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Topic Briefing

Introduction to the Decommissioning Project

Roy Aspden
Decommissioning Project Manager

Murchison decommissioning project

- Introducing CNR International North Sea operations
- Murchison in facts and figures and a potted history
- Cessation of production
- Overall decommissioning scopes and timeline
- Goals and approach to decommissioning project
- Comparative Assessment of removal options
- The importance of stakeholder input in shaping the way ahead

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Our UK North Sea operations

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- International offshore oil and gas production operations in UK North Sea and West Africa
- Operator of Murchison since 2002

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Our mission statement

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"TO DEVELOP PEOPLE TO WORK TOGETHER TO CREATE VALUE FOR THE COMPANY'S SHAREHOLDERS BY DOING IT RIGHT WITH FUN AND INTEGRITY"

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Murchison in facts and figures

- Installed 1980
- Cross border field; 78% UK / 22% Norway
- Weight of steel jacket and piles 26,400 tonnes
- Weight of topsides 24,000 tonnes installed in 24 modular lifts
- Accommodation for 192 personnel
- Water depth 155m
- 33 platform wells 4 subsea wells
- Peak oil production in 1983 127,000 barrels oil per day
- Oil production in 2012 3,700 barrels oil per day

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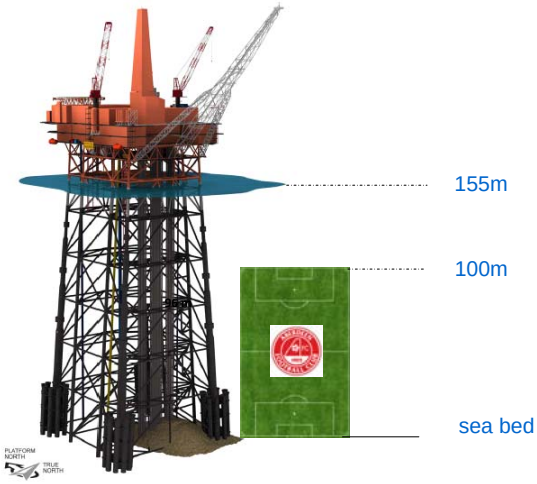
Murchison – an idea of size



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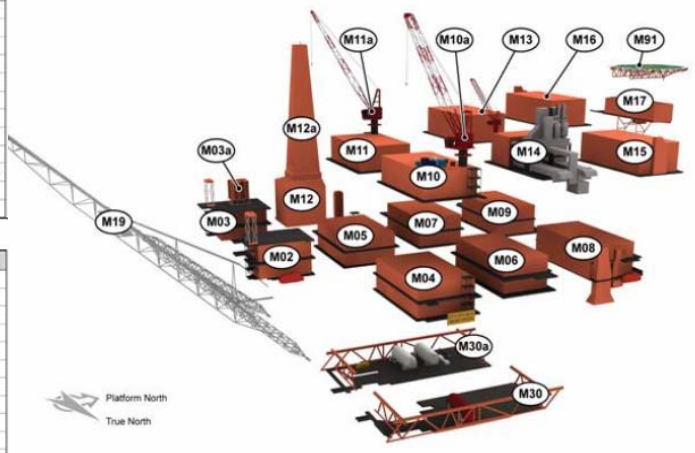
Murchison modular topsides

MODULE	DESCRIPTION
M02	Wellbay East (WBE)
M03	Wellbay West (WBW)
M03a	Bulk Storage Tanks (BST)
M04	Separation Module (SEP)
M05	Metering Module (MET)
M06	Gas Compression Module (GCM)
M07	Gas Sales Module (GSM)
M08	Utilities Module East (UME)
M09	Utilities Module West (UMW)
M10	Drilling Power & Fabrication Workshop (DPF)
M10a	East Platfrom Crane (ECR)
M11	Mud Module (MUD)

MODULE	DESCRIPTION
M11a	West Platform Crane (WCR)
M12	Drilling Substructure (DRS)
M12a	Drilling Derrick (DRK)
M13	MCR and Workshop (MCR)
M14	Power Generation Module (PWR)
M15	Accommodation East (LQE)
M16	Accommodation West (LQW)
M17	Accommodation New (LQN)
M19	Flare Boom (FLB)
M30	Module Support Frame East (MSFE)
M30a	Module Support Frame West (MSFW)
M91	Helideck (HEL)



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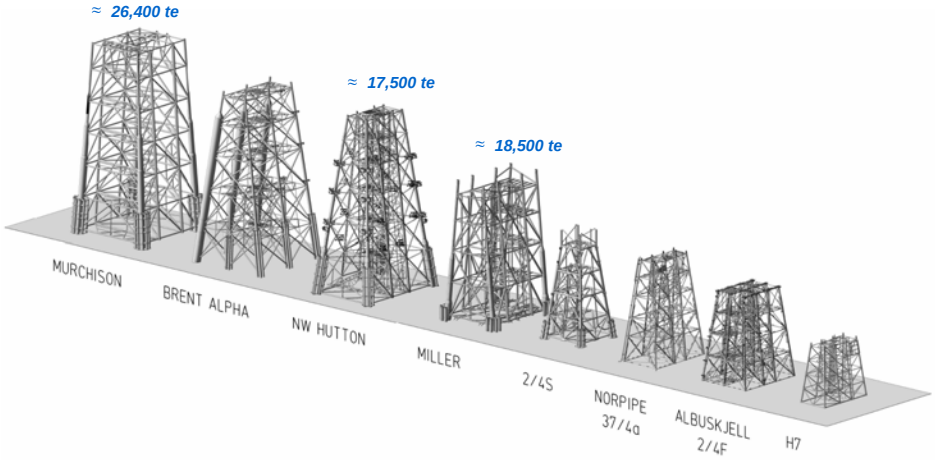
Murchison jacket comparative size



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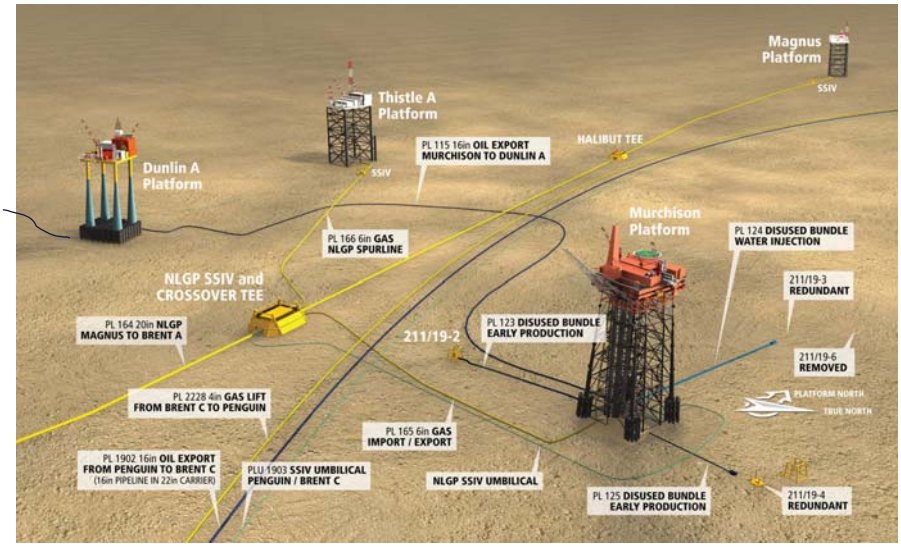
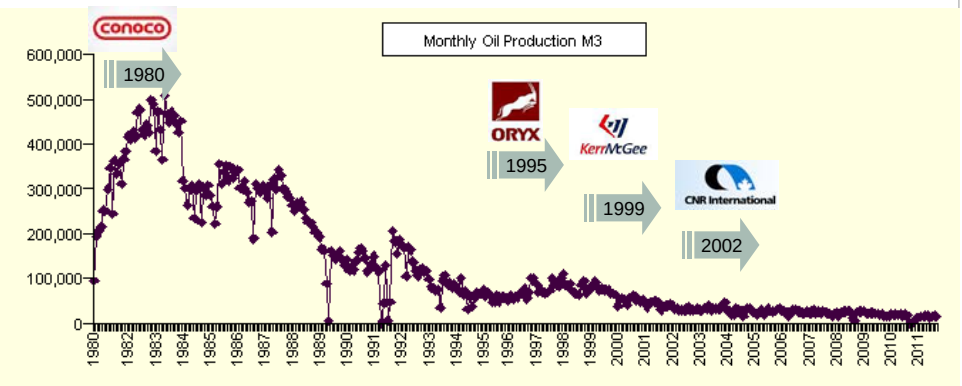
Murchison subsea infrastructure



