertainty remains on attempts to predict levels of oil (including free oil) and other components which potentially could be released if the cuttings pile is disturbed. This was addressed in the review of the Environmental Assessment of Options for the Management of the Murchison Drill Cuttings Pile (MURDECOM-BMT-EN-STU-00132); and CNRI has since indicated that when practicable attempts to directly deep-sample the pile will be attempted.

In considering options for the decommissioning of the cuttings pile the 'leave *in situ'* option may appear the best in the short term, but it leaves a long-term legacy factor. However, it is only an option when linked to the jacket decommissioning derogation option, i.e. leaving footings in place; when the footings provide shelter from fishing disturbance.

Although cuttings pile decommissioning options were considered separately, as required by DECC, it is obvious that they are interlinked to the options for jacket decommissioning. If the jacket footings are left in place (i.e.

derogation option) the cuttings pile will be left *in situ*. If full removal was the jacket option, the cuttings pile would have to be removed to provide access for cutting operations.

If the footings were to be removed in jacket decommissioning, the cuttings pile would also need to be removed using one of several methods. The option of dispersing the cuttings to the neighbouring seabed presents the worst environmental option, certainly in the short term (only issue considered of major significance in the ENVID).

Other options involve lifting the cuttings to the surface, for onward handling/disposal. The recovery operation can be undertaken with only moderate potential environmental impact. Technical studies, however, suggest the large volumes of water added to the cuttings during recovery would present major subsequent handling operations, particularly if the final disposal is onshore.

The possibility of re-injection of the recovered cuttings via an existing Murchison well was considered a potentially viable option but requires detailed study. If practicable, it could provide a good environmental option, combining moderate/acceptable short-term risk with removal of any long-term/legacy risk; assuming it can be permitted under UK regulations relating to historic (Murchison) cuttings. This is discussed in more detail in the Draft CA report.

Although there are differences in energy use (and consequent atmospheric emissions) between the decommissioning options, they are minor; and it should be noted that placed in perspective against total Murchison activities they are less than total emissions generated by Murchison during normal operations in 2011. Therefore, these energy/emission figures should not play a significant role in assessing the different cuttings pile decommissioning options in the CA process.

2.4 Pipeline

2.4.1 Technical Issues

A number of issues were raised in the Atkins Report (Murchison Subsea and Pipeline Assets, MURDECOM-ATK-PI-REP-00027) regarding the current condition of the pipelines and bundles (e.g. internal condition, contents etc.). These will be addressed by CNRI during the design stage.

There are a number of 3rd party lines crossing over the Murchison oil/gas/umbilical lines. These will not be disturbed.

The Murchison Platform imports gas from the BP-operated NLGP network via PL165 and associated control umbilical. These lines will be decommissioned at a later date as part of the NLGP system and are therefore not part of the Murchison Programme.

2.4.2 Safety Issues

Statistically, there will be potentially 0.14 fatalities from pipeline snagging events over an assumed 400 year persistence period, although this calculation is based on older historic data (e.g. Westhaven tragedy data) and there have been major technological advances with global positioning systems (GPS) and “Fishsafe” systems since that time.

It would be difficult to predict fishing activity intensity in ten years’ time with any degree of accuracy far less over 400 years. Thus the IRC recognises the difficulties in predicting risk exposures over such a long period into the future.

The on-going survey commitments for pipelines left *in situ* have not been incorporated in the QRA and that will be an important comparative factor to consider.

2.4.3 Environmental and Societal Issues

The Scottish Fishermen’s Federation (SFF) report (Commercial Fisheries Socioeconomic Impact Study MURDECOM-SFF-EN-STU-00131) identified interference to fishing activities resulting from the presence of vessels involved in burying exposed sections by trenching, removing spools and burying ends as potentially

generating socioeconomic risk of "moderate significance". The IRC considers this to be ranked too high, when considering on-going vessel activity in the area and consideration of duration.

In stakeholder dialogue, the SFF considered the risk from trenching operations in the stiff clay of Murchison area of particular concern, because of risk of significant berms being produced, posing a snagging hazard.

2.5 Conclusions (from Phase 1 and 2 Report Reviews)

Over 2011 and 2012, for each of the reports undertaken/commissioned by CNRI to inform the CA process, the IRC provided formal reports, identifying key points of importance, noting any omissions in the content of these studies, and assessing the validity of the technical content and resulting conclusions. Where necessary any requirements for particular follow-up action were identified, with accompanying technical justifications and appropriate regulatory context. CNRI addressed these either directly or through their subcontractors and the reported to the IRC.

In addition to formal review, throughout phases 1 and 2 there was extensive communication between CNRI and the IRC, particularly email exchanges, to ensure respective inputs to document reviewing, providing a firm foundation for CA.

Technically, solutions can be engineered to remove the jacket, either partially or fully, although there are significant increased safety risks in removing the jacket footings. Jacket removal involves the use of existing offshore practices.

The rate of oil loss and persistence of the undisturbed drill cuttings pile are well within the OSPAR Stage 1 threshold values and indicate that within the OSPAR recommended management regime the cuttings pile may be left undisturbed.

Although cuttings pile decommissioning options are considered separately, as required by DECC, they are interlinked to the options for jacket decommissioning. If the jacket footings are left in place (i.e. derogation option) the cuttings pile will be left in situ. If full removal was the jacket option, the cuttings pile would have to be removed to provide access for cutting operations.

