

Decommissioning Futures Nuclear

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Today's Nuclear Session



Cross-Industry Collaboration

Karl Sanderson – Nuclear Decommissioning Authority

Nuclear Decommissioning Future Strategy

Martin Liefeith – Nuclear Decommissioning Authority

Supply Chain Opportunities

John Berry – Sellafield Limited

Technical Challenges and Innovation

Frank Allison – Game Changers

International Opportunities

Jon Halladay – Department for International Trade

Common Decommissioning Challenges



Nuclear - Oil & Gas - Defence - Renewables - Space - Process - Resources Waste - Transport - Power Generation & Distribution - Construction

| Industry | Cost £ Billion | Schedule (Years) | Major Scope Items |
|--|---|-------------------|---|
| UK Civil Nuclear (NDA)¹ | undiscounted 132 discounted 135 within next 20 years 48 | ~120 (to 2137) | 17 sites, including Sellafield, Dounreay, Magnox NPPs, Capenhurst, Springfields, Low Level Waste Repository |
| UK Civil Nuclear (EDFE) ² | provision 20 | ~100 | 8 Nuclear Power Stations |
| UK Defence (Nuclear Powered Submarines) ³ | provision 7.5 | >30 | 20 out-of-service + 10 in-service |
| UK Oil & Gas ⁴ | P50 51 P90 66 | <50 | UK Continental Shelf |
| UK Renewables ⁵ | ~4-12 | ~50 | Offshore Wind |

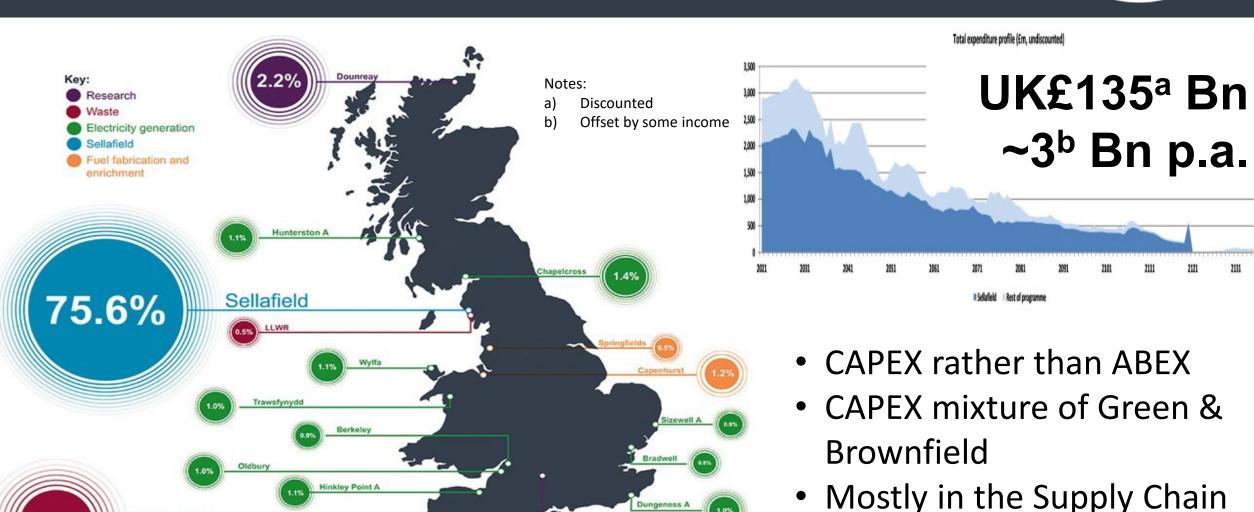
High decommissioning costs shared by a number of industries: UK potential to become global leader, creating a decommissioning capability across sectors, and valuable exportable skills

Sources:

- 1. NDA Annual Report & Accounts 2019/20 Nuclear Provision
- 2. Nuclear Liabilities Fund Annual Report & Accounts 2018
- 3. National Audit Office Investigation into submarine defueling and dismantling April 2019 ISBN 9781 786042552
- 4. Oil & Gas Authority UKCS Decommissioning 2020 Cost Estimate Report 2020 inventory 2019 prices
- 5. The Crown Estate current versus future estimate for capacity yet to be built

Costs: A UK view over 120+ years





8.3%

Geological Disposal Facility (GDF)

Themes of Common Interest – Sharing Lessons Learned





- Net Zero & Environmental Sustainability
- Attracting Talent & Building Capability ✓
- Sustainable Regional Economies *
- Designing for Decommissioning *
- Winning International Business *
- Late Life Asset Management ✓
- Governance & Assurance *
- Project Management ✓
- Technical Innovation
- Commercial Models ✓
- Policy & Regulation ✓
- Cost & Schedule ✓
- Supply Chain ✓
- Standards ✓
- Safety *

2021: emerging themes of common interest:

- Scope Aggregation / Campaigning / Parallel Workfronts
- Digital / AI / BIM / Machine Learning / Virtual Working
- 3. Regulatory Change

| | | | | | ` | | | | |
|---|--|---------|-------|---------|-----------|-----------|-----------|--------------|-------|
| Theme | Commonality between Decommissioning of Nuclear - Oil & Gas - Offshore Wind Industries | Defence | Space | Process | Resources | Utilities | Transport | Construction | Waste |
| Project Management | Management of large complex projects that exhibit similar characteristics e.g. brownfield. Efficiency of scope | | | | | | | | |
| | aggregation (fleet) approaches to multiple sites; pooling of project / engineering team / vessel resources across projects. Uncertainties associated with ageing infrastructure; uncertainties related to chacterization of inventory; approaches to demolition / dismantling. Transition from operations to decommissioning; cultural leadership & transitions / change management / EDI; building project delivery capability fit for decommissioning. Performance reporting approaches. Brand / Reputation Resilience; re-assuring the public / building public confidence; reputation threat mitigations / opportunities. What happens when things go | | | | | | | | ì |
| Communical Mandale | wrong (e.g. 2014 Geologic Disposal Facility)? | | | | | | | | |
| Commercial Models | Decommissioning requiring a different mindset to risk transfer, difficulty in developing novel / fit-for-purpose commercial models for decommissioning in industries that have well-established commercial behaviours. Lessons learned from Nuclear include for example; Parent Body Organisation (PBO) model versus wholly-owned subsidiary models; Programme & Project Partner (PPP) model. Lt from O&G include for example; bundling scope into campaigns across fields and across operators. Opportunity to turn net cost into profit by bundling decommissioning operations (e.g. offshore wind subsea cables). | | | | | | | | |
| Supply Chain | Supply chain opportunities; barriers to entry; how are they advertised and procured. Measures to ensure | | | | | | | | |
| | support for UK based jobs; Social Value; Supply Chain Action Plans. Government versus provate sector procurement rules. Support for SMEs. Taking advantage of R&D Innovation grant funding, nationally, regionally & across sectors to develop expertise. Platforms for sharing innovation and collaboration. | | | | | | | | |
| Technical Innovation | Developing new technologies, techniques, systems & processes to solve difficult and complex decommissioning challenges. Innovation centres / organizational models / campaigns; grand challenges. Specific technologies; robotics; land / sub-sea / aerial ROVs / AUVs / drones; characterization of as-built condition; digital twins / Al / Augmented Reality / BIM techniques / post-Covid; impermeable barriers; under-water laser cutting; explosives; vibrating hammer foundation removal; automated detection & removal (e.g. sub-sea cables). Joint calls for | | | | | | | | |
| Cost and Schedule | academic research. Ability to compare (transparency in) cost and schedule estimates & outcomes, in a timely manner, across the | | | | | | | | |
| cost and screedic | process of decommissioning; sector premiums. Accelerating the reduction of risk (schedule), and reducing the decommissioning provision (cost). Drivers of cost and schedule over-runs may be different in nature from enablers of cost and schedule reductions and may need exploring separately. Challenges in accurate estimation. Good practice in approaches to; benchmarking; reference class forecasting; probabilistic forecasting; optimism bias removal. Workfront productivity / 'tool-time'; performance management. | | | | | | | | |