Murchison production history and ownership

2010 production was 3% of 1983 peak and on a declining trend



Source DECC on-line database of field production histories
https://www.og.decc.gov.uk/pprs/full_production.htm

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Cessation of production

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- Now reaching economic and technical End of Field Life (EoFL)
- EoFL occurs when operating costs relative to post-tax production revenues no longer makes an economic return
- EoFL can also occur when platform process systems cannot handle much smaller production rates than designed for
- CNRI has submitted its application to DECC licensing unit for Cessation of Production

Goals of decommissioning project

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- HSE excellence
- Protect and enhance reputations of all involved
- Predictable outcomes
- Cost efficiency
- Continuous improvement

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Approach to decommissioning

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- Do it right with integrity
- Commission expert studies and engage with stakeholders to base decisions on informed knowledge base
- Keep everyone informed – no surprises
- Learn from others
- Share our learning to benefit others
- Build a sustainable capability for our rolling programme

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Murchison decommissioning baseline plan

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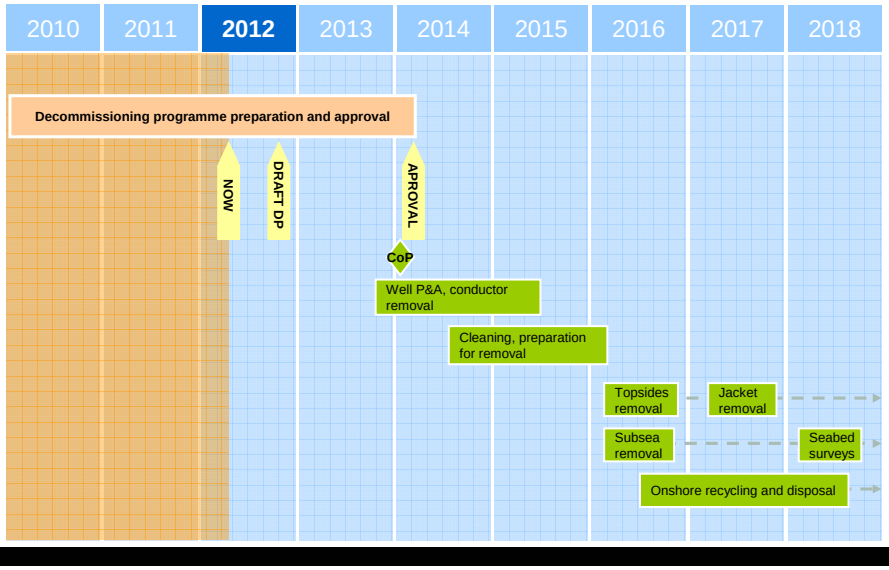

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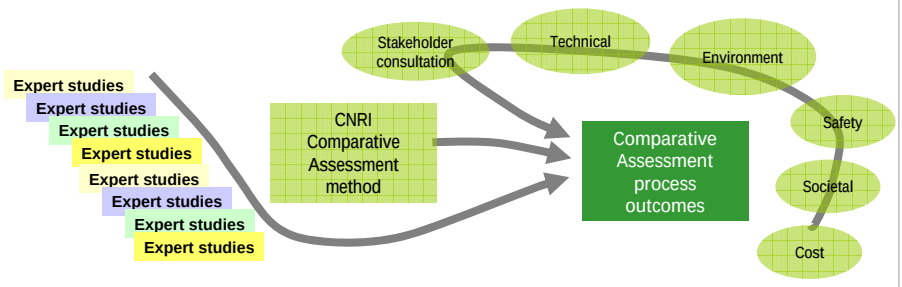
The role of the Independent Review Consultancy

- Verify completeness of studies for CNRI's assurance
- Verify Comparative Assessment (CA) method
- Verify compliance with CA process and the outcomes



Importance of stakeholder engagement

- To understand stakeholders issues and concerns
- To help stakeholders understand our challenges
- A continual process not a one-off
- To help us shape our Decommissioning Programme and make the right choices

Question and answer

Any questions of clarification?

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Murchison decommissioning project

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Topic Briefing

Decommissioning Options for Pipelines, Debris and Other Subsea Infrastructure

Steve Etherson
Subsea and Pipelines

Pipelines, debris and other subsea infrastructure

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Overview:

- Bundles
- Wellheads and protection structures
- 6" NLGP pipeline
- 6" NLGP SSIV control umbilical
- 16" oil export pipeline
- Debris

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Murchison subsea infrastructure layout

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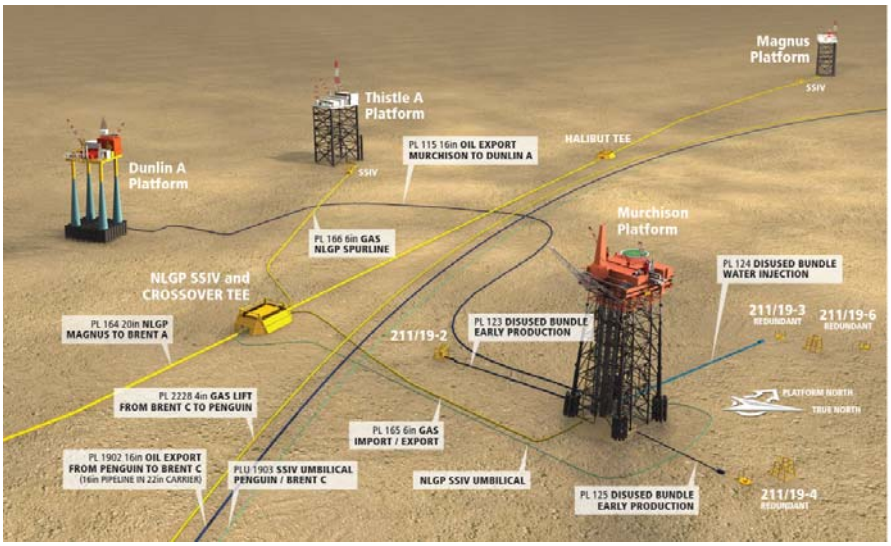

Bundles: details

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- 3 x bundles of 12.75" dia x 6.35/10.32 mm wall thickness (w/t) PL123, PL124, & PL125
- 2 x 88.9mm dia x 6.35mm w/t pipes and 4 x 21.4mm dia control lines are inside the bundles
- PL123 is 800m long and 100% exposed with wellhead and protection structure still in place and bundle still connected to the well
- PL124 is 2km long and 100% exposed with pipeline bent in two places
- PL 125 is 1.3Km long, 100% exposed, disconnected from the wellhead, wellhead and protection structure still in place