It is recognised that, if the drill cuttings pile were to be disturbed in any way, an additional formal CA of drill cutting options would have to be made in accordance with Stage 2 of OSPAR Recommendation 2006/5. This is because definitive assessment of potential environmental risks from such cuttings pile disturbance requires a good understanding of the internal structure/chemistry of the pile. Currently, this is largely dependent on modelling outputs. Although such modelling has been robust, the lack of adequate ground truthing by direct sampling leaves significant uncertainties in the event that the pile were to be removed as in a full jacket/drill cuttings pile removal scenario. Therefore, the IRC considers that the initial CA developed in the drill cuttings management report and its supporting modelling studies would need to be revisited with the results from the full pile sampling.

It was strongly recommended by the IRC, as by several stakeholders, that CNRI gives consideration to deep sampling of the cuttings pile to supplement the shallower sampling already undertaken. CNRI has since indicated that when practicable attempts to directly deep sample the pile will be made.

In the event of the cuttings pile requiring removal from under the jacket, the option of simply relocating cuttings to the seabed neighbouring the jacket presents major environmental concern, certainly in the short-term (rated significant in the ENVID); whereas any options involving lifting the cuttings to the surface, followed by offshore or onshore processing, involve handling and processing of large volumes of oily water and would require reclassification of the cuttings as waste.

However, if it proved technically possible, cuttings re-injection (CRI) could present a realistic environmental option; but would depend on regulatory acceptance as CRI is not currently permitted for existing cuttings piles. With the already stated interdependence of footing and cuttings pile decommissioning options, CRI would provide a satisfactory environmental determinant for full jacket removal. (However CNRI has indicated that further required study cannot be undertaken while the well is producing, giving rise to significant uncertainties about practicality).

Considerable uncertainty surrounds CRI of drill cuttings pile including regulatory approval, method, and environmental impact of raising cuttings to surface, injectivity and capacity to accept the volume of slurrified Murchison cuttings. For these reasons CNRI has determined that Murchison is not an appropriate candidate for

experimentation, and has considered that such technology would be better trialled and matured on a smaller cuttings pile.

Several environmental issues were covered in detail by specialist reports in Phase 2 since they informed the core EIA process. However, as addressed in the review of the CA process, issues such as underwater noise and, particularly, energy use and atmospheric emissions play minor determinant roles on final decommissioning option selection.

The IRC considers that for the subjects covered at end Phases 1 and 2 in the IRC review process there was sufficient information in place on most issues for CNRI to inform the CA; however some factors required further consideration within the CA workshop process itself, for example (see Section 3, below);

- More detailed consideration of the practicalities of removal of jacket footings, including provision of further in-house information by CNRI consultants and in-house engineers (see Section 3);
- Direct measurement of the drill cuttings pile structure, to validate modelling studies;
- Assessment of drill cuttings removal, processing and disposal options should full jacket removal remain a decommissioning option.

3 COMPARATIVE ASSESSMENT PROCESS

3.1 Overview of CA Process

3.1.1 IRC Reporting Summary

The IRC has been involved in a 'rolling' review of the CA process being undertaken by CNRI, providing interim draft reviews of documents from CNRI, these documents themselves often in draft form, supported by extensive email communications.

The IRC has already provided a separate statement on the procedures that CNRI employed to manage the CA process [MURDECOM-XDS-PM-PRO-00059]. Prior to receiving the first draft CA Report, but after CNRI had completed the CA workshop series, the IRC undertook an interim review of the CA workshops. The IRC undertook an initial review of a first draft of the CA Report and reported initial comments at a meeting with CNRI (October 2012, with notes (email) circulated from CNRI and the IRC). The revised CA Report [MURDECOM-CNR-PM-REP-00225] was reviewed by the IRC [MURDECOM-XDS-PM-REP-00002] prior to being presented to Stakeholders by CNRI including as a pre-read for those attending a Stakeholders Workshop on 8 November 2012) [MURDECOM-CNR-PM-REP-00225].

In this final IRC report on the full CA process and associated EIA, key points regarding the CA process are summarised.

3.1.2 Consultation/Stakeholder Engagement

3.1.2.1 Overall Policy

CNRI introduced a broad approach to stakeholder consultation, both through one-to-one contact and open workshops.

CNRI invited The Environment Council (EC), an organisation which specialises in stakeholder engagement, to design and facilitate two workshops, the pre-CA workshop in March and the post-CA Report workshop in November; and to independently facilitate the discussions in both.

3.1.2.2 Stakeholder Workshop – Pre-CA (March 2012)

The aim of the March stakeholder workshop was to provide an opportunity for stakeholders to hear and give feedback on the plans to date for the Murchison platform and to inform development of the decommissioning programme in the light of stakeholder reflections.

The workshop objectives were:

- Brief participants on:
    - Murchison platform context, decommissioning approach and plans.
    - Progress of studies to date and indications of decommissioning options and likely issues and challenges for the platform.
- Review the approach to decommissioning and engagement with stakeholders.
- Collectively discuss the issues and challenges faced by decommissioning the Murchison platform.
- Gain feedback from participants on the proposed decommissioning option(s) in particular any perceived "gaps" in technical studies to date and priority issues for further consideration.

The March workshop was highly structured with CNRI staff initially "setting the scene" with overview presentations, followed by smaller stakeholder groups focussing on three 'facility' areas:

- Steel jacket removal / footings

- Pipelines/debris/other subsea infrastructure
- Drill cuttings.

After the more formal CNRI-led sessions, stakeholders were divided into three smaller discussion groups of mixed sectors of interest by the EC facilitation team. This was in order to give more time to each person to contribute and to 'fold in' a range of views. These groups each discussed the three issues in turn, supported by a workshop EC facilitator and members of the CNRI team. Then, in an attempt to round off the workshop, stakeholders along with EC and CNRI staff were divided into other small round table groups to consider priority areas for consideration by CNRI; with a final plenary feedback of these ideas.

