
Geotechnical Aspects of North Sea Decommissioning



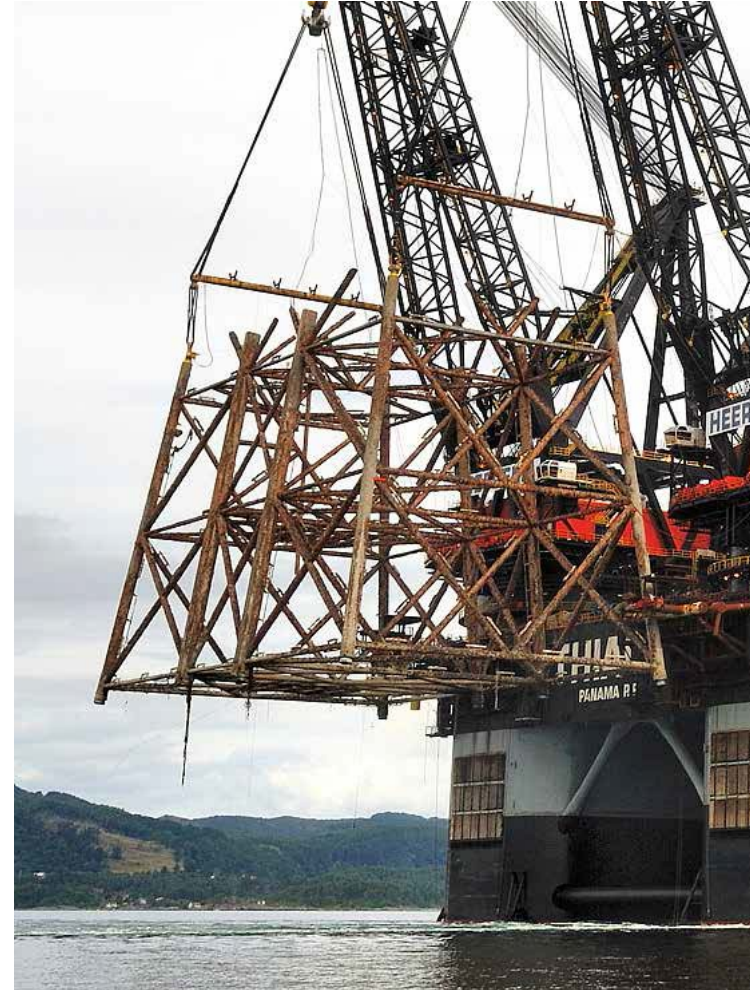
XODUS
SUBSEA

Andy Small, Principal Engineer

www.xodussubsea.com



- > Decommissioning market
- > International standards and UK legislation
- > Current practice:
 - Moorings and subsea structures
 - Pipelines and umbilicals
 - Pipeline bundles
- > Angus Field case study
- > Summary



Geotechnical Aspects of North Sea Decommissioning

North Sea Decommissioning Market (UKCS)