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Bundles: options

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Bundle pipeline PL123, PL124 & PL125:

- Leave in situ (span remediation)
- Minimal removal, i.e. remove mattresses, leave bundles in-situ (span remediation)
- Removal of exposed sections, cut and lift
- Burial of bundles and recover mattresses
- Total removal of bundles and mattresses

Remaining wellheads and protection structures are to be removed

Bundle cut from buoyancy tank

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Bundle with drag chain attached

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Buoyancy tank and bundle connected to well head pull-in frame

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Buoyancy tank and bundle connected to well head pull-in frame

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Wellhead protection structure with fishing net

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Wellhead inside protection structure

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Wellhead 211/19-4 protection structure laying on side

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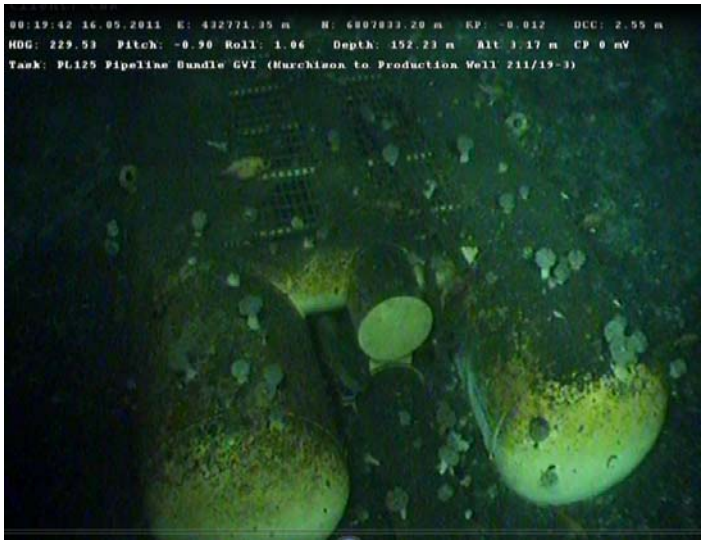
Buoyancy tank platform partially buried in drill cuttings



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Bundle disconnected from buoyancy module at platform

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Buoyancy and bundle connected

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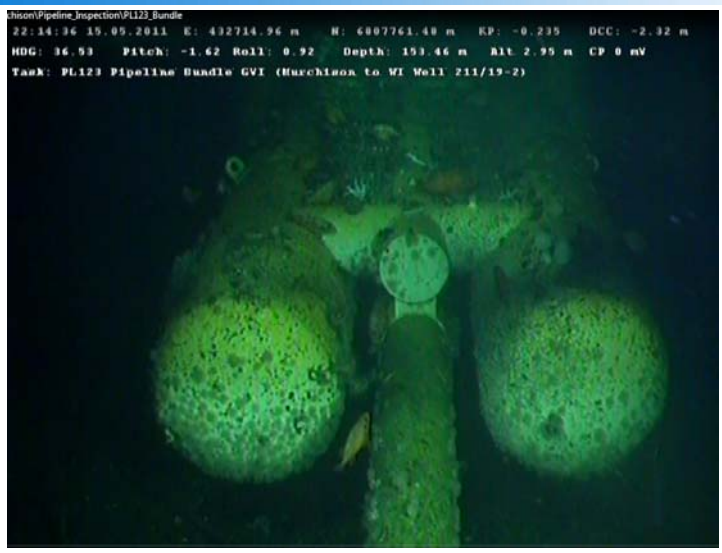

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6" NLGP pipeline: overview (1)

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- 6" NLGP pipeline owned / operated by NLGP partnership (dialogue begun)
- 6" NLGP pipeline runs from Murchison Platform to the "T" tie-in on the 20" trunk line 2.6km away
- Hydraulic valves controlled by umbilical from the Murchison platform
- Pipeline is trenched and naturally backfilled for 70% of length
- The pipeline crosses under three pipelines
- Spool at Murchison platform is hyperbolically welded to riser and pipeline

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6” NLGP pipeline: overview (2)

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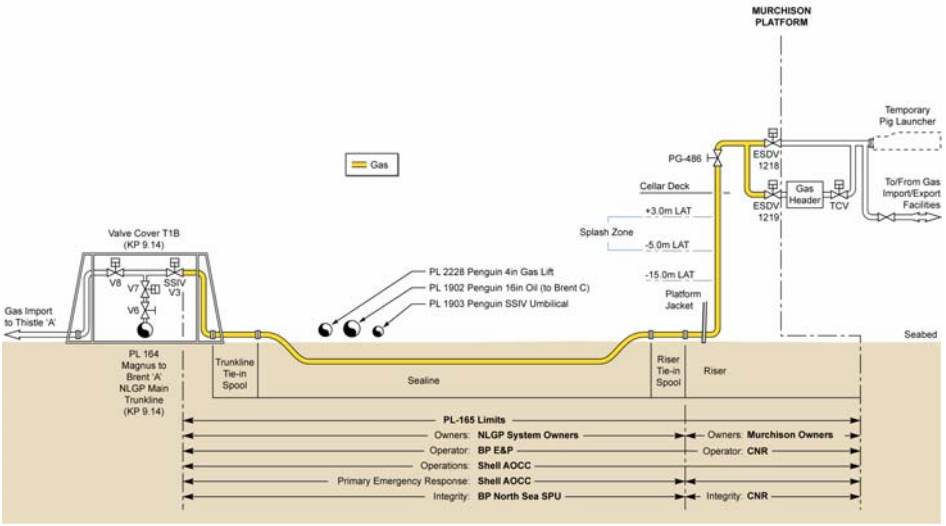

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NLGP SSIV and control umbilical: overview (1)

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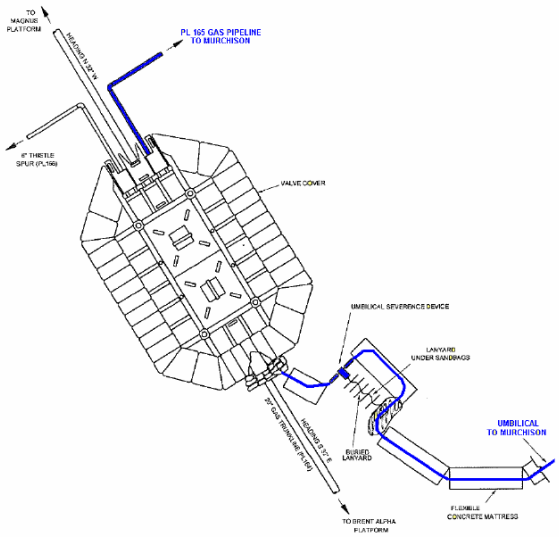

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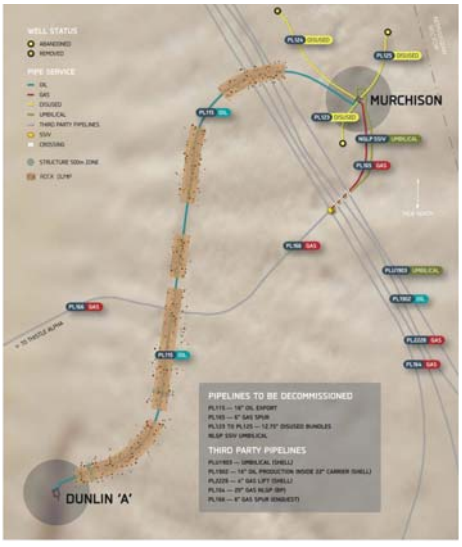
NLGP SSIV control umbilical: overview (2)