A transcript report [MURDECOM-TEC-PM-REP-00184] of the meeting was posted on the CNRI decommissioning website (www.cnri-northsea-decom.com) and all stakeholders (whether or not they attended) were advised of its publication, inviting further feedback, comments or questions.

Following the March workshop CNRI followed up one-to-one meetings with several organisations including:

Environment – Joint Nature Conservation Committee (JNCC), Greenpeace, Royal Society for Protection of Birds (RSPB), Marine Scotland, DECC Environmental Management Team (EMT), Scottish Oceans Institute, and University of East Anglia (UEA);

Societal - Scottish Fishermen's Federation (SFF); UK Fisheries Offshore Oil & Gas Legacy Trust Fund Limited (FLTC)

Supply Chain –Subsea UK, Aberdeen and Grampian Chamber of Commerce (AGCC), Decom North Sea, PILOT, and direct liaison with contractors; as well as partners and Murchison crew/staff.

The outcome of the first phase of on-going consultation/stakeholder engagement was fed into the main project CA process.

3.1.2.3 Stakeholder Workshop –Post Draft CA Report (November 2012)

Again independently facilitated by The Environment Council on behalf of CNRI, the key aims of this workshop were:

- To update participants on the activities undertaken since the last stakeholder workshop (March 2012), and how stakeholder input has been taken account of and the process moving forwards;
- To build understanding of the recommendations being proposed for the Murchison platform decommissioning following the CA and answer any outstanding questions;
- To hear and understand from stakeholders;
- In respect of the CA for the Murchison platform, what else (if anything) needs addressing before submission of the Decommissioning Programme;
- Any issues outside of the scope of the CA which need to be incorporated into on-going planning; then
- Collate the learning on issues arising from stakeholder engagement on platform decommissioning: both in terms of the content and the process to apply in future by CNRI and others.

The CNRI project team made a series of presentations to summarise the project status, notably the CA process, supported by a series of slides which can be accessed on the CNRI website. Attendees had been provided with a pre-read copy of the draft CA Report, as reviewed by the IRC [MURDECOM-XDS-PM-REP-00002].

Stakeholders had the opportunity to raise questions in relation to key decommissioning themes that are relevant to the CA and to the execution of the project under the headings: Environmental & Societal; Technical & Safety; and Engineering & Contracts. These themes incorporated the CA of: Jacket and Footings; Drill Cuttings; and Pipelines & Subsea Infrastructure.

The questions that were raised by stakeholders and the answers provided by CNRI were noted by the facilitators at the workshop and are set out in a summary and transcript report (MURDECOM-CNR-PM-REP-00236 and

MURDECOM-CNR-PM-REP-00237). In some instances stakeholders contributed additional information to the answers provided.

In addition to many points requiring clarification of technical details, some issues related to fundamental points regarding the CA procedures employed and to wider policy issues such as CNRI stance regarding the potential use of new/emerging technologies.

An excellent summary of the second workshop outcome, with details of all the questions and answers, was prepared by the facilitators, the EC, setting out the key points of feedback from the November stakeholder event for the CNRI Murchison Platform, 8 November 2012, following the production of the CA Report on decommissioning options.

The IRC attended both open Stakeholder workshops as observers, and reviewed the reports produced by the Environment Council facilitators. The IRC did not attend any of the stakeholder one-to-one meetings and did not review any minutes/outcomes from these.

Information on the CNRI Stakeholder/Engagement process is also subject of a separate report [MURDECOM-CNR-PM-REP-00233]. This report was not reviewed by the IRC but will be presented on the CNRI website [http://www.cnri-northsea-decom.com] together with this report and other documents in support of the Decommissioning Programme.

3.1.3 Option Ranking Methodology

CNRI developed a CA method statement to outline a framework for conducting detailed CA for the evaluation of alternative disposal options during the decommissioning planning process. The CNRI framework was 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 CNRI CA methods are covered in detail in the following documents:

- Comparative Assessment Method Statement DECOM-CNR-PM-PRO-00081
- Comparative Assessment Procedure MURDECOM-CNR-PM-PRO-00136.

The IRC reviewed the process outlined in these documents [MURDECOM-XDS-PM-PRO-00059], followed by the issue of a Verification Certificate (June 2012) stating that "*the process described in the Method Statement and the Procedure will deliver robust, scientifically-based CA, based on five main safety, environmental, technical, societal and economic criteria*".

During the original review the IRC did present some concerns regarding the option to follow such an extremely detailed process as an interpretation of DECC Guidance Notes. It was particularly concerned that some of the detail might detract from the key issues in considering a possible derogation option for the jacket, notably technical and safety factors; but recognised that under the DECC Guidance Notes *there was no requirement for the IRC to verify the final means of weighting and balancing the options* .The IRC verified the CA Procedures to be followed [MURDECOM-XDS-PM-PRO-00206].

In a late stage of revision of the CA Report a degree of 'traffic light flagging' of sub-criteria was introduced in the final scoring tables (in Section 5) supported by brief reference to its application in the CA procedures.

3.1.4 Specialist Workshops

Although the IRC did not attend the individual technical workshops, it did review the resulting minutes, to verify that procedures had been followed. It was not the intention to provide a critique of specific technical discussions/decisions, which are 'owned' by CNRI, but it was expected that the background to such decisions would be presented in a comprehensive and transparent manner.

Workshops were held for the following: jacket (technical), pipelines (technical), drill cuttings (all criteria), safety, environmental, societal, and economic.

In each specialist workshop listed above, scores were presented for sub-criteria appropriate to the criterion concerned.