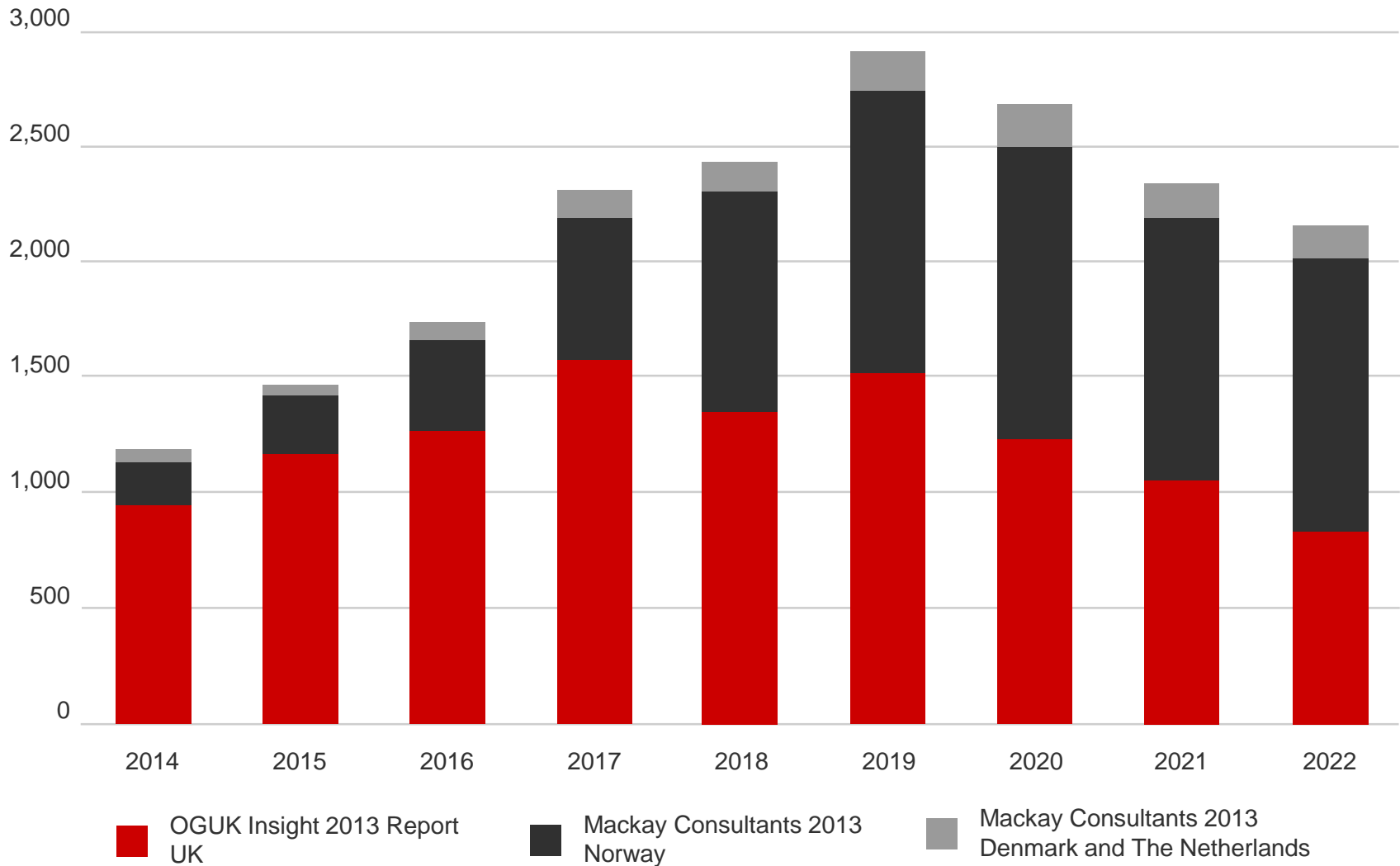


- > Mature basin ~1968
- > ~300 undeveloped discoveries
- > 12% (88) of installations have been decommissioned e.g. jackets and floating
- > ~280 SPS and ~3000 pipelines / umbilicals
- > ~2% of pipelines have been decommissioned