- 94 mm dia x 2.6km long
- 1.8km of rock dump on umbilical
- Two pipelines cross over the umbilical
- Umbilical controls three hydraulic valves in the SSIV on the 20" NLGP "T" tie-in point

Seabed layout



16” oil export pipeline to Dunlin platform: details

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- 16” pipeline (PL 115) with weight coating of 57.2mm
- 15.9mm wall thickness X60 grade pipe
- Approximately 50% of original wall thickness at 6 o/c position in some areas of the pipeline
- 19.1km long between Murchison and Dunlin
- Crosses under 4 pipelines and 1 umbilical crossing
- 56% of pipeline rock dumped with 44% exposed in trench
- Murchison spoolpiece has been welded
- Dunlin spoolpiece is flanged on platform end and welded at pipeline end

16” oil export pipeline to Dunlin platform: options

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- Leave in-situ
- Minimal removal
- Removal of exposed sections
- Burial
- Selective removal and burial
- Total removal

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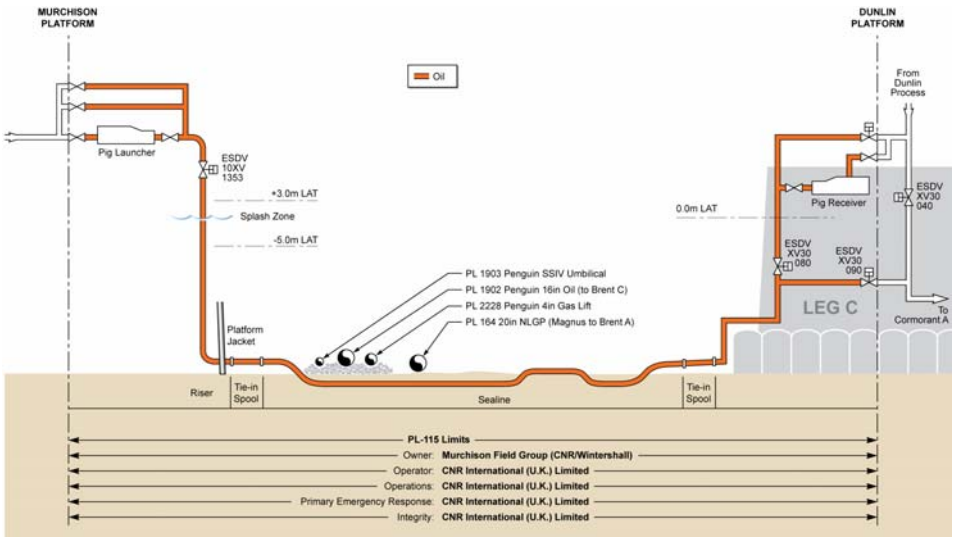
16” oil export pipeline to Dunlin platform



Debris

- Debris to be removed on pipeline and bundle routes (**432** targets identified)
- Debris to possibly be removed inside Murchison 500m zone (**189** targets identified)
- See ISS 2011 survey report for target numbers and locations

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Debris: name that object!

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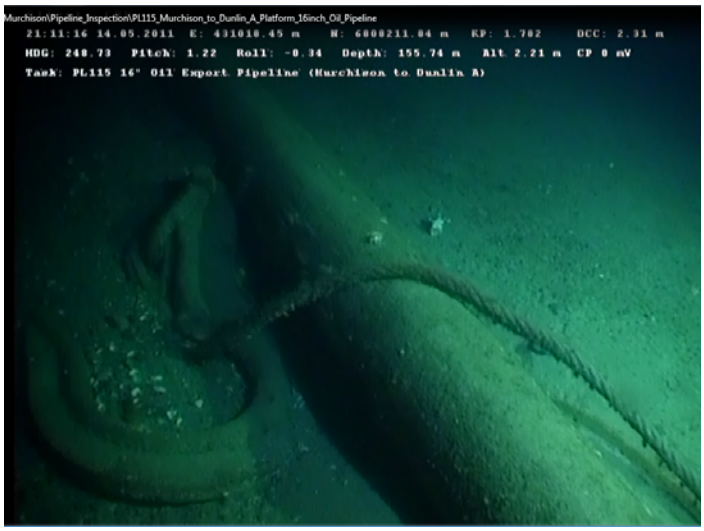
Debris



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Debris

Question and answer

Any questions of clarification?

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Murchison Decommissioning Project

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Topic Briefing

Decommissioning Options for the Jacket

Mike Corcoran
Decommissioning Strategy

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Jacket components

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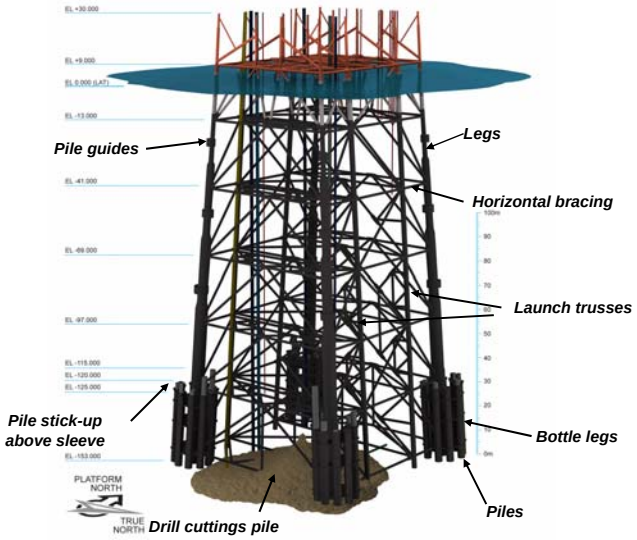

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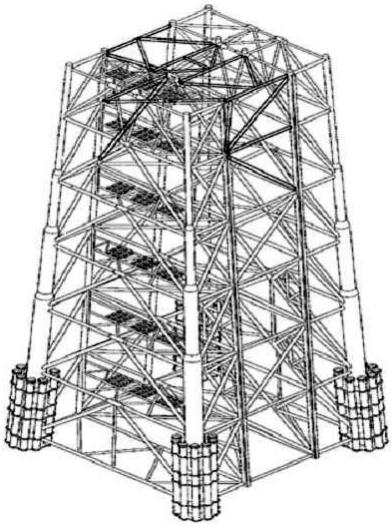
Jacket condition



- General condition / structural integrity
- Flooded members / damage
- Ballast valves
- Pile stick up / densitometers
- Drill cuttings pile
- Marine growth

Jacket removal options

Refloat using buoyancy tanks

Remove using purpose built vessel

Remove in sections using large crane vessel

Remove in small sections using a crane vessel

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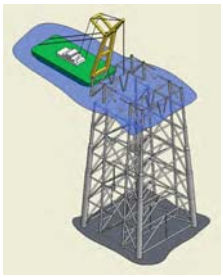
Full removal using buoyancy tank assemblies

Wt jacket submerged = 23,700 te
Buoyancy = 23,600 te
(Buoyancy from braces, legs & BTA's)

Jacket is refloated and towed from site to Norwegian fjord

Buoyancy tanks floated out, up-ended and attached to jacket



Jacket is grounded in Norwegian fjord and dismantled in-situ using sheer leg cranes

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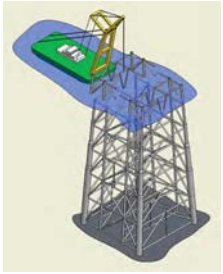
Partial removal using buoyancy tank assemblies