At the end of the discussions in each workshop, each participant was asked to give an overall score for the option in each sub-criterion and the reasons behind their choice. Where there was a large range of scores or disagreements as to the scoring of an option, the reasons behind this were discussed and recorded; before arriving at a mean average of those scores. In the minute, these scores were presented clearly, in a form directly applicable to the ranking process presented in the final main CA workshop.

In the case of the jacket specialist (technical) workshop, the sub-criteria[1] employed were:

- Technical feasibility,
- Ease of recovery from excursion, and
- Use of proven technology and equipment.

3.1.5 Main CA Workshop

The aim of the main CA workshop (held 10 May 2012) was to identify the recommended decommissioning option for each of the various facilities under consideration, which in turn would allow CNRI and partners Wintershall to confirm the decommissioning work programme with regard to the Murchison facilities. As indicated in Section 1.4, the IRC attended the main CA workshop as observers.

The outcomes of each of the special/technical assessment workshops, recorded as formal Minutes, were circulated to the attendees at the main CA workshop. This information was supplemented by input on the chief areas of concern raised by stakeholders during engagement up to that date and was presented to the CA workshop attendees during the meeting for assessment and discussion.

This workshop examined the results and the original raw data behind the weighted scores to:

- Review the scores for each of the options,
- Summarise and take into consideration stakeholder's views,
- Determine if there were any differences in the performance of the different options,
- Determine the extent to which any observed differences in the weighted scores were significant,
- Identify and explain the cause(s)of any differences between options, and
- Identify the best decommissioning option for each of the facilities under assessment.

After this first collation of option scoring data, the IRC noted that there was little difference between the ranking of full or partial jacket removal options (excluding cost) employing conventional heavy lift vessel (HLV) or Single Lift Vessels (SLV). However, it was recognised that some of the figures employed needed to be re-visited. The IRC repeated a concern expressed when reviewing procedures, that some of the detail might detract from the key issues in considering a possible derogation option for the jacket, notably technical and safety factors. Certainly, as the data were presented, it was not possible to arrive at definitive decommissioning recommendations, particularly for the jacket.

At the conclusion of the 10 May workshop session issues requiring follow-up attention included revisiting:

- Safety data, particularly relating to long-term risk to fishermen;
- Technical issues associated with footings removal, notably pile cutting;
- Problems associated with potential drill cuttings processing/re-injection; and
- Pipeline removal, including rock-dumping options.

[1] *Each specialist workshop employed a number of sub-criteria, but for brevity not all have been listed here.*

Two follow-up sessions were undertaken (in June and July 2012) before establishing the decommissioning options recommended in the main CA Report.

Although the CA process addressed the decommissioning options for the pipeline facilities and drill cuttings pile as well as the jacket, the IRC focussed particular attention on the jacket example to examine the procedures/decision-making applied.

Figure 3.1, a copy of Table 14 taken from the Draft CA Report, provides an example of an option scoring table from the final CA process stages. The jacket options sub-criteria are ranked for full or partial removal for each of the decommissioning and removal methods; with added 'traffic light' flagging.

The IRC considered that regarding the jacket decommissioning options had a clearer and stronger technical feasibility case against full removal been made in the original Technical Workshop; this, along with a simpler CA option ranking process, would have resulted in the recommended jacket decommissioning option being recognised much earlier.

Criteria	Subcriteria	Removal Methods							
		SSCV		SLV		HLV		BTA	
		Full	Partial	Full	Partial	Full	Partial	Full	Partial
Safety	Personnel offshore	0.3	0.7	0.4	1.0		0.8	0.3	0.5
	Personnel onshore	0.3	1.0	0.3	1.0		1.0	0.3	1.0
	Fishermen	1.0	0.3	1.0	0.3		0.3	1.0	0.3
Environment	Operations	0.7	0.7	0.7	0.8		0.6	0.5	0.6
	End points	0.7	0.9	1.0	0.9		0.9	0.8	0.9
	Energy	1.0	1.0	1.0	1.0		0.9	0.8	0.8
	Emissions	1.0	1.0	1.0	1.0		0.9	0.7	0.7
Technical Feasibility	Technical feasibility	0.4	0.8	0.3	0.6	0.0	0.8	0.2	0.3
	Recovery	0.7	0.8	0.3	0.4	0.0	0.7	0.2	0.2
	Proven technology	0.5	0.9	0.3	0.5	0.0	0.8	0.3	0.6
Societal	Fisheries	0.9	0.6	0.9	0.6		0.6	0.9	0.6
	Amenities	1.0	1.0	1.0	1.0		1.0	0.8	0.8
	Communities	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Cost	Capex								

Low	Worst performance/outcome
Medium	
High	Best performance/outcome

Figure 3.1 Extracted Table 14 from CNRI Comparative Assessment Report

3.2 Draft CA Report – CNRI Decommissioning Option Recommendations

3.2.1 General

The Murchison CA Report is part of a suite of CNRI documents that support the Murchison Decommissioning Programme, comprising:

- Murchison Comparative Assessment Report (CA Report)
- Murchison Environmental Statement
- Murchison Stakeholder Consultation Report
- Murchison IRC (Verification) Final Report

These four key documents will be made available electronically on the website (www.cnri-northsea-decom.com) together with the supporting documents reviewed by the IRC as part of the verification process.

The Draft CA Report reviewed by the IRC provides a thorough, well-illustrated description of the Murchison facilities – their origins and subsequently their potential decommissioning options. It gives a detailed overview of the potential alternative use of Murchison facilities, including:

- Platform relocation and reuse in a new oil/gas exploration and production area;
- Alternative use for the Murchison Platform in its present location; with extensive consideration of such options as wind energy, wave and tidal energy, carbon capture and storage and some non-energy uses.