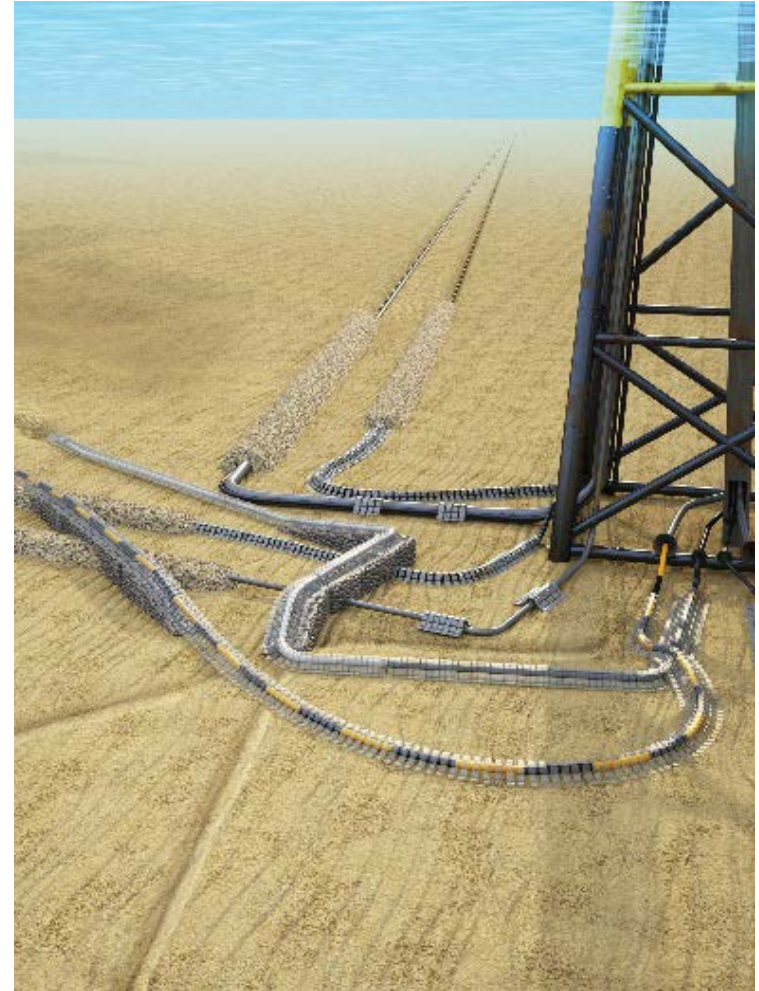
Geotechnical Aspects of North Sea Decommissioning

Annual Estimated North Sea Decommissioning Expenditure (£M)





- > OSPAR 98/3:
 - Ensure safety of navigation
 - Minimise pollution of marine environment
 - Protect fishing activities
- > Topsides must be returned to shore
- > Applicable <10,000Te structures
- > Strategic “hubs” to be maintained to maximise UKCS recovery
- > Limited guidance for pipelines





Aspects to relevant to most foundation types:

- > Reverse installation techniques
- > Lift from seabed:
 - Seabed suction
 - Skirts
 - Capacity of lifting points
- > Breakout load assessment
- > Time effects:
 - Consolidation
 - Chemical bonding
- > Breakout load reduction
 - Localised dredging
 - Full dredging

Individual foundation types can also be considered:

- > Suction Caissons
- > Driven Piles



Geotechnical Aspects of North Sea Decommissioning

Subsea Structures and Moorings, Suction Caissons and Anchors



- > Designed for recovery?
- > Modular construction
- > Overpressure monitoring
- > Considerations:
 - Critical overpressures
 - Corrosion of piping
 - Piecewise deconstruction
 - Soil plug retained
 - Soil set-up
- > Contingencies:
 - External Dredging
 - Buoyancy
 - Rock dumping



Geotechnical Aspects of North Sea Decommissioning

Subsea Structures and Moorings, Driven Piles



- > Typically 15-25m long piles Subsea Structures
- > Typically 40-50m long piles Moorings
- > Remove structure, cut piles below mudline
- > Internal / external cuts
- > Dredging options for cutting equipment
 - External large dredging
- > Possible to extract from seabed?
- > Possible seabed remediation works.