Wt jacket submerged = 13,000 te
Buoyancy = 15,000 te
(Buoyancy from braces & BTA's)

Jacket is towed from site to Norwegian fjord

Buoyancy tanks floated out, up-ended and attached to jacket



Jacket is grounded in Norwegian fjord and dismantled in-situ using sheer leg cranes

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Removal using conventional heavy lift vessel

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Crane Capacity 14,000te

Top section 4075 te

North & South section 3400te ea

Footing 3000te ea

Partial removal

Partial removal

Full removal

Full removal

Transport top sections to shore on hook

Rigging to recover footings

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Removal using single lift vessel

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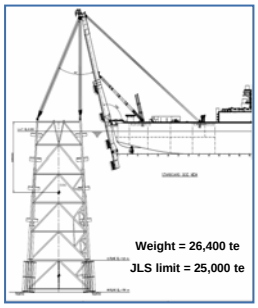
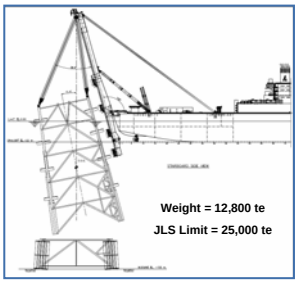
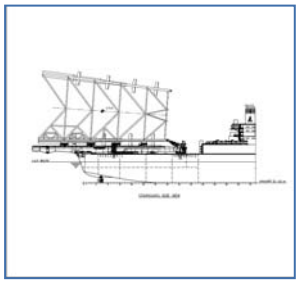


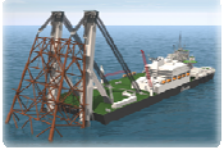
Full removal in single piece is not feasible



Partial removal in single piece



Transport to shore and skid offload



Bottle legs removed individually using auxiliary hoist blocks weight bottle 3,000 te+ auxiliary capacity 3,000 te

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Removal using ship shape lift vessel

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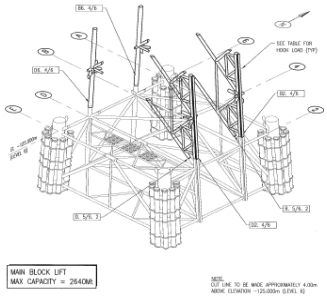
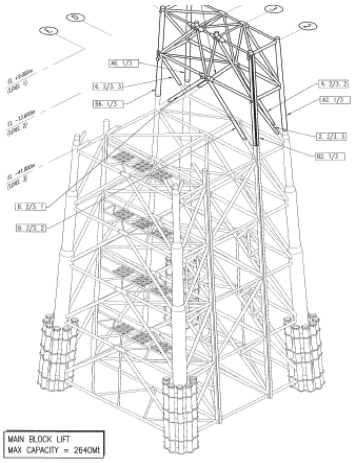
Jacket removed in small sections down to footings, vessel does not have the capacity to lift the 3,000 te bottle legs with submerged block





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Jacket Removal Options - Summary

	Conventional heavy lift	Single lift vessel	Small crane vessel	Buoyancy tank assembly	Offshore man days
					
Full Removal	✓	✓ ?	✗	✓?	30,000
Partial Removal	✓	✓	✓	✓	17,000
Proven Technology	**Yes**	**No**	**Yes**	**No** (Frigg Jacket was 12,000te)	

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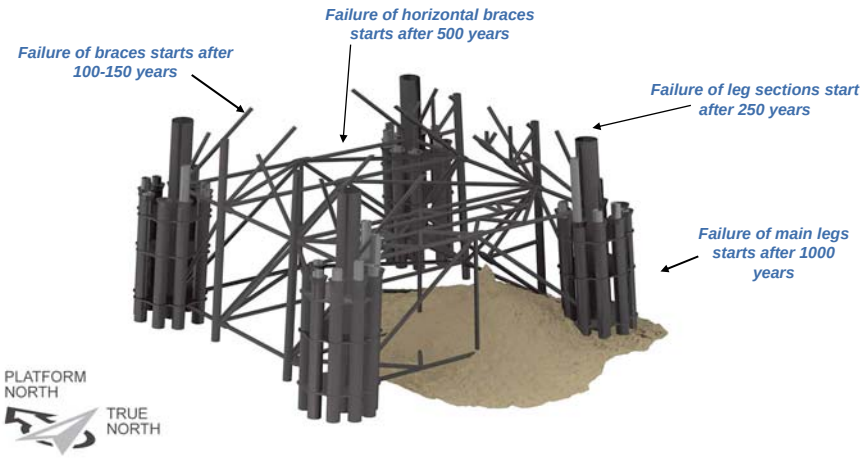
Jacket: full vs. partial removal - issues

	Full removal (single piece or in sections)	Partial removal
Drill cuttings pile and debris	Relocate 22,000 te drill cuttings and debris, to expose lower jacket frame members Use ROV dredger: 150- 500+ days	Leave drill cuttings and debris within footings area
Foundation pile cutting	Remove debris inside piles Dredge out soil plugs to -4m Cut piles internally	Piles left insitu
On-bottom stability	Ensure on bottom stability of isolated bottle legs after cutting piles	Footings left in-situ and stable
Cutting jacket	New tooling required for 6m and 4m dia leg cuts	New tooling required for 6m and 4m dia leg cuts

Predicted degradation rate of footings



Question and answer

Any questions of clarification?

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Topic Briefing

Getting to the Final Decommissioning Plan

Process

Dr. Liz Galley
Environment

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1

Murchison EIA process

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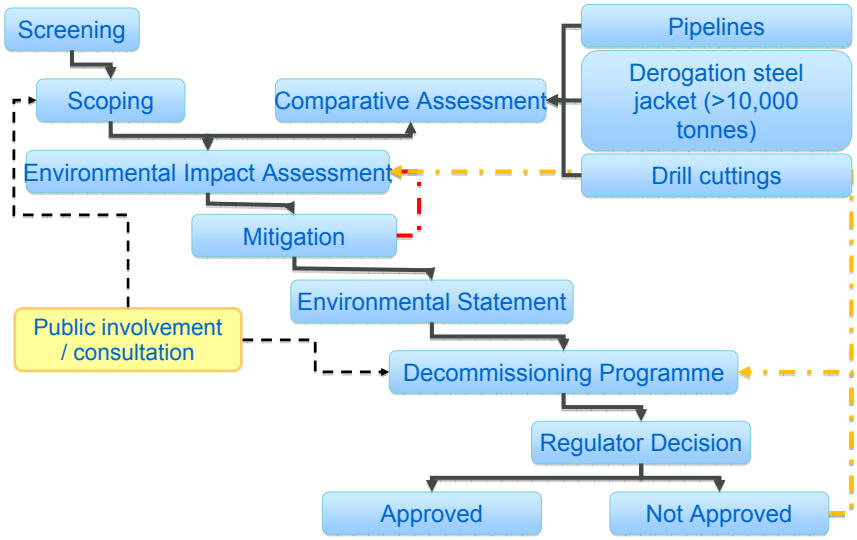

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EIA scoping

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Murchison EIA scoping:

- High level report – June 2011
- Identified supporting studies:
  - Drill cuttings pile modelling: long term fate, OSPAR thresholds, human disturbance
  - Socio-economic impacts to commercial fishermen
  - Energy and emissions study
  - Underwater noise assessment
  - Safety risk to fishermen

EIA scoping

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- Murchison EIA scoping report – June 2011
  - Feedback from stakeholders to date:
    - Contamination of the marine environment
    - Fishing activity of non-UK vessels
    - "Legacy" impacts
    - Marine growth
    - Artificial reef effect
    - Cumulative impacts pipelines decommissioning
    - Resource usage and atmospheric emissions
- Revised scoping report – February 2012