No viable reuse or alternate use was identified and consequently the option to reuse the platform was not taken forward into the detailed CA process. The Draft CA Report describes the following decommissioning options which were taken forward into the CA process:

<u>For the Murchison Jacket</u>

- Full removal of the jacket to 3m below seabed;
- Partial removal of jacket down to top of footings.

Each option was assessed for each of the removal methods considered, namely:

- Removal using a semi-submersible crane vessel (SSCV);
- Removal using a HLV;
- Removal using a SLV;
- Removal by refloating using buoyancy tank assemblies (BTAs.)

<u>For the Murchison Drill Cuttings Pile</u>

- Leave the drill cuttings pile *in situ* to degrade naturally;
- Recover cuttings slurry to surface separate, treat liquids for discharge overboard, ship solids to shore in containers for further treatment and disposal or re-use;
- Recover cuttings slurry to surface and ship to shore for processing, separation and treatment;
- Recover cuttings slurry to surface, grind cutting to a maximum diameter of 300 microns and inject the slurry into a nominated cuttings reinjection (CRI) well;
- Disperse and distribute over the sediments surrounding the Murchison platform.

<u>Combined Jacket and Drill Cuttings Pile Options</u>

- Full removal of jacket with each of the drill cuttings pile options;
- Partial removal of jacket with each of the drill cuttings pile options.

For the Murchison Export Pipeline PL115

- Leave *in situ;*
- Minimal removal i.e. removal the Murchison and Dunlin tie-in spools only;
- Recover end tie-in spools and exposed sections of the pipeline by cut and lift;
- Recover end tie-in spools and trench & bury the exposed lengths of pipeline;
- Recover end tie-in spools and place rock cover over exposed lengths of pipeline to match the existing rock profile;
- Remove the pipeline completely by cut and lift after displacing the existing rock cover.

3.2.2 Jacket Decommissioning

Since jacket decommissioning is central to any derogation from OSPAR requirements, the IRC has focussed on this part of the Draft CA Report review.

CNRI emphasises that *the presumption of total removal is the starting point for the CA process. By way of derogation a CA process has to be undertaken in accordance with OSPAR Annex 2 that requires there are significant reasons why a partial removal option is preferable to full removal for reuse, recycling or disposal on land.*

Two jacket decommissioning options were identified as being compliant with the OSPAR Decision 98/3 and the DECC Guidance Notes and therefore assessed within the formal CA process (in Section 4 of the report):

- *Full removal, with foundation piles cut 3m below the mudline (the total weight of jacket removed would be approximately 27,584 te);*
- *Partial removal of the jacket down to the top of footings, defined as the top of the highest pile (the total weight of jacket removed would be approximately 14,884 te).*

This section then described the four options being investigated as using:

- *A SSCV for removing the Murchison jacket in large sections and individual components;*
- *A HLV for removing the Murchison jacket in small sections;*
- *A SLV to remove the Murchison jacket in a single piece;*
- *BTAs to refloat the Murchison jacket in a single piece.*

It then details the different methods, including summarising three technical studies undertaken to assess the feasibility of full removal and partial removal of the Murchison jacket:

- *Two studies were based on using the 14,000te capacity SSCVs, removing the jackets in large sections;*
- *One study was undertaken using a smaller 5,000te capacity HLV removing the jacket in individual and small sections.*

A further study was reported, with a jacket being removed using the new SLV the *Pieter Schelte*, currently under construction. The SLV has a jacket lift system capacity of 25,000te whereas the Murchison jacket has a total lift weight of 27,584 te

The report also briefly addressed a different removal concept which is based on *reusing the BTAs that were used to refloat the 12,000te Frigg DP2 jacket.*

The four tanks, each weighing 1,025te, would be modified to suit the Murchison jacket configuration. Each tank would be towed to the Murchison site, mated and attached to the jacket using preinstalled anchor points. To provide additional buoyancy the four corner jacket legs would have to be made airtight after removing the module support frame, and a new buoyancy control system installed for each leg.

Following detailed discussions during the CA main workshop, CNRI gives detailed explanations in both section 3.3.3 and 5.2 of the Draft CA Report of the technical problems of attempting to remove the full jacket, i.e. including footings.

It was accepted that *using a conventional SSCV full jacket removal is within the vessel capacity, albeit with the complex issues of cutting free the foundation pile assemblies whilst maintaining structural integrity*.

Based on the capacities of the removal methods assessed, all four methods are capable of removing the Murchison jacket down to the top of footings but only the SSCVs method could potentially fully remove the platform with any level of confidence.

Also, it was recognised that full removal of the jacket would require the cutting of the footings below the seabed surface. This could be achieved with two options:

- Internal pile cutting;
- External pile cutting.

A detailed description is given about the difficulties, but not impossibilities, of finding a cutting solution, even for the large bottle legs and piling; but it is accepted that with available technologies, capacities of the equipment and vessels currently available, full removal of the jacket footings would present many difficulties, involving operations likely to require significant engineering before work could commence.

Full removal of the jacket would involve longer offshore operations with increased risk to offshore personnel, as demonstrated in the PLL figures presented from safety studies in the CA workshop and summarised in Section 5.2.2 of the report. The report states that *this increase in risk is unjustifiable as it goes against the principle of reducing risks to as low as reasonably practical.*

It is recognized that in contrast, partial removal creates a long term and persistent risk to fishermen from the potential snagging of their fishing gear on the remaining footings, which are expected to remain for up to 1000 years. CNRI suggest that *if the snagging risk profile and thus the PLL is held constant over the 1000 year life of the footings and then added to the operational PLL to partially remove the jacket then on comparison the full jacket removal would have a total PLL 23% higher than the combined partial removal option*.