| Late Life Asset Management | Challenges in annual budgetary cycle versus business planning cycle. Managing the final phases of an asset's life to optimise its productivity whilst maintaining its integrity and | | | | | | | | |
| | preparing it for decommissioning. Efficient overlapping of late operations and onset of decommissioning; minimizing duration of warm stacking; managing trade-offs between OPEX and ABEX; cultural change and leadership during transition. | | | | | | | | |
| Policy & Regulation | Multiplicity of agencies covering regulation onshore and offshore, together with changing legislation. Level- playing fields between industries. Common approaches to future regulation / challenging of existing treaties; governance structures. Implications of Brexit for changes to policy. 'Social Licence to Operate' and supportive communities. Commercial viability / desirability of decommissioned end-states / approaches. Efficient regulation within environmental, economic and social contract boundaries. Full costs of leaving in situ versus removal. High levels of regulatory oversight. | | | | | | | | |
| Attracting Talent & Building | Competition with new build / development and operations for attracting and retaining diverse talent. | | | | | | | | |
| Capability Winning International Business | Capability development, transferability of skills, ageing workforce. UK depth of experience throughout the supply chain & exportable UK expertise. Role of Authorities and operators in facilitating supply chain exports. Encapsulating and exporting the Intellectual Property of | | | | | | | | |
| Sustainable Regional Economies | Authorities. Changing primary, regionally based economic activity into something more diversified, resilient and sustainable. Long term job creation in areas facing decline or change. HMG drive to use SMEs for driving innovation and | | | | | | | | |
| Net Zero & Environmental | creating new jobs. Government and market trends impact, such as energy transition and Net Zero targets. Scope 1, 2 and 3. | | | | | | | | |
| Sustainabilty | Opportunity to repurpose on-shore and off-shore assets for other uses, including industrial and ecological, e.g. H_2 production, CO_2 capture and storage. Design for re-use. Low-carbon manufacturing. Recycling: polymer turbine blades; uncontaminated steel structures; contaminated metals; management of waste streams. | | | | | | | | |
| Standards | Aligning standards; removing duplication and improving consistency, across industries & internationally. | | | | | | | | |
| | Streamlining standards for decommissioning versus new-build. Road-map and funding for industry groups. Standardised methodology for review and issue of standards. | | | | | | | | |
| Governance & Assurance | Methodologies, tools and techniques in support of high decision quality. The assurance (peer review and assist) of projects during maturation. 1^{t_1} , 2^{nd} and 3^{nd} line. Measuring assurance effectiveness and value. The withholding of bad news. Optimism bias removal. | | | | | | | | |
| Safety | Commonalities in decommissioning; unstable onshore facilities (power stations, chimneys, grounded offshore platforms), and high hazard facilities to congested spaces (e.g., within nuclear site fences, offshore platforms). Safety cases and integrated attitude to risk (safety, security and environment). | | | | | | | | |
| Designing for Decommissioning | The idea of including, in the design phase of new-build and brownfield work, consideration for more efficient ultimate decommissioning. | | | | | | | | |





CROSS INDUSTRY CONVERSATIONS – DECOMMISSIONING ROUND TABLE

On 30 October 2018, the Nuclear Decommissioning Authority (NDA) and Oil & Gas Authority (OGA) hosted, in conjunction with Sellafield Ltd., a workshop of qualified managers from the oil & gas and civil nuclear sectors. This meeting was part of a series of discussions that will share learnings in areas of common interest between the decommissioning aspects of the sectors, which includes 14

The agenda was a full-day discussion on 3 of the 14 themes: Project Management Commercial Models and Supply Chain. Challenges in these areas are common to both industries, and each have experienced successful, and less than successful outcomes in decommissioning to date. The workshop's aim was to share key lessons learned with a view to reducing future costs, and support delivery of the decommissioning mission. A 31 October site visit to Sellafield's facilities helped demonstrate some of the issues involved in decommissioning the world's most complex nuclear site, and helped oil & gas participants visualize common challenges.

This document presents the key points emerging from this sharing of mutual learnings, structured by

The civil nuclear and oil & gas decommissioning programmes share the following characteristics; complex engineering challenges; heavily regulated environments; large scale in terms of timescales and cost; early days in the learning curve. In the UK, one key difference exists between the sectors; oil & gas has commercially owned operating assets funding their own decommissioning liability legacy nuclear assets are a public liability, and the private liability is capped for nuclear assets stil

The workshop was conducted under the Chatham House Rule, with comments and discussion unattributed. It was agreed that the output from the roundtable in the form of these notes be captured and made available to workshop participants are colleagues in the organizations with

Contextual Opening Remarks

The UK nuclear industry is experiencing a period of significant strategic transformation and HM Sovernment has recently set out its policy for the future in the form of the Nuclear Sector Deal and

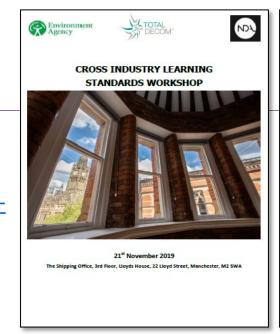
The nuclear industry has been engaged in a number of cross-sector initiatives such as 'Big Tech',

Cross Industry Conversations - Decommissioning Roundtable - West Cumbria, October 2018

Public Domain **Materials**

www.totaldecom.com/crossindustry-collaboration/

- Workshop write-ups
- Webinars
- **Progress Report**









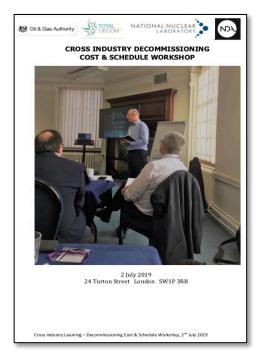
On 13th February 2019, the Oil & Gas Technology Centre (OGTC) hosted a cross-industry engagement between nuclear decommissioning and oil & gas sectors, focusising on Technical Innovation, one of the thematic areas of common interest previously agreed between the Nuclear Decommissioning Authority (NDA) and Oil & Gas Authority (OGA). This workshop forms part of a series of similar engagements between these sectors.

Technical Innovation is one of ~15 themes of common interest, but a narticularly important one, which can be readily understood as a driver of value, job creation, and exportable UK expertise. Technical Innovation is seen by both the Nuclear Decommissioning and Oil & Gas sectors to be a key enabler of step changes in cost and schedule reduction, a wider subject on which a further engagement is planned mid-2019.

The landscape of Research and Development (R&D), with links to academia, project funding, and commercial entitles developing solutions, tends to have sectoral specific challenges. Whereas there may be orifdentially considerations, it is recognised that there are benefits from sharing learnings; to avoid duplication of effort; speed up development; and potential for joint working on intitatives.

oss-Industry Insights - Technology Innovation Workshop - Nuclear / Oil & Gas - OGTC. Aberdeen









Cross-Industry Collaborative Projects – Examples & Potential



Net Zero

Oil & gas, wind, nuclear, hydrogen

Jobs

- Regional economy sustainment
- Skills passports

Integrated Supply Chains

- Facilitating innovation channels
- Joint data / document archive
- Joint access to space data

Waste

- Extending LLWR waste diversion business model
- UK smelter

Oil & Gas Technology Centre

Offshore technology and the energy transition

National Decommissioning Centre

- Anchor Partnership
- Innovation, including non-technical

Academia

- Joint Calls
- Include non-STEM
- PhDs
- Post-docs etc.



Making a difference