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Environmental site survey

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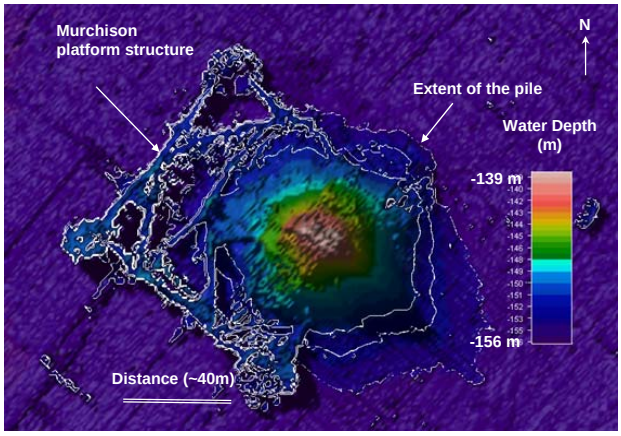
Acoustic survey

- Map Murchison drill cuttings pile using multibeam echo sounder



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Environmental site survey

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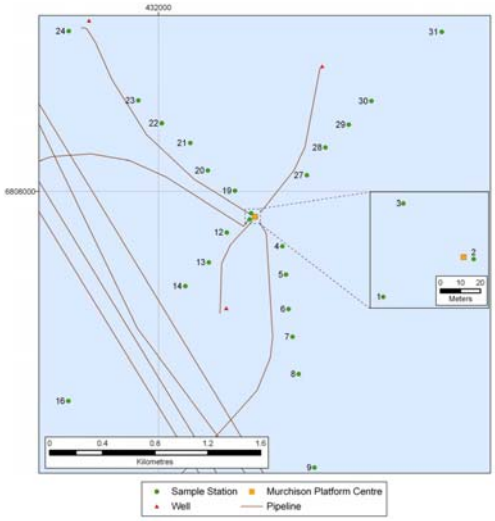
Seabed sampling

- Chemical contaminants, biological analysis



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Survey results (Fugro ERT, 2011)

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<500m from platform:
- –Contaminant
  - Total hydrocarbon >50 µg /g
- –Biological
  - Modified community structure in vicinity to platform
  - Opportunistic / pollutant tolerant species present, indicate organic enrichment
  - Reduced diversity

>500m from platform:
- –Contaminant
  - Total hydrocarbon <50 ug /g
- –Biological
  - Moderate to high biodiversity
  - Community typical of sediments at this depth in NNS
  - Considered as background sediments

EIA – sources of impact

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- Vessel use during ALL operations
- Well P&A
- Topsides decommissioning offshore
- Jacket decommissioning
- Pipeline decommissioning
- Drill cuttings pile
- Disposal of materials onshore

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Requirement for Comparative Assessment

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- OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations
  - Platform derogation cases (steel jacket >10,000 tonnes)
- Petroleum Act 1998
  - Platform derogation cases
  - Pipeline decommissioning
- OSPAR Recommendation 2006/5
  - Drill cuttings

Comparative Assessment framework

[Based on DECC Guidance Notes, V6 2011]

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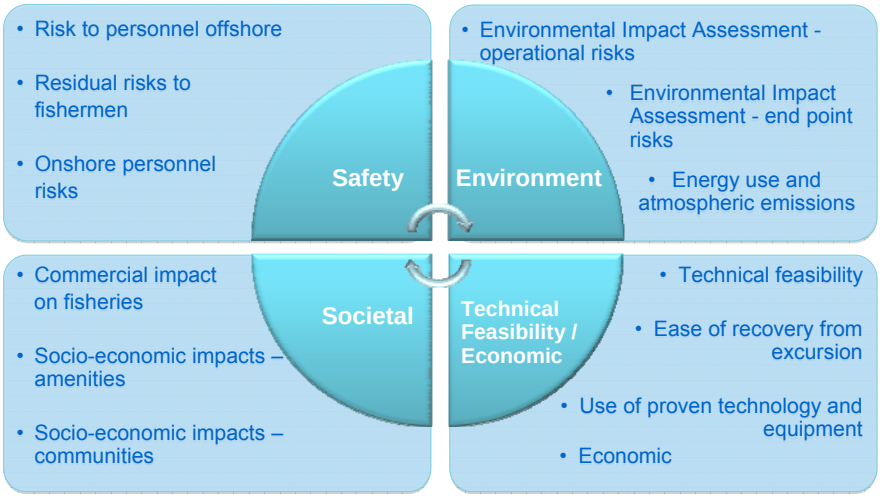
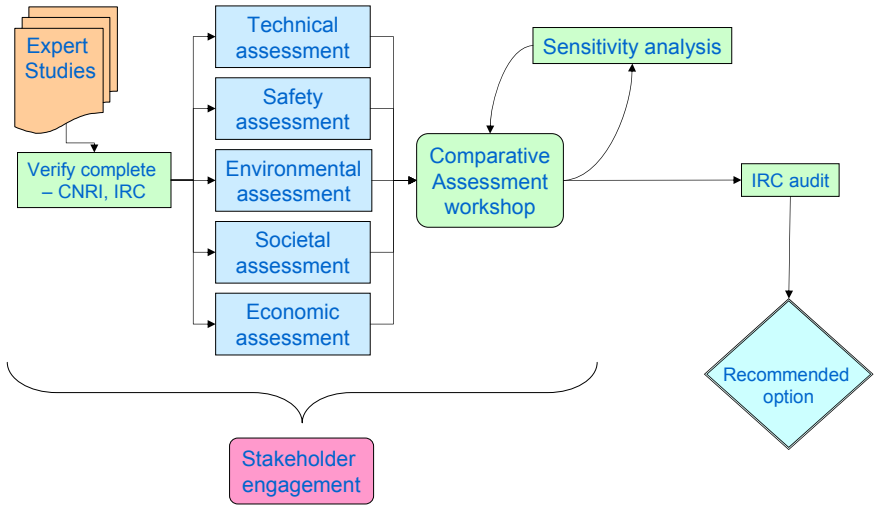


Comparative Assessment process



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Question and answer

Any questions of clarification?

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Murchison decommissioning project

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Topic Briefing

Overview of Decommissioning studies

Findings to Date

Mike Corcoran

Decommissioning Strategy

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Study approach

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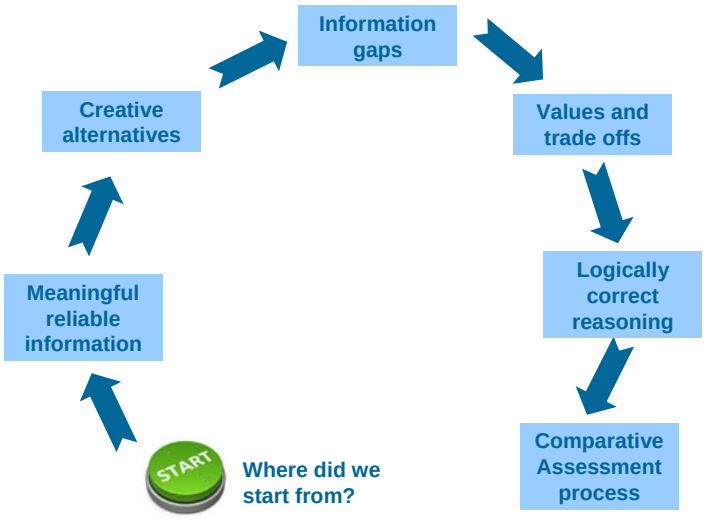