The overall recommended option for the Murchison jacket was determined to be partial removal of the structure down to the top of footings. It was found that the main drivers for this conclusion were the safety and technical feasibility criteria.

Economic assessments demonstrated that 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. The one exception was the refloat option where the cost difference between full and partial removal was not significant.

Assuming the recommended option of partial removal is adopted in the decommissioning plan; the final removal method selection would depend on detailed specification and project tendering.

3.2.3 Murchison Drill Cuttings Pile Decommissioning

Five options were assessed for the drill cuttings pile:

- Leave the pile *in situ* to degrade naturally;
- Distribute the pile onto the adjacent seabed, beyond the jacket footprint;
- Recover the drill cuttings to surface and inject down a designated CRI well;
- Recover the drill cuttings to surface and ship to shore for separation treatment and disposal;
- Recover the drill cuttings to surface, separate treat and dispose of liquids and ship solids to shore for treatment and disposal.

In considering the drill cuttings pile, the report emphasised *that the technical feasibility of both the leave in situ option and the redistribution of cuttings option scored highly as a result of high technical feasibility and use of proven technology for the redistribution option*, which is implicit with a 'do nothing' option. Also, this would be the

lowest cost option. The report then states that - *all the other options require the drill cuttings pile to be recovered from the seabed to the surface for treatment, reinjection or store and return to shore for treatment. There is no industry experience of recovering volumes of the size of Murchison and hence these options scored low (traffic light – red) on technical feasibility and development of available technology*. However, the IRC is of the opinion that should a full jacket recovery option have been a possibility, with need for cuttings pile part/complete clearance, a more rigorous examination of cuttings handling would have been required.

The report also briefly addressed environmental considerations, particularly regarding the issue of short-term impact if the cuttings pile is disturbed compared with leaving undisturbed for several decades or longer. This latter option was discussed further in the ES. It also noted that the cuttings redistribution option had been used in other projects.

Although cuttings pile decommissioning options are considered separately as required by DECC, it is obvious that they are interlinked to the options for jacket decommissioning. If the jacket footings are left in place (i.e. derogation option) the cuttings pile will be left *in situ*. If full removal was the jacket option, the cuttings pile would have to be removed to provide access for cutting operations.

3.2.4 Murchison Pipeline PL115 Decommissioning

The report addressed the six options for decommissioning the PL115 pipeline (as described in detail in report Section 3.3.5):

- Leave the pipeline *in situ*, intermittently exposed on the seabed and with existing rock cover;
- Minimal removal – remove Dunlin and Murchison tie-in spools, leave the remainder *in situ;*
- Partial removal of the exposed lengths by cut and lift;
- Trench and bury the exposed lengths;
- Remedial rock placement over the exposed lengths;
- Total removal of the pipeline by cut and lift after dispersing existing rock cover.

CA assessment identified two options as comparable based on the overall weighted scores:

- Leave *in situ* and
- Remedial rock placement, with the latter scoring marginally higher overall based on the lower risk to fishermen.

These scores were driven by safety and technical feasibility concerns.

3.2.5 Decommissioning of the Early Production Flowline Bundles

Although the report cites five options for decommissioning flowline bundles, CNRI confirms that *the DECC Guidance Notes suggest that small diameter pipelines, including flexible flowlines and umbilicals which are neither trenched nor buried should normally be entirely removed.*

Therefore, the pipeline bundles PL123, PL124 and PL125 will be removed completely and returned to shore in lengths of approximately 12m, each length weighing 1,740kg.

Consequently the pipeline bundles were not considered further in the formal CA process.

3.2.6 CNRI Decommissioning Recommendations in the Draft CA Report

Thus, after providing a concise overview of the rationale behind the selection of the Field's recommended decommissioning options, CNRI concluded that:

- *The jacket will be removed down to the top of footings at 44m above the seabed and returned to shore for reuse, recycling or disposal. The jacket footings will be left in place;*

- *The drill cuttings pile located within the jacket footings will be left in situ to degrade naturally with time;*
- *The short early production pipeline bundles and associated subsea equipment will be removed and returned to shore for recycling or disposal;*
- *The main oil export line (PL115) will be left in situ with remedial rock placement over exposed sections, and*
- *The main pipeline tie in spools, at either end, will be removed and returned to shore for recycling or disposal.*

3.3 Summary IRC Conclusions of the CA Process

Some brief summary points are appropriate to close this section covering the CA process, developed followed and reported by CNRI. However, several points are more appropriately considered in the next section (Section 4), which presents conclusions drawn from all reviews undertaken within the full CA remit of the IRC role.

As identified in Section 1.3, 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 Process.

This was achieved by ensuring that the IRC maintained an independence from CNRI's CA decision making process. This is particularly important under the DECC Guidance Notes which state that *verification is **to confirm that the assessments are reliable** and there is no requirement to verify the final means of weighting and balancing the options but **the process must be transparent**.*

The IRC recognises the commitment of CNRI to establishing a sound basis to the identification of the recommended decommissioning options for the different Murchison facilities, developing a firm foundation for CA and adherence to the CA process throughout.