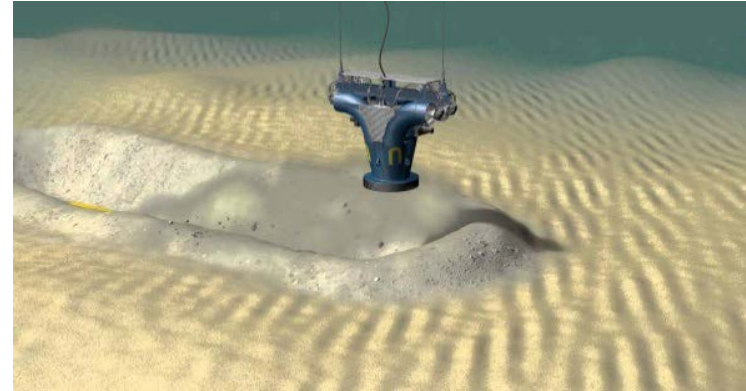
Geotechnical Aspects of North Sea Decommissioning

Pipelines, Flowlines and Umbilicals



- > Comparative assessment
- > Review options – select – eliminate
- > Costs, EIA, technical feasibility
- > Abandonment “in-situ”:
 - Cut or trench ends
 - Legacy management
- > Removal:
 - Assessment of uplift loads
 - Deburial
 - Reverse s-lay, reeling
 - Piecewise recovery

- > Pipeline Bundles Relatively unique to North Sea
- > Towheads (manifolds) connected to carrier pipe with multiple products
- > None have been decommissioned yet
- > Proposed removal options:
 - Reverse tow
 - Piece-wise deconstruction
 - Abandonment In-situ