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The scale of the challenge…

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Reliable information

- Platform condition surveys
- Process and weight surveys
- Jacket surveys
- Environmental baseline surveys
- Operating history / efficiencies
- Original construction history
- Platform integrity

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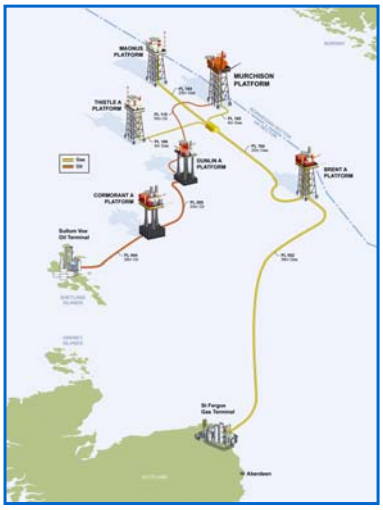
Creative alternatives for Murchison



1. **Continue as a producing asset**
   - Improved operating efficiencies
   - Stranded reserves
   - Enhanced recovery
2. **Re-use/relocate**
   - Tie back to third party production
   - Carbon capture
   - Infrastructure hub
3. **New use**
   - Offshore wind energy
   - Wave/tidal energy generation
   - Enhanced recovery
4. **Future technology**
   - Store field records in National Hydrocarbons Data Archive

➔ ***After screening alternatives: decision to decommission***

Decommissioning alternatives

- North Sea experience
- Gulf of Mexico experience
- Supply chain – new technology/techniques
- Salvage industry experience
- Participation in industry work groups
- Nuclear decommissioning technology/crossover
- Engagement with stakeholders

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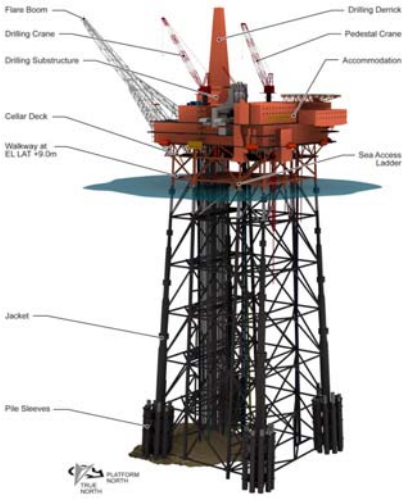
Decommissioning options



- 34 wells will be plugged and abandoned in accordance with the Oil & Gas UK Guidelines on Well Abandonment
- Topside structures will be removed, backloaded and transported to shore for re-use and recycling
- Jacket removal options include full removal and partial removal
- Various options are being considered for the drill cuttings pile
- Various options are being considered for pipelines PL115, PL123, PL 124 & PL125

Supporting studies

Over 70 studies and activities were identified and grouped to be undertaken in-house or subcontracted over 20 contract packages:

- **Surveys:** information gathering/verification
- **Operations:** simultaneous operations (SIMOPs) between well P&A and continuing production
- **Decommissioning services contract (DSC):** shutdown, engineer down and clean (EDC), separation
- **Topside and jacket removal:** reverse lift, single lift, piece small
- **Pipeline:** cleaning, removal options
- **Environmental:** environmental impact assessment and support studies/documentation
- **Safety:** option safety assessment
- **Independent Review Consultancy:** independent review of studies and assessment procedures
- **Integrity:** checks against removal options, and long term degradation

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Drawing on excellence in the field

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ISS · ert · FUGRO · scopus · anatec · SCOTTISH FISHERMEN'S FEDERATION · xodus GROUP · Woodhill Frontier · ATKINS · GL Noble Denton · BMT Cordah · WG WOOD GROUP PSN

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CNRI selected from best-in-class technical expertise to assist in developing and evaluating decommissioning options

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Removal studies

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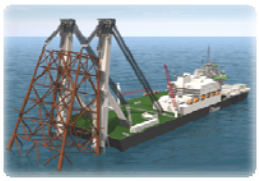
AkerSolutions

Allseas



MARINE CONTRACTORS

Seaway Heavy Lifting Engineering B.V.

Four detailed studies undertaken with specialist contractors covering conventional and new technologies for removal of topsides and jackets

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Safety Studies

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Major Accident Hazard Management

- Hazid studies of engineering down and clean and separation scopes
- Hazid studies of jacket, topside, pipeline options
- Identify major accidental events and consequences for each option
- Quantitative risk assessment (QRA) for each jacket option

Hazid meetings were attended by project personnel, CNRI technical authorities and specialist technical consultants

Technical assessment

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➔ Noble Denton review of all removal options by the different contractors

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Environmental studies

- Environmental baseline survey
- Murchison EIA scoping report
- Decommissioning waste management strategy
- Permits and consents register
- Drill cuttings pile management study
- Energy and emissions study
- Noise assessments
- Assessment of the socioeconomic effects on fishermen
- Assessment of the safety risk to fishermen
- Environmental impact of all decommissioning options
- Material disposal register / permit requirements

Options selection process

➔ Comparative Assessment….

Question and answer

Any questions of clarification?

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Murchison decommissioning project

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Topic Briefing

Murchison
Drill Cuttings Pile

Dr Liz Galley
Environment

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Murchison drill cuttings pile

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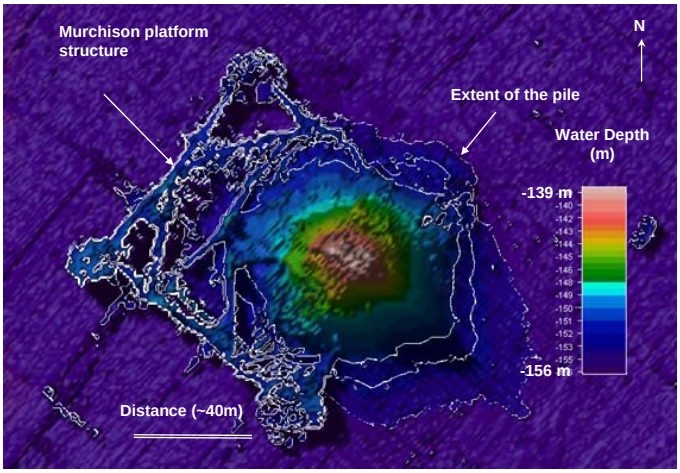
Pile characteristics
Volume – 22,545 m^3
Area – 6,840 m^2
Height – 15.34 m
Water depth – 156 m



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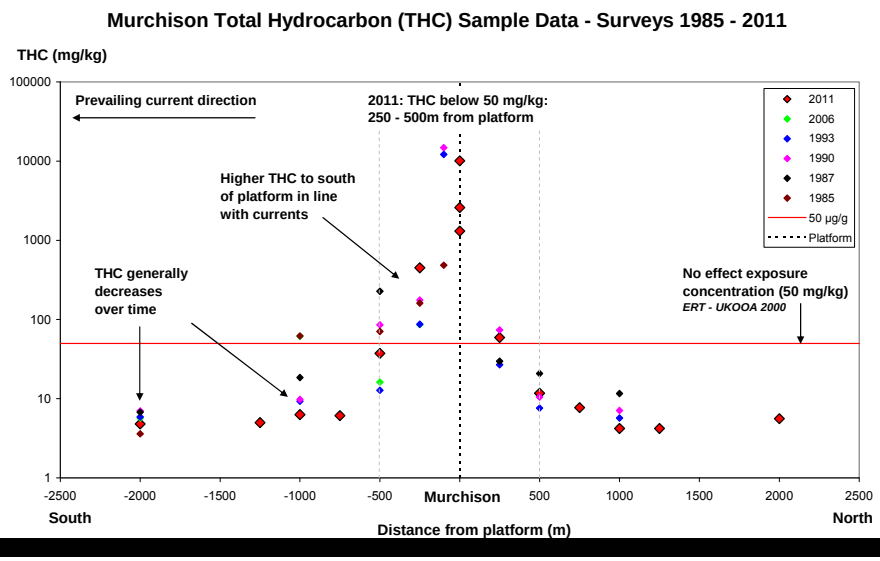
Hydrocarbon content



OSPAR recommendation 2006/5

2008 desktop study:

- Below OSPAR Recommendation 2006/5 Stage 1 screening thresholds:
  - Rate of oil loss
  - Persistence

2011 survey results, preliminary 2012 modelling results:

- Below OSPAR Recommendation 2006/5 Stage 1 screening thresholds

➢OSPAR Recommendation 2006/5:

- No further action is necessary and the cuttings pile may be left in-situ to degrade naturally

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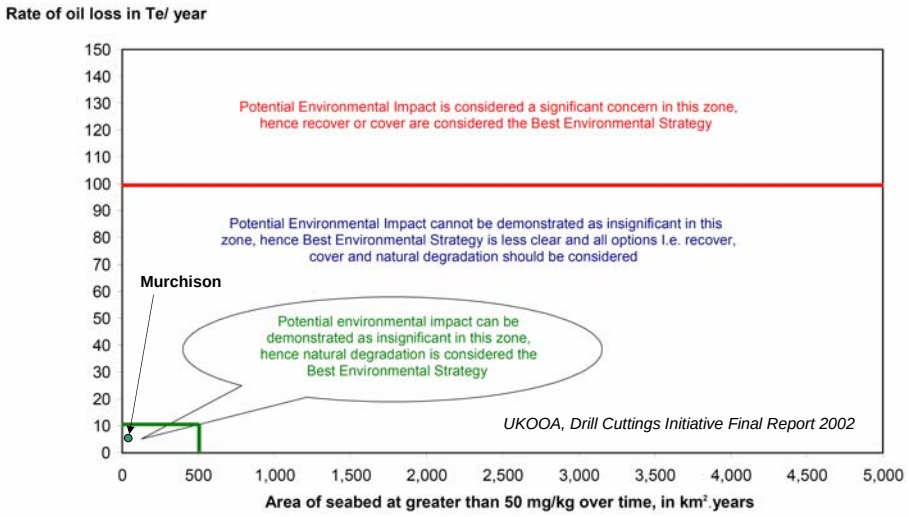
UKOOA best environmental strategy



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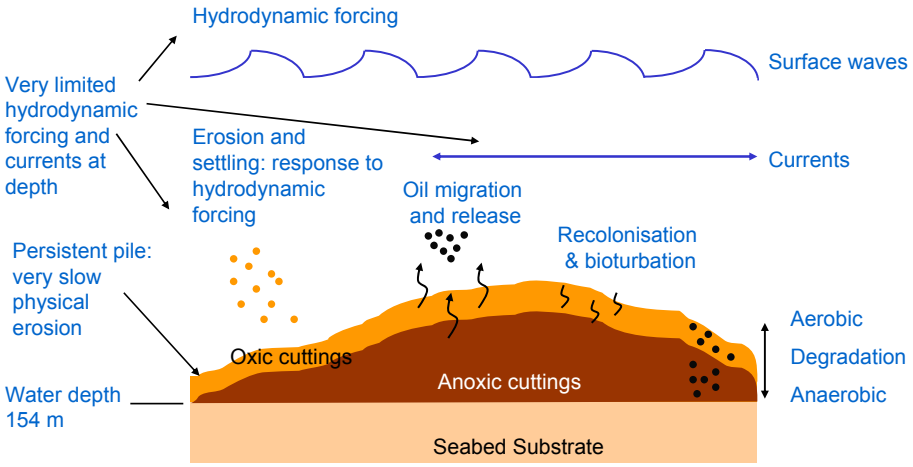
Cuttings pile degradation processes



UKOOA, Drill Cuttings Initiative 2002

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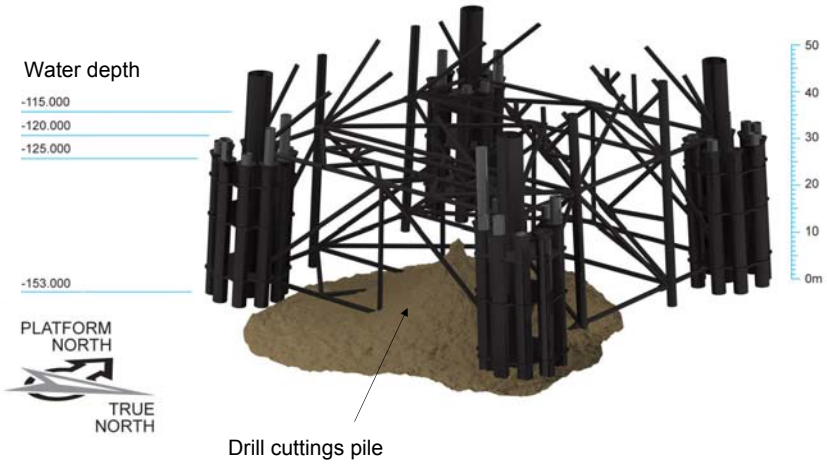
Murchison jacket footings



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Drill cuttings pile removal

Historical examples:

- NW Hutton – UKOOA Drill Cuttings JIP Trial:
  - Volume cuttings recovered – 14 m^3
  - Volume seawater recovered – 339 m^3
  - Average water : cuttings – 20:1
  - Duration of dredging – 3 days

- Ekofisk pile excavation:
  - Volume cuttings relocated – 8,400 m^3
  - Duration of dredging – 350 days
  - 10,000 tonnes CO_2 emitted

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Murchison pile removal options

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Stage 1: Excavate the pile using suction dredge system

Stage 2: Relocation / disposal of cuttings

1. Treat liquids offshore, solids onshore for disposal
2. Treat liquids and solids onshore for disposal
3. Offshore injection of slurry
4. Dispersion / redistribution offshore

Drill cutting removal challenges

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- Limited access to pile within jacket legs and braces
- Debris within the pile - block dredge
- Back-flushing of cuttings to remove debris – resuspension of contaminants
- Large volumes of water recovered:
  - Storage of cuttings / water on recovery vessels
  - Treatment / separation of water
  - Discharge of treated water
- Disposal of 22,545 m^3 of treated drill cuttings
- Redistribution of the pile:
  - Release of contaminants into water column
  - Transfer of contaminants to new area of seabed
- CO_2 emissions from operations
- Long duration of operations offshore (~1-3 years)

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Further work

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Drill cuttings pile modelling

- Long-term fate of the pile:
  - Physical presence
  - Concentration of main contaminants

- Effects of human disturbance of the pile:
  - Dispersion / redistribution drill cuttings offshore
  - Dispersion of drill cuttings from backflushing to remove blockages

Drill cuttings comparative assessment

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- Comparative Assessment (CA) of removal options:
  - Access Murchison jacket footings

- CA informed by:
  - Methods for pile removal – technical feasibility
  - Fugro ERT 2011 survey results
  - Drill cuttings pile modelling – effects of human disturbance
  - Environmental impact assessment of options
    - Offshore and onshore
      - Safety assessment
      - Cost estimation

Question and answer

Any questions of clarification?