4 OVERALL IRC REPORT CONCLUSIONS

1. Having been nominated by CNRI as IRC, Xodus undertook an independent review of over 30 reports on studies commissioned by CNRI in support of the CA process (plus several documents produced internally) which would identify the best solutions for the Murchison jacket footings, subsea infrastructure and drill cuttings pile.
2. **The IRC considers that for the subjects covered in reports from Phase 1 and 2 studies, there was sufficient information in place for CNRI to support the CA and the associated EIA for Murchison.** However, at that stage in the IRC review it was recognised that some factors required further consideration within the CA process itself, giving examples in Section 2.5, item 11. These points were addressed by CNRI in the CA process.
3. The IRC recognised the commitment of CNRI to establishing a sound basis to the identification of the preferred decommissioning options for the different Murchison facilities.
4. The IRC recognises that in any CA process there will be a need to 'loop back' to contributing studies, but such re-visits and requirements for new data throughout the Murchison CA workshop extended considerably the full schedule and delayed identification of key determinants in option assessments.
5. When originally reviewing the proposed CA procedure outlined in Comparative Assessment Method Statement DECOM-CNR-PM-PRO-00081 and Comparative Assessment Procedure MURDECOM-CNR-PM-PRO-00136, the IRC presented some concerns regarding the option to follow such an extremely detailed process as an interpretation of DECC Guidance Notes. It was particularly concerned that some of the detail might detract from the key issues in considering a possible derogation option for the jacket, notably technical and safety factors; but recognised that under DECC Guidance Notes *there was no requirement for the IRC to verify the final means of weighting and balancing the options* .Within that remit, the IRC verified that "*the process described in the Method Statement and the Procedure will deliver robust, scientifically-based CA, based on five main safety, environmental, technical, societal and economic criteria*".
6. The IRC recognised that this was CNRI's first decommissioning programme, which perhaps contributed to a long CA schedule, but through a solid and auditable path CNRI did identify recommended decommissioning options for the different Murchison facilities, listed in Section 3.3.6 above as quoted from their final CA Report.
7. **The IRC considers that for the CA as described in the CA Report (with the support from earlier informing reports) there is sufficient information in place for CNRI to support the development of a Murchison Decommissioning Plan.**
8. **The CNRI efforts given to stakeholder consultation have been considerable,** particularly the two well-timed workshops (in March and November), run with valuable independent support from the Environment Council. As was discussed at the November workshop it is always difficult to assess the right level of consultation required and the expected outcomes. IRC was slightly concerned at the first workshop, feeling that it was over-presented and not leaving adequate time for discussion but the second workshop got the balance right and obviously at this stage in the project had provided ample pre-read material to stimulate discussion.

REFERENCES

1. Guidance Notes - Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998. Offshore Decommissioning Unit - Department of Energy and Climate Change. Version 6, March 2011.

2. Southall, B. L., A. E. Bowles, William T. Ellison, J. J., J. J. Finneran, R. L. Gentry, C. R. G. Jr., D., Kastak, D. R. Ketten, J. H. Miller, P. E. Nachtigall, W. J. Richardson, J. A. Thomas, and P. L. Tyack. 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals 33:1-521

APPENDIX 1 IRC TEAM SUMMARY

The IRC team has been drawn from the expertise base within Xodus Group. The IRC was led by Mike Taylor (with later project management support from Zoe Cairns). Key players in the IRC team were Professor Cliff Johnston (environment and drill cuttings), Mike Taylor (structural), Colin McWhirr (safety), Steve Allan (subsea), Zoe Cairns (environment and social), and Caroline Laurenson (topside interfaces). Additional specialist support was drawn from elsewhere within Xodus as required, for example Simon Stephenson (acoustics). Summary CVs for each of the key team members are provided below.

Mike Taylor

Mike Taylor is a Chartered Structural Engineer and a Senior Structural Consultant at Xodus Group with over 30 years oil and gas experience covering topsides greenfield and brownfield construction and major studies involving both jackets and topsides.

Mike has experience in engineering research , design , fabrication and installation experience covering major drilling and production platforms, including integrated decks, power, process, drilling and accommodation modules in the North Sea and Caspian Sea. The last 15 years have been in the position of Project Manager or Lead/Principal Engineer. The experience has been shared almost equally between Greenfield and Brownfield projects and between Conceptual and Detail designs. Mike has also acted as Project Manager on many projects including advanced structural analysis, structural integrity management, and the design of oil & gas topsides, and marine renewable energy devices.

He was the IRC Team Leader and Structural Consultant on BP Miller and Project Manager for Fairfield Dunlin CGB decommissioning independent review and verification. Prior to joining Xodus, Mike was Lead Structural Engineer on the Shell Brent C LTFD Project, which involved the decommissioning and removal of several topsides modules.

Professor Cliff Johnston

Professor Cliff Johnston, an Associate Consultant with Xodus Group, has a long environmental pedigree, and has previously set up and managed the Institute of Offshore Engineering (Heriot Watt University) as well as establishing and acting as Managing Director for Environment & Resource Technology (ERT) Ltd, the Orkney Water Test Centre (OWTC) Ltd and the International Centre for Island Technology (ICIT). His pedigree particularly relating to pollution control was recognised in 1995 by appointment to the first Board of the then new regulatory body - Scottish Environment Protection Agency, SEPA. The breadth and depth of offshore experience has been recognised by both industry and regulatory agencies in the UK and internationally.

In the oil and gas industry sector key experience includes:

- Detailed knowledge of the oil and gas industry internationally, with over 30 years consultancy, contract services, research and training experience with most major international operators;
- Good understanding of environmental management issues, ranging from policy, regulation and impact assessment through to definition of engineering solutions;
- Understanding of wider, particularly environmental technology, market opportunities, with contacts throughout relevant industry and governmental agencies;
- Over 40 years academic/training experience at all levels from in-house company training to advanced post-graduate teaching, with strong interests in issues across policy - environmental science - engineering interfaces;
- Proven track record in project development and management, with strong innovative/lateral thinking abilities; and above all,
- Strong commitment to provision of top-level independent professional support, working for industry and government agencies.

Cliff acted as the Environmental Consultant the BP Miller IRC and was part of the review team on the technical studies and comparative assessment process for the Fairfield Dunlin CGB decommissioning independent review and verification and the subsequent Dunlin Alpha Decommissioning EIA/ES review.

Zoe Cairns

Zoe Cairns is a founding Director of Aurora Environmental Ltd (now the Xodus Environment Division) and has over 22 years' experience in environmental management for the oil and gas industry. During this time she has built up wide ranging experience in undertaking environmental studies, in particular the oil and gas industry. Particular areas of expertise lie in EIA for major offshore and coastal developments, and her experience includes EIAs for offshore oil and gas exploration, offshore oil and gas/condensate developments, deep-water FPSO developments, pipeline studies, BAT/BPEO assessments, onshore oil and gas terminals and decommissioning programmes. Decommissioning experience dates back to 1997 and the undertaking of one of the first comparative assessments in UK waters for the Mobil Linnhe subsea development. This led to undertaking a detailed EIA for the selected option for the Linnhe decommissioning programme and subsequent submission to DECC in 2009.

Zoe was also involved in early scoping for the BP Miller decommissioning environmental work, a detailed EIA for the BP Don decommissioning programme, BPEO assessments for BP NW Hutton, and review of cuttings piles on behalf of Shell UK.

A major area of on-going interest is that of environmental legislation and policy, and Zoë is the editor and technical author for the Oil and Gas UK Environmental Legislation Guide, which is updated periodically and is available on the web (http://www.ukooaenvironmentallegislation.co.uk). Zoe has helped clients develop an understanding of the regulatory requirements for decommissioning, in particular for Marathon UK and also for Repsol. Zoe was also lead technical author of a review of international, European and national legislative requirements for decommissioning and disposal of offshore structures as part of study examining implications of decommissioning needs on Scottish waste handling and infrastructure on behalf of the Scottish Environment Protection Agency.

Zoe was part of the IRC for the Fairfield Dunlin CGB derogation, and subsequently led on the Dunlin Alpha decommissioning programme and EIA/ES review. Zoe is currently project director/study sponsor for the Marathon Brae Alpha decommissioning comparative assessment and EIA.

Colin McWhirr

Over 28 years experience in the petrochemical/oil & gas sector, seventeen of which was gained with a major operator. His engineering and management development was based on gaining a core discipline skill in technical safety combined with broadening assignments in operations support and project engineering. Has a comprehensive background in Safety Case development, including all the support work to prove integrity and the assessment of competence of Safety Management arrangements. He was technical safety consultant on Xodus Group's independent review of the BP Miller decommissioning.

He has recently been involved in the development of system performance standards, linking this to facility overall integrity management. He is a leading authority in Technical Safety (culminating in the head of technical safety whilst at Shell Expro) and was a member of the UKOOA Hazard Management Sub-Committee.

Colin also has extensive experience in the development of project and business management systems, including the application of business risk management techniques. He has wide experience covering front end and detailed design, construction site engineering, offshore construction and commissioning, offshore operations and maintenance.

His work experience covers:

- Safety Case Preparation and SMS Development
- Onshore COMAH Safety Reports, MAPP Reports & Site Emergency Plans
- Development of Performance Standards and PFEER/DCR Written Schemes
- Chairing HAZOP, HAZID & SIMOPS reviews

- In-depth Knowledge of QRA - including Probabilistic Analysis
- Formal Safety Assessments and System Integrity Reviews
- Safety Reviews and Audits (Project and Operations)
- Safety System Design (F&G Detection, ESD, Fire Protection, EER etc) • Development of Scenario Based Emergency Response Procedures
- Reliability Engineering and FMEA • Development of Project Management Systems
- Development of Integrity Management Systems and Total Risk Registers
- Development of Project Control Frameworks and Best Managed Risk Techniques
- He is a specialist in failure analysis, incident investigation and root cause analysis.
- Operations Systems Safety Management (Including Permit to Work and Supporting Standards)

Steve Allan

Steve Allen is a Chartered Engineer with a balanced career history gained over 12 years (6 years Operator) with experience in both project and operational roles (topside, downhole and subsea sectors) gained overseas and in the UK, and has completed roles in operations, construction, IRM and decommissioning.

As decommissioning consultant at BP He was responsible for managing all financial budgets, engineering interfaces, project planning, HSE and execution activities in order to maintain and then decommission the Don Field (7 well subsea tie back) in the North Sea. Additional responsibilities include liaising with government bodies, and third party investors and for ensuring compliance with current UK regulatory guidelines. He was also responsible for liaising with the regulatory authorities on project progress and producing the Decommissioning Programme for submission to the DTI.

Caroline Laurenson

Caroline is a Chartered Member of the IChemE with a 1st in Chemical Engineering from Strathclyde. With over 7 years in the oil and gas industry her experience ranges from conceptual pre-FEED work right through to detailed design, operations support, commissioning and most recently decommissioning work for Shell's Brent field. Definition of the Brent field decommissioning scope is a complex project. There are a great many interdependencies between the platforms, the surrounding infrastructure and the timing of when each milestone will be achieved. During the concept stage Caroline produced a number of reports and technical notes to assess the options, the most significant being an investigation into the feasibility of putting the platforms into an unmanned status to reduce operating costs if the schedule is extended. Caroline was lead process engineer for the Brent Alpha platform. She assessed the existing platform systems and utilities to define the scope for engineering down and decide what is required to support decommissioning activities. She delegated tasks within the process engineering team and liaised with the other disciplines, operations representatives, the wells department and subsea teams to ensure all scopes were aligned. Caroline was part of the IRC team working on the CNR Murchison decommissioning and was part of the review team on the technical studies and comparative assessment process for the Fairfield Dunlin CGB decommissioning independent review and verification, as well as part of the review team for the subsequent Dunlin Alpha Decommissioning Programme revew.