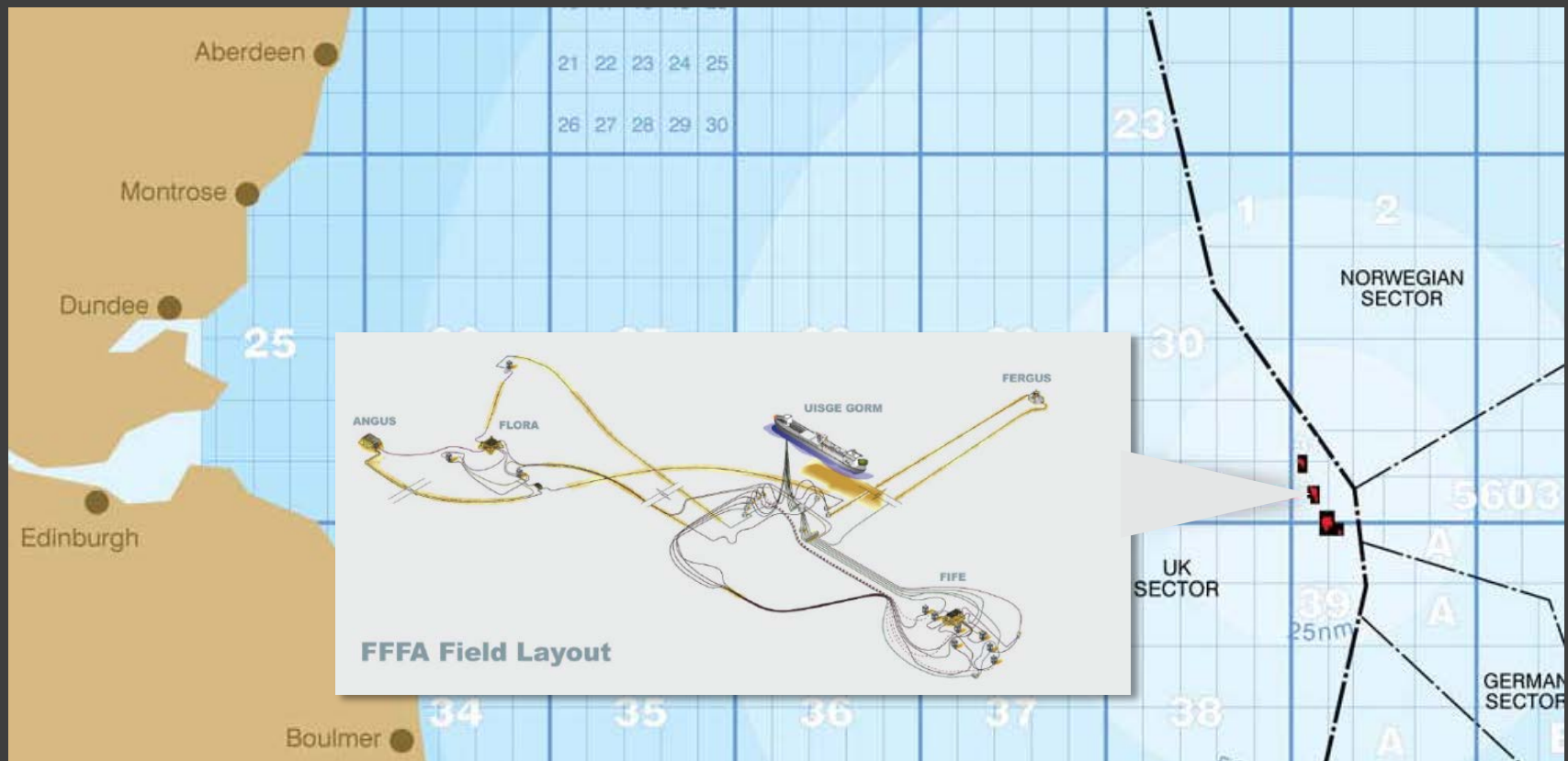


Case Study

Hess Angus Piled Structure Removal



- > UKCS Block 31, 205miles from Aberdeen
- > FPSO Uisge Gorm with subsea tie-back
- > 2001 to 2006 with three satellites
- > FPSO off station, subsea architecture remains
- > Requirement to remove under OSPAR



Case Study

Hess Angus Piled Structure Removal



Structure geometry

- > 26m Length, 19.3m wide, 8m high

Pile geometry

- > 4 A-shaped piles
- > Length 7.4m, breadth 3.0m

Geotechnical conditions

- > Holocene veneer over medium dense to dense sand





Review

- > Original design and installation reports
- > Inspection footage
- > Geotechnical conditions

Nominated vessel

- > Cranage
- > Deck space
- > Equipment requirements

Development of philosophy and procedures

- > Exploit modular construction
- > Piecewise deconstruction
- > Full pile removal



Case Study

Hess Angus Piled Structure Removal – Deconstruct Sequence



> Roof panels and SCM recovered



Case Study

Hess Angus Piled Structure Removal – Deconstruct Sequence



- > Structure cut from footings
- > Lifted off footings and flipped
- > Leg stumps recovered
- > Piles recovered
- > Structure cut in half



Case Study

Hess Angus Piled Structure Removal – Deconstruct Sequence



- > South section recovered



Case Study

Hess Angus Piled Structure Removal – Deconstruct Sequence



- > North section recovered placed in South section



Case Study

Hess Angus Piled Structure Removal – Key Findings



- > 3 of the 4 piles were recovered with very little tensile uplift
- > 1 pile required a further 20Te of uplift
- > 5 to 19 mins to vibration with 20Te of uplift applied (pile + vibrohammer + clamps + rigging)
- > Secondary cut locations had to be adopted due to the vibrations induced in the structure
- > 6 days from start to completion of offshore operations



- > Decommissioning represents a significant cost to Operators however there are opportunities to reduce these costs by collaboration between Offshore Service Companies and Operators
- > Subsea structures, pipelines and umbilicals present specific technical challenges and new ideas and technologies are required to overcome these
- > Understanding the geotechnical aspects and managing geotechnical risk will be of significant benefit to projects to mitigate cost overruns and ensure effective offshore operation planning
- > Review and interpretation of installation data e.g. pile driving records, suction caisson installation pressures offer potential to refine decommissioning engineering
- > Use of smaller vessels and effective operational sequencing to minimise vessel days can substantially reduce costs



Xodus Subsea Ltd

- > Greg Cook and Peter Tipler

Technocean Subsea AS

- > Ronye Egborge and Afam Ejidike

Hess Corporation and their FFFA Partners

Thank you



XODUS
SUBSEA

www.xodussubsea